This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

HARVARD UNIVERSITY

VE RI TAS

BERNHARD KUMMEL LIBRARY
OF THE
GEOLOGICAL SCIENCES

John Eliot-Wolff
November 1880.

HARVARD UNIVERSITY,
CAMBRIDGE,
MASS.
Dept. of Mineralogy & Petrography.

EE
15

HARVARD UNIVERSITY,
CAMBRIDGE,
MASS.
Dept. of Mineralogy & Petrography.

C
7758
14

A
SYSTEM
OF
MINERALOGY.

DESCRIPTIVE MINERALOGY,

COMPRISING THE

MOST RECENT DISCOVERIES.

BY

JAMES DWIGHT DANA,

SILLIMAN PROFESSOR OF GEOLOGY AND MINERALOGY IN YALE COLLEGE. AUTHOR OF A MANUAL OF GEOLOGY; OF
REPORTS OF WILKES'S U. S. EXPLORING EXPEDITION ON GEOLOGY; ON ZOOPHYTES; AND ON
CRUSTACEA, ETC.

AIDED BY

GEORGE JARVIS BRUSH,

PROFESSOR OF MINERALOGY AND METALLURGY IN THE SHEFFIELD SCIENTIFIC SCHOOL OF YALE COLLEGE.

"Hæc studia nobiscum peregrinantur....rusticantur."

Fifth Edition,

REWRITTEN AND ENLARGED, AND ILLUSTRATED WITH
UPWARDS OF SIX HUNDRED WOODCUTS.

(7TH SUB-EDITION, WITH TWO APPENDIXES AND CORRECTIONS.)

NEW YORK:
JOHN WILEY & SONS, PUBLISHERS,
15 ASTOR PLACE.
1877.

~~H 549.5~~

HARVARD UNIVERSITY,
CAMBRIDGE,
MASS.
Dept. of Mineralogy & Petrography.

1898 June 23
Gift of
J. E. Wolff

~~RARE
BOOK
ROOM~~
SPEC
QE
372
D23
1877

Entered according to Act of Congress, in the year 1868, by
JOHN WILEY & SON,
In the Clerk's Office of the District Court of the United States for the Southern District
of New York.

JOHN F. TROW & SON,
PRINTERS AND BOOKBINDERS,
205–213 *East 12th St.*,
NEW YORK.

PREFACE.

The large size of this volume on Descriptive Mineralogy, exceeding by one-half the corresponding part of the preceding edition, is not without good reason.

In the first place, the long interval of fourteen years has elapsed since the last edition was published, and during this period the science has made great progress. Chemical researches have been carried forward in connection with almost every species, and analyses have been largely multiplied; and it is the plan of the work to be complete in this department, so far as to include all analyses. Crystallographic investigations also have been numerous and important. Moreover, the number of species has been much enlarged, and every part of the science has had accessions of facts.

In addition, a new feature has been given the work, in the systematic recognition and description of the *varieties* of species. The first edition of this Treatise, that of 1837, was written in the spirit of the school of Mohs. The multitudes of subdivisions into subspecies, varieties, and subvarieties, based largely on unimportant characters, which had encumbered the science through the earlier years of this century, and were nearly smothering the species, were thrown almost out of sight by Mohs, in his philosophic purpose to give prominence and precision to the idea of the species. Much rubbish was cleared away, and the science elevated thereby; but much that was necessary to a full comprehension of minerals in their diversified states was lost sight of. In the present edition an endeavor is made to give varieties their true place; and to insure greater exactness with regard to them, the original locality of each is stated with the description.

Further, the work has received another new feature in its historical synonymy. A list of synonyms has hitherto been mainly an index to works or papers on the species, and often without any regard to the original describer or description. Hausmann's admirable Handbuch (1847) is partly an exception. Leonhard's "Oryktognosie" (1821, 1826), following the method of Reuss of the opening century, contains a full catalogue of references to publications on each species; but it fails of half its value because the references have no connection in any way with the synonymy. In most recent works, an author who has merely adopted a name is often quoted as if the original authority. The present work is no longer open to this criticism. As now issued, the first author and first place of publication of each species, and of each name it has borne, and of the names of all its varieties, are stated in chronological order, with the dates of all publications cited; and, besides, remarks are added in the text when the subject is one of special interest. The facts and conclusions have been derived in almost all cases from the study of the original works themselves; and this Treatise has become thereby, to some extent, an account of ancient as well as modern minerals. These historical researches added a third to the labor of preparing the edition for the press, thereby delaying the publication of the work about a year. But such studies are endless, especially when they relate to past centuries, and the work, however long continued, must be incomplete. As an example: the word *schorl*, which figured largely in the mineralogy of the last century and the earlier part of the present, is traced by some writers to the Swedis and is cited from Cronstedt (1758). From Dr. Naumann, of Leipsic, I learne of the occurrence of the word in the Magnalia Dei of Brückmann (1727). Afte ward I found it in Ercker's Aula Subterranea (1595); and later in Gesner o Fossils (1565), and in the Sarepta of Matthesius (1562), which contains a detaile description of it. In what earlier works the word occurs, and what was its origi are among the questions unanswered. (See further p. 205.)

The introduction of formulas on the basis of the new system of chemistry, wit the necessary explanations, constitutes another addition. The formulas, it will b observed, while in principle those of the leaders of the system, have some peculia features, serving to give them greater compactness on the page, and make the more easy of comparison, and bringing out well the unity and simplicity of typ among inorganic compounds.

In these and other ways the volume has unavoidably become enlarged. Not page, and scarcely a paragraph, of the preceding edition remains unaltered, and fu five-sixths of the volume have been printed from manuscript copy. I may here add that, notwithstanding the impaired state of my health, this manuscript—the paragraphs on the pyrognostic characters excepted—was almost solely in the handwriting of the author, or in that of a copyist from it. Neither the consultation o original authorities, the drawing of conclusions, nor the putting of the results o paper, has been delegated to another. And being now but half way between th fifties and sixties, it is my hope that the future will afford another opportunity fo similar work.

The optical qualities of minerals have been but briefly stated, and in general fo those species alone which seemed to require this addition to their distinctive characters, as a full presentation of them would have added much more to the size of the volume. The best work on the subject, and one containing many original observations, is the excellent Mineralogy of DesCloizeaux, the first volume of which, on the Silicates, was published in 1862. The second, unfortunately for the science, has not yet appeared. Other works in this department are Brooke & Miller's Mineralogy (1852); Grailich's Vienna edition of Miller's Crystallography (1856), and his own Krystallographisch-optische Untersuchungen (1858).

In classification, the general system remains unaltered. It is based on a comprehensive view of the characters of minerals as species in the inorganic kingdom of nature, the preëminence being given to chemical, the next place to crystallographic, the third to the different physical characters. The author believes (after having tried the so-called natural history system of Mohs for two editions) that light from no source should be shut out where the relations of species and groups in nature are to be determined. As in the preceding edition, the method avoids almost entirely the distinction, in most cases wrong, founded on the fact of the base in oxygen ternaries or salts being in the protoxyd state, or in the sesquioxyd, or in both combined, and proceeds on the ground that the basic elements in these and the other different states are mutually replaceable in certain proportions determined by their combining power with oxygen. But while the progress of chemistry and the kindred sciences requires no modification of the general plan of the classification, but gives it new support, it has rendered many minor changes necessary, and some that are of much importance.

The historical inquiries above alluded to were prompted by a desire to place the nomenclature of mineralogy on a permanent basis. They were incident to a search after a reason for choosing one name rather than another from among the number that stand as claimants. Part of the existing diversity is due to national partiality, and much of it to indifference. It has become somewhat common for authors to select the name they like best without reference to authority, or to reject an old fo a new one on no other ground than that of their preference. Increasing confusion in nomenclature has consequently attended the recent progress of the science; and in view of this fact the novel expedient has been tried of endeavoring to escape the confusion by adding one more to the number of names. The right method is manifestly that which has proved so successful in the other natural sciences, viz., the recognition, under proper restrictions, of the law of priority; and this method the author has aimed to carry out.

Moreover, it has seemed best that the science should not only have a system of nomenclature, but should also stand by it; that, accordingly, the termination *ine*, which is prominently chemical, should be left to the chemists, and that other miscellaneous endings should, as far as possible, be set aside, or be made to conform to the system. With this in view, changes have been made in accordance with the principles explained in the course of the remarks beyond on Nomenclature.

In the preparation of this volume, the author owes much to the coöperation of his friend, Prof. George J. Brush. Prof. Brush has had sole charge of the blowpipe department. The pyrognostic characters have been entirely rewritten by him; and while he has had the works of Plattner and von Kobell always at hand, he has, for much the larger part of the species, made personal trials of the reactions before writing them out; so that, although the facts stated are not generally new, they still are mostly from his own observations. His skill also in analytical chemistry, and his thorough knowledge of minerals, have enabled him to remove doubts, afford aid and advice, and furnish new facts, on various points throughout the progress of the work. Prof. Brush has also given the proofs, while the work was in the press, the benefit of his revision.

I take pleasure also in acknowledging the assistance of Prof. George F. Barker of this city, an excellent chemist in both the old and new systems, during the last six months before the book went to press; and later, that of Sydney I. Smith, assistant in the zoological department of Yale College.

The author is under obligations to many men of science for their kind response to his inquiries, and for much information in their letters; among whom he would mention, with gratitude, Dr. Carl F. Naumann of Leipzig, W. Haidinger of Vienna, Prof. von Kobell of Munich, Friedrich Hessenberg of Frankfort-on-the-Main, Dr. G. vom Rath of Bonn, Dr. G. A. Kenngott of Zurich, Dr. Hanns Bruno Geinitz of Dresden, Dr. A. Kunth of Berlin, Dr. A. Krantz of Bonn; Prof. Forchhammer of Copenhagen, Dr. A. E. Nordenskiöld of Stockholm, Prof. C. W. Blomstrand of Lund, Sweden, Mr. L. J. Igelström of Filipstad, Sweden, Prof. A. E. Arppe of Christiania, Norway; Louis Sæmann of Paris, whose letters were numerous and always valuable, and whose death, in 1866, was a misfortune to this work as well as to the sciences he cultivated; Prof. A. DesCloizeaux of Paris, A. Damour of Paris, F. Pisani of Paris, Mr. Guyerdet of Paris; David Forbes, Esq., of London, N. S. Maskelyne, Esq., of the British Museum; Dr. F. A. Genth of Philadelphia, Prof. C. U. Shepard of Amherst, Prof. J. P. Cooke of Cambridge, Mass., Prof. C. M. Warren of the Technological Institute, Boston, Prof. T. S. Hunt of Montreal, Prof. Jas. C. Booth of the U. S. Mint, Philadelphia, Prof. H. How of Windsor, Nova Scotia, Profs. Silliman, O. C. Marsh, A. E. Verrill, and W. H. Brewer, of New Haven, Ct., W. W. Jefferis, Esq., of Westchester, Pa., and Prof. A. Winchell of Ann Arbor, Michigan.

In addition, the book has received private contributions to the text of analyses and other information from P. Collier, B. S. Burton, C. S. Rodman, C. A. Goessmann, C. S. Sharples, G. F. Barker, G. C. Wheeler, and E. W. Root.

Among works consulted, the publications on chemical mineralogy of Rammelsberg of Berlin, and especially his Mineralchemie, have afforded great assistance. The very full and able Annual Reports (or Uebersichte) of Dr. Kenngott of Zurich, on the progress of mineralogy from 1844 to 1861, and those of the Giessen Jahresbericht, have been freely and constantly consulted. Much use has been made also of the mineralogical works of **DesCloizeaux**, **Dufrénoy**, **Hausmann**, **Breithaupt**, **Naumann**, **Haidinger**, **von Kobell**, **Kokscharof**, **Hessenberg**, **Quenstedt**, **Brooke & Miller**, **Greg & Lettsom**, and **Shepard**; also the valuable History (Geschichte) of Mineralogy of **von Kobell**; the classical work on the Precious Stones and Gems of the Ancients by **King**; and the various recent American Geological Reports. Among these Reports, the volume of the Canadian survey for the year 1863, containing extended mineralogical contributions by Prof. T. S. **Hunt**, deserves special mention. A full list of the works consulted in studying up the history of the species, and the later progress of the science, is to be found on pages xxxv to xlv of the Introduction.

In Crystallography, the sources of recent information have been mainly **Kokscharof**'s Mineralogie Russlands, and his Memoirs in the Bulletin of the St. Petersburg Academy; **DesCloizeaux**'s Mineralogie, and various Memoirs; the Mineralogische Notizen of F. **Hessenberg**, of which eight parts have appeared; **Naumann**'s and **Quenstedt**'s works on Mineralogy; the Memoirs of **Zippe**, **von Zepharovich**, **Grailich**, A. **Schrauf**, v. **Lang**, **Zirkel**, and **Kenngott**, in the Berichte and Denkschriften (mostly the former) of the Vienna Academy; of **Dauber**, G. **Rose**, **vom Rath**, **Schröder**, **Schabus**, in Poggendorff's Annalen; of **Websky** and **vom Rath**, in the Zeitschrift of the German Geological Society at Berlin; of A. E. **Nordenskiöld**, in the Œfversigt of the Swedish Academy; of **Quintino Sella**, in his Studii, and in the publications of the Turin Academy; of **Miller**, v. **Lang**, **Maskelyne**, and **Greg**, in the Philosophical Magazine; of Prof. J. P. **Cooke**, in the American Journal of Science. The Mineralogy of **Brooke & Miller** (1852) has been freely used again, as in the preparation of the preceding edition.

This volume would probably be more acceptable to some chemists if the formulas on the old system were rejected altogether. But chemistry has not advanced so far on the new road, but that most mineralogical papers are still written as if there were no new system, and a large part of chemists would understand the constitution of the species better from the old formulas than from the new. Moreover, the great majority of the persons who consult a Mineralogy would find the new formulas and new terminology quite unintelligible. It has seemed reasonable therefore that both systems should be presented. The new formulas will be more easily understood or learned from their association with the old, and thus the book may help forward the views it only partially adopts. The past history of the work evinces no aversion to change where the progress of science requires it.

This work has been posted up, as far as was possible, to the date of publication. The facts which have come to hand too late for their proper place in the volume, are inserted in a Supplement. And it is proposed to make this the first of a series of supplements to appear from time to time in the American Journal of Science.

JAMES D. DANA.

April 30, 1868.

From the Preface to the First Edition (1837).

* * * * * The classification of the mineral species, which is here adopted, is strictly a *Natural* Arrangement. The superiority of this method is exhibited in the body of the work, and in connection with the remarks on Chemical Classifications, in Appendix B. Although founded by **Mohs** on the external characters of minerals, it exhibits, in a considerable degree, the chemical relations of the species; and those who are accustomed to prefer a chemical arrangement will probably perceive that, in addition to such qualities as appear to recommend the chemical method, it possesses other advantages not less important.

The changes which have been made in the nomenclature of minerals appear to be demanded by the state of the Science. The present names, excepting those proposed by MOHS, are utterly devoid of system, unless we may consider such the addition of the syllable *ite* to words of various languages; and even this glimmering of system has been capriciously infringed by a French mineralogist of much celebrity;—they seldom designate any quality or character peculiar to the mineral; neither do they exhibit any of the general relations of the species, by which the mind may, at a glance, discover their natural associations, and be assisted in obtaining a comprehensive view of the science. On the contrary, they are wholly independent, and often worse than unmeaning, appellatives, and are only tolerable in a very unadvanced state of the Science. As a necessary consequence of this looseness of nomenclature, most of the species are embarrassed with a large number of synonyms, a fertile source of confusion and difficulty.

As a remedy for this undesirable state of things, a system of nomenclature, constructed on the plan so advantageously pursued in Botany and Zoology, was proposed by the author in the fourth volume of the Annals of the New York Lyceum. The necessity for something of the kind is very apparent, and the author trusts that it will not be considered a needless innovation. * * * * * *

From the Preface to the Second Edition[*] (1844).

The natural system adopted in this Treatise has received such modifications in the present edition as were demanded by the advanced state of the Science; and the systematic nomenclature has required some corresponding changes.

Besides the natural classification, another, placing the minerals under the principal element in their composition, has been given in Part VII.; and various improvements on the usual chemical methods have been introduced, which may render it acceptable to those that prefer that mode of arrangement. * * * *

From the Preface to the Third Edition (1850).

This Treatise, in the present edition, has undergone so various and extensive alterations, that few of its original features will be recognized. The science of Mineralogy has made rapid progress in the past six years; chemistry has opened to us a better knowledge of the nature and relations of compounds; and philosophy has thrown new light on the principles of classification. To change is always seeming fickleness. But not to change with the advance of science, is worse; it is persistence in error; and, therefore, notwithstanding the former adoption of what has been called the Natural History System, and the pledge to its support given by the author in supplying it with a Latin nomenclature, the whole system, its classes, orders, genera, and Latin names, have been rejected; and even the trace of it which the synonymy might perhaps rightly bear has been discarded. The system has subserved its purpose in giving precision to the science, and displaying many of the natural groupings which chemistry was slow to recognize. But there are errors in its very foundation, which make it false to nature in its most essential points; and, in view of the character of these errors, we are willing it should be considered a relic of the past.

Yet Science is far from being ready with an acceptable substitute. Most *chemical* systems have been more artificial than the "natural" system; and doubts now hang

---

[*] This edition, failing to find a publisher in New York, was printed at the expense of the author.

over some of the principles of chemistry that are widest in their influence on classification. In view of the difficulties on either side, it was a point long questioned, whether to venture upon a classification that might be deemed most accordant with truth among the many doubts that surround the subject; or to adopt one less strict to science, that might serve the convenience of the student for easy reference, and for the study of mineralogy in its economical bearings, while, at the same time, it should exhibit many natural relations, and inculcate no false affiliations or distinctions of species. The latter alternative has been adopted;—the classification is offered simply as a convenient arrangement, and not an exhibition of the true affinities of species in the highest sense of the term. Among the Silicates, however, it will be perceived that the groupings in the main are natural groupings; and, throughout the work, special care has been taken to inculcate, as far as possible, the true relations of species, both by remarks, and by an exhibition of them in tables. * *

From the Preface to the Fourth Edition (1854).

In the Preface to the last edition of this Treatise, the classification of minerals then adopted was announced as only a temporary expedient. The system of MOHS, valuable in its day, had subserved its end; and in throwing off its shackles for the more consistent principles flowing from recent views in Chemistry, the many difficulties in the way of perfecting a new classification led the author to an arrangement which should "serve the convenience of the student without pretending to strict science."

A classification on chemical principles was however proposed in the latter part of the volume, in which the Berzelian method was coupled with crystallography in a manner calculated to display the relations of species in composition as well as form, and prominently "exhibit the various cases of isomorphism and pleomorphism among minerals." The progress of Science has afforded the means of giving greater precision and simplicity to this arrangement, until now it seems entitled to become the authorized method of a System of Mineralogy. Whether regarded from a physical or chemical point of view, the groupings appear in general to be a faithful exhibition of the true affinities of the species.

The mind uneducated in Science may revolt at seeing a metallic mineral, as galena, side by side with one of unmetallic lustre, as blende; and some systems, in accordance with this prejudice, place these species in separate orders. Like the jeweller, without as good reason, the same works have the diamond and sapphire in a common group. But it is one of the sublime lessons taught in the very portals of Chemistry, that nature rests no grand distinctions on lustre, hardness, or color, which are mere externals, and this truth should be acknowledged by the mineralogist rather than defied. Others, while recognizing the close relations of the carbonates of lime, iron, zinc, and manganese (calcite, spathic iron, smithsonite, and dialogite), or of the silicates of lime, iron, manganese (wollastonite, augite, rhodonite), are somewhat startled by finding silicate of zinc, or silicate of copper, among the silicates of the earths, or of other oxyds. But the distinction of "useful" and "useless," or of "ores" and "stones," although bearing on "economy," is not Science. * * * * * * * *

TABLE OF CONTENTS.

Introduction.

Descriptive Mineralogy: General Subdivisions 1

I. NATIVE ELEMENTS 2

II. SULPHIDS, TELLURIDS, SELENIDS, ARSENIDS, ANTIMONIDS, BISMUTHIDS 26

1. Simple Sulphids and Tellurids of Metals of the Sulphur and Arsenic Groups 26

2. Simple Sulphids, Tellurids, Selenids, Arsenids, Antimonids, Bismuthids, Phosphids of Metals of the Gold, Iron, and Tin Groups 33

3. Sulpharsenites, Sulphantimonites, Sulphobismuthites 84

III. COMPOUNDS OF CHLORINE, BROMINE, IODINE 110

IV. FLUORINE COMPOUNDS 123

V. OXYGEN COMPOUNDS 131

I. Oxyds, or Binary Oxygen Compounds 131

I. Oxyds of Elements of Series I 131

A. Anhydrous Oxyds 131

B. Hydrous Oxyds 167

II. Oxyds of Elements of the Arsenic and Sulphur Groups, Series II. 183

III. Oxyds of Elements of the Carbon-Silicon Group, Series II 189

II. Ternary Oxygen Compounds 202

1. Silicates 202

A. Anhydrous Silicates 202

I. Bisilicates 207

II. Unisilicates 250

III. Subsilicates 362

B. Hydrous Silicates 393

I. General Section of Hydrous Silicates 394

II. Zeolite Section 421

III. Margarophyllite Section 447

Appendix to Hydrous Silicates 509

2. Tantalates, Columbates 512

3. Phosphates, Arsenates, Antimonates, Nitrates 526

A. Phosphates, Arsenates, Antimonates 526

I. Anhydrous 527

II. Hydrous 548

B. Nitrates 591

4. Borates........................ 59
5. Tungstates, Molybdates, Vanadates........................ 60
6. Sulphates, Chromates, Tellurates........................ 61
  I. Anhydrous........................ 61
  II. Hydrous........................ 63
7. Carbonates........................ 669
  I. Anhydrous........................ 669
  II. Hydrous........................ 704
8. Oxalates........................ 718
VI. HYDROCARBON COMPOUNDS........................ 720
Species of uncertain place in the System........................ 761
Catalogue of American Localities........................ 765
Supplement........................ 793
Index........................ 807

INTRODUCTION.

The object of this introduction is to supply such tables and information as will make the work convenient for use; and, toward this end, some explanations of an elementary character are included, with special reference to readers not familiar with chemistry and other collateral sciences.

1. GENERAL SCHEME OF ARRANGEMENT IN THE DESCRIPTIONS.

In the Descriptions of Species, the characteristics are mentioned in the following order:—1, Crystalline Form and Structure; 2, Hardness, Specific Gravity, Lustre, Color, Diaphaneity, etc.; 3, Varieties, Chemical Composition; 4, Pyrognostic and other Chemical characters; 5, under the head of Observations, Geological position, Localities, Mineral associates, etc.; 6, Altered forms; 7, Artificial and Furnace products.

2. CHEMISTRY.

1. A *barred letter* in a symbol of an element, in the table of atomic weights which follows, and also throughout the work (except in formulas after the new system, see p. xv), signifies *two* atoms of the element: *e. g.*, $\overline{\mathrm{Al}}=2\ \mathrm{Al}$ or Al^2.

2. *Dots over a symbol* stand each for an atom of oxygen in the compound referred to: *e. g.*, $\dddot{\overline{\mathrm{Al}}}=2\ \mathrm{Al}+3\ \mathrm{O}$, or $\mathrm{Al}^2\,\mathrm{O}^3$; and $\dot{\mathrm{Ba}}=\mathrm{Ba\,O}$.

3. The *atomic weight of a compound* equals the sum of the atomic weights of its constituents: *e. g.*, for $\dddot{\overline{\mathrm{Al}}}$, the atomic weight $=2\times13{\cdot}75+3\times8=51{\cdot}5$; for $\dot{\mathrm{Ba}},=68{\cdot}5+8=76{\cdot}5$; for $\dddot{\overline{\mathrm{Al}}}\,\ddot{\mathrm{Si}}$, the atomic weight $=51{\cdot}5+30=81{\cdot}5$.

4. The *atomic ratio* for the constituents of a compound is the ratio between the number of atoms of the same: *e. g.*, for the aluminum and oxygen in $\dddot{\overline{\mathrm{Al}}}$, it is 2 : 3; for the alumina and silica in $\dddot{\overline{\mathrm{Al}}}\,\ddot{\mathrm{Si}}$ it is 1 : 1, there being 1 of alumina to 1 of silica; for the aluminum, silicon, and oxygen in $\dddot{\overline{\mathrm{Al}}}\,\ddot{\mathrm{Si}}$, it is 2 : 1 : 5, there being in the compound 2 of aluminum, 1 of silicon, and 5 of oxygen (5 dots).

5. The *oxygen ratio* for the constituents of an oxygen compound is the ratio between the number of atoms of oxygen in the different oxygen compounds present: *e. g.*, the O. ratio for the alumina and silica in $\dddot{\overline{\mathrm{Al}}}\,\ddot{\mathrm{Si}}$ is 3 : 2, alumina containing 3 O and silica 2 O; for the magnesia and silica in $\dot{\mathrm{Mg}}\,\ddot{\mathrm{Si}}$, the O. ratio is 1 : 2.

6. The *percentage ratio* (or number of parts in 100) for the constituents of a compound is deduced from the ratio between the atomic weight of the compound and that of each constituent: *e. g.*, as 51·5 of alumina contain 24 of oxygen, so 100 will contain 46·6; or, for the percentage of aluminum, 51·5 : 27·5 : : 100 : 53·4; again, as 81·5 $\dddot{\overline{\mathrm{Al}}}\,\ddot{\mathrm{Si}}$ contain 30 of silica, hence 81·5 : 30 : : 100 : the silica in the compound, etc.; or since $\dddot{\overline{\mathrm{Al}}}\,\ddot{\mathrm{Si}}$ contain 27·5 Al + 14·0 Si + 40·0 O, making in all as before 81·5, hence 81·5 : 27·5 : : 100 : the p. c. of aluminum; or 81·5 : 40 : : 100 : the p. c. of oxygen; etc.

ALUMINUM, Al	13·75	
Alumina, $\dddot{\bar{\text{Al}}}$	51·5	(O 46·6)
ANTIMONY (Stibium), Sb	122	
Antimonious acid, $\dddot{\text{Sb}}$	146	
Antimonic acid, $\overset{\cdot\cdot\cdot\cdot\cdot}{\text{Sb}}$	162	
Sulph. Antim., Sb S^3	170	(S 28·24)
ARGENTUM, Ag (Silver)	108	
ARSENIC, As	75	
Arsenous acid, $\dddot{\text{As}}$	99	
Arsenic acid, $\overset{\cdot\cdot\cdot\cdot\cdot}{\text{As}}$	115	(O 34·78)
Sulphid of A., As S^3	123	(S 39·02)
AURUM, Au (Gold)	196	
BARIUM, Ba	68·5	
Baryta, $\dot{\text{Ba}}$	76·5	(O 10·45)
BERYLLIUM, Be (Glucinum)	4·7	
$\dot{\text{Be}}$	12·7	(O 63)
BISMUTH, Bi	210	
Oxyd of Bismuth, $\dddot{\text{Bi}}$	234	(O 10·24)
BORON, B	11	
Boric acid, $\dddot{\text{B}}$	35	(O 68·57)
BROMINE, Br	80	
CADMIUM, Cd	56	
CÆSIUM, Cs	133	
CALCIUM, Ca	20	
Lime, $\dot{\text{Ca}}$	28	(O 28·57)
CARBON, C	6	
Carbonic acid, $\ddot{\text{C}}$	22	
CERIUM, Ce	46	
Protoxyd of C., $\dot{\text{Ce}}$	54	(O 14·81)
CHLORINE, Cl	35·46	
Hydrochlor. acid, H Cl	36·46	
CHROMIUM, Cr	26·24	
Oxyd of Chromium, $\dddot{\bar{\text{Cr}}}$	76·48	(O 31·38)
Chromic acid, $\dddot{\text{Cr}}$	50·24	(O 47·77)
COBALT, Co	29·5	
Oxyd of Cobalt, $\dot{\text{Co}}$	37·5	(O 21·34)
COLUMBIUM, Cb (Niobium)	94	
Columbic acid, $\overset{\cdot\cdot\cdot\cdot\cdot}{\text{Cb}}$	134	(O 29·85)
COPPER (Cuprum), Cu	31·7	
Suboxyd of Copper, $\dot{\bar{\text{Cu}}}$	71·4	(O 11·20)
Oxyd of Copper, $\dot{\text{Cu}}$	39·7	(O 20·15)
DIDYMIUM, D	48	
ERBIUM, E	56·3	
FERRUM, Fe (Iron)	28	
Protoxyd of Iron, $\dot{\text{Fe}}$	36	(O 22·22)
Sesquioxyd of Iron, $\dddot{\bar{\text{Fe}}}$	80	(O 30)
FLUORINE, F	19	
Hydrofluoric acid, H F	20	(F 95)
GLUCINUM (Beryllium), Be	4·7	
Glucina, $\dot{\text{Be}}$	12·7	(O 63)
GOLD (Aurum), Au	196	
HYDRARGYRUM, Hg (Mercury)	100	
HYDROGEN, H	1	
Water, $\dot{\text{H}}$	9	(O 88·89)
INDIUM, In	35·9	
IODINE, I	127	
IRIDIUM, Ir	99	
IRON (Ferrum), Fe	28	
Protoxyd of Iron, $\dot{\text{Fe}}$	36	(O 22·22)
Sesquioxyd of Iron, $\dddot{\bar{\text{Fe}}}$	80	(O 30)
KALIUM, K (Potassium)	39·11	
Potassa, $\dot{\text{K}}$,	47·11	(O 16·98)
LANTHANUM, La	46·4	
Protoxyd of L., $\dot{\text{La}}$	54·4	(O 14·7)
LEAD (Plumbum), Pb	103·5	
Oxyd of Lead, $\dot{\text{Pb}}$	111·5	(O 7·17)
LIME, see **CALCIUM**.		
LITHIUM, Li	7	
Lithia, $\dot{\text{Li}}$	15	(O 53·33)
MAGNESIUM, Mg	12	

	1	2	3	4	5	6	7	8	9
$\dddot{\bar{\text{Al}}}$	0·4660	0·9320	1·3980	1·8640	2·3301	2·7961	3·2621	3·7281	4·1941
$\overset{\cdot\cdot\cdot\cdot\cdot}{\text{As}}$	0·3478	0·6956	1·0434	1·3913	1·7391	2·0869	2·4347	2·7826	3·1304
$\dot{\text{Ba}}$	0·1046	0·2091	0·3137	0·4183	0·5228	0·6274	0·7320	0·8366	0·9411
$\dot{\text{Be}}$	0·63	1·26	1·89	2·52	5·15	3·78	4·41	5·04	5·67
$\dot{\text{Ca}}$	0·2857	0·5714	0·8571	1·1428	1·4285	1·7142	1·9999	2·2857	2·5714
$\ddot{\text{C}}$	0·7273	1·4546	2·1819	2·9092	3·6365	4·3638	5·0911	5·8184	6 5457
$\dddot{\bar{\text{Cr}}}$	0·3138	0·6276	0·9414	1·2552	1·5690	1·8828	2·1967	2·5105	2·8243
$\dddot{\text{Cr}}$	0·4777	0·9554	1 4331	1·9008	2·3885	2·8662	3·3339	3·8216	4·2993
$\dot{\text{Co}}$	0·2133	0 4266	0·6400	0·8533	1·0667	1·2800	1·4933	1·7066	1·9200
$\dot{\bar{\text{Cu}}}$	0·1120	0·2240	0·3360	0·4480	0·5600	0·6720	0·7840	0·8960	1·0080
$\dot{\text{Cu}}$	0·2015	0·4030	0·6045	0·8060	1·0075	1·2090	1·4105	1·6120	1·8136
$\dot{\text{Fe}}$	0·2222	0·4444	0·6666	0·8888	1·1110	1·3332	1·5554	1·7776	1·9998

Magnesia, $\dot{\mathrm{Mg}}$	20	(O 40)
MANGANESE, Mn	27·5	
Protoxyd of M., $\dot{\mathrm{Mn}}$	35·5	(O 22·53)
Sesquioxyd of M., $\overset{\cdot\cdot\cdot}{\overline{\mathrm{Mn}}}$	79	(O 30·38)
MERCURY (Hydrargyrum), Hg	100	
MOLYBDENUM, Mo	46	
Molybdic acid, $\overset{\cdot\cdot\cdot}{\mathrm{Mo}}$	70	(O 34·28)
NATRIUM, Na (Sodium)	23	
Soda, $\dot{\mathrm{Na}}$	31	(O 25·81)
NICKEL, Ni	29·5	
Protoxyd of Nickel, $\dot{\mathrm{Ni}}$	37·5	(O 21·33)
NIOBIUM (Columbium), Cb	94	
Columbic acid, $\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{Cb}}$	134	(O 29·85)
NITROGEN, N	14	
Nitric acid, $\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{N}}$	54	(O 74 07)
$N H^4 O$	26	
OSMIUM, Os	99·5	
OXYGEN, O	8	
PALLADIUM, Pd	53	
PHOSPHORUS, P	31	
Phosphoric acid, $\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{P}}$	71	(O 56·34)
PLATINUM, Pt	98·94	
PLUMBUM, Pb (Lead)	103·5	
Oxyd of Lead, $\dot{\mathrm{Pb}}$	111·5	(O 7·17)
POTASSIUM (Kalium), K	39·11	
Potassa, $\dot{\mathrm{K}}$	47·11	(O 16·98)
QUICKSILVER (Hydrargyrum) Hg	100	
RHODIUM, Rh	52·16	
RUBIDIUM, Rb	85·4	
RUTHENIUM, Ru	52·16	
SELENIUM, Se	39·5	
SILICIUM, Si	14	
Silica, $\ddot{\mathrm{Si}}$	30	(O 53·33)
SILVER (Argentum), Ag	108	
SODIUM (Natrium), Na	28	
Soda, $\dot{\mathrm{Na}}$	31	(O 25·81)
STANNUM, Sn (Tin)	59	
Oxyd of Tin, $\ddot{\mathrm{Sn}}$	75	(O 21·33)
STIBIUM, Sb (Antimony)	122	
Antimonious acid, $\overset{\cdot\cdot\cdot}{\mathrm{Sb}}$	146	
Antimonic acid, $\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{Sb}}$	162	
Sulph. Antim., $Sb S^3$	170	(S 28·24
STRONTIUM, Sr	43·75	
Strontia, $\dot{\mathrm{Sr}}$	51·75	(O 15·46)
SULPHUR, S	16	
Sulphuric acid, $\overset{\cdot\cdot\cdot}{\mathrm{S}}$	40	(O 60)
TANTALUM, Ta	182	
Tantalic acid, $\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{Ta}}$	222	(O 18·01)
TELLURIUM, Te	64·14	
THALLIUM, Tl	203	
THORIUM, Th	119	
Thoria, $\ddot{\mathrm{Th}}$	135	(O 11·84)
TIN (Stannum), Sn	59	
Oxyd of Tin, $\ddot{\mathrm{Sn}}$	75	(O 21·33)
TITANIUM, Ti	25	
Titanic acid, $\ddot{\mathrm{Ti}}$	41	(O 39·02)
TUNGSTEN (Wolframium), W	92	
Tungstic acid, $\overset{\cdot\cdot\cdot}{\mathrm{W}}$	116	(O 20·69)
URANIUM, U	59·4	
Protoxyd of U., $\dot{\mathrm{U}}$	67·4	(O 11·87)
Sesquioxyd of U., $\overset{\cdot\cdot\cdot}{\overline{\mathrm{U}}}$	142·8	(O 16·8)
VANADIUM, V	68·5	
WOLFRAMIUM, W (Tungsten)	92	
Tungstic acid, $\overset{\cdot\cdot\cdot}{\mathrm{W}}$	116	(O 20·69)
YTTRIUM, Y	32·18	
Yttria, $\dot{\mathrm{Y}}$	40·18	(O 19·16)
ZINC, Zn	32·53	
Oxyd of Zinc, $\dot{\mathrm{Zn}}$	40·53	(O 19·74)
ZIRCONIUM, Zr	44·80	
Zirconia, $\ddot{\mathrm{Zr}}$	60·80	(O 26·31)

	1	2	3	4	5	6	7	8	9
$\dot{\mathrm{H}}$	0·8889	1·7778	2·6667	3·5556	4·4445	5·3334	6·2223	7·1112	8·0001
$\dot{\mathrm{K}}$	0·1698	0·3396	0·5094	0·6792	0·8491	1·0189	1·1887	1·3585	1·5283
$\dot{\mathrm{Li}}$	0·5333	1·0666	1·5999	2·1332	2·6665	3·1998	3·7331	4·2664	4·7997
$\dot{\mathrm{Mg}}$	0·40	0·80	1·20	1·60	2·00	2·40	2·80	3·20	3·60
$\dot{\mathrm{Mn}}$	0·2253	0·4507	0·6760	0·9014	1·1267	1·3521	1·5774	1·8028	2·0281
$\overset{\cdot\cdot\cdot}{\overline{\mathrm{Mn}}}$	0·3038	0·6076	0·9113	1·2151	1·5190	1·8227	2·1265	2·4304	2·7341
$\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{N}}$	0·7407	1·4814	2·2221	2·9628	3·7035	4·4442	5·1849	5·9256	6·6663
$\dot{\mathrm{Na}}$	0·2581	0·5162	0·7743	1·0324	1·2905	1·5486	1·8067	2·0648	2·3229
$\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{P}}$	0·5634	1·1268	1·6902	2·2536	2·8170	3·3804	3·9438	4·5072	5·0706
$\dot{\mathrm{Pb}}$	0·0717	0·1435	0·2152	0·2870	0·3587	0·4304	0·5022	0·5740	0·6457
$\ddot{\mathrm{Si}}$	0·5333	1·0666	1·6000	2·1333	2·6666	3·2000	3·7333	4·2666	4·8000
$\dot{\mathrm{Sr}}$	0·1545	0·3091	0·4637	0·6183	0·7729	0·9275	1·0821	1·2367	1·3913

The *percentage of oxygen* in each of the oxygen compounds enumerated in the preceding table of atomic weights is stated in parentheses after the atomic weight of the compound; and the *percentage of sulphur*, in the same manner, after the atomic weight of many of the sulphids.

7. The *atomic ratio is calculated from the percentage ratio*, by dividing each number by the atomic weight of the constituent: the percentage ratio of Al and O in alumina being 53·4 : 46·6, 53·4 ÷ 13·75 gives 3·93, and 46·9 ÷ 8 = 5·85; whence the ratio 3·93 : 5·85, which, by dividing the larger by the smaller, is found to equal 1 : 1·5 or 2 : 3, which is the atomic ratio of the aluminum to the oxygen.

For the compound $\dddot{\bar{Al}}\,\ddot{Si}$, the percentage of silica and alumina is 36·8, 63·2; whence, dividing the former by 30 (at. w. of silica), and the latter by 51·5 (at. w. of alumina), the ratio obtained is 1 : 1, the compound consisting of 1 of each alumina and silica; or taking the percentage for the silicon, aluminum, and oxygen in the same, and dividing them, respectively, by 14, 13·75, 8, the ratio deduced would be 1 : 2 : 5.

8. The ratio of alumina and silica in a compound may also be obtained by comparing the amounts of oxygen in the percentages of the constituents. Take, *e. g.*, a silicate of alumina consisting of $\ddot{Si}$ 36·8, $\dddot{\bar{Al}}$ 63·2 = 100. If 100 of silica contain 53·33 of oxygen (see table) then 36·8 will contain 36·8 × ·5333 or 19·625 (since 100 : 36·8 : : 53·33 : the required percentage); so if 100 of alumina contain 46·6 of oxygen, 63·2 will contain 46·6 × ·632 or 29·45; now 19·625 : 29·45 (the ratio obtained) = 2 : 3; and since silica contains 2 of oxygen and alumina 3, it follows from the result of the calculation that the compound contains 1 of silica to 1 of alumina, or has the formula $\dddot{\bar{Al}}\,\ddot{Si}$. This is the usual method of calculating the ratio of the constituents in the case of oxyds. It involves multiplications of the percentage of each of the constituents by the percentage of oxygen for that constituent; and in order to facilitate these multiplications a table is given below the table of atomic weights, containing multiples of these oxygen percentages for each of the digits 1 to 9.

9. The letter R is used as a general symbol for any element; $\dot{R}$, for protoxyds in general; $\dddot{\bar{R}}$, for sesquioxyds in general.

10. In the formula $3\,\dot{Ca}^2\,\ddot{Si} + \dddot{\bar{Al}}^2\,\ddot{Si}^3$, the prefix 3 applies to the whole $\dot{Ca}^2\,\ddot{Si}$ (or, in general, to all before the first comma, or first + or —); but the small ^{2} only to $\dot{Ca}$, it signifying 2 $\dot{Ca}$; and, in the second part, the small ^{2} signifies that there are 2 $\dddot{\bar{Al}}$, and the small ^{3}, 3 $\ddot{Si}$. The oxygen ratio for the $\dot{Ca}$ and $\ddot{Si}$ in the first part is 1 : 1, there being 2 $\dot{Ca}$ to 1 $\ddot{Si}$, 2 $\dot{Ca}$ as well as 1 $\ddot{Si}$ containing 2 O; and in the second part it is 1 : 1, there being 2 $\dddot{\bar{Al}}$ to 3 $\ddot{Si}$. The oxygen ratio for the whole $\dot{Ca}$, $\dddot{\bar{Al}}$, $\ddot{Si}$ in the formula is 6 : 6 : 12 = 1 : 1 : 2; and for the $\dot{Ca} + \dddot{\bar{Al}}$, $\ddot{Si}$ it is 1 + 1 : 2 or 1 : 1.

In the formula $(\frac{1}{2}\,\dot{Ca}^3 + \frac{1}{2}\,\dddot{\bar{Al}})^2\,\ddot{Si}^3$, the index ^{2} signifies 2 of all within the parenthesis. The oxygen ratio of the part in the parenthesis is 1 : 1, there being $\frac{1}{2}\,\dot{Ca}^3$ to $\frac{1}{2}\,\dddot{\bar{Al}}$; the O. ratio for $\dot{Ca}$, $\dddot{\bar{Al}}$, $\ddot{Si}$, in the formula, is 1 : 1 : 2; and for $\dot{Ca} + \dddot{\bar{Al}}$, $\ddot{Si}$, it is 1 : 1. Thus the two formulas here explained express identically the same constitution.

There are many compounds allied to the above, for example: $(\frac{1}{2}\,\dot{Mg}^3 + \frac{1}{2}\,\dddot{\bar{Al}})^2\,\ddot{Si}^3$, $(\frac{1}{2}\,\dot{Fe}^3 + \frac{1}{2}\,\dddot{\bar{Al}})^2\,\ddot{Si}^3$, $(\frac{1}{2}\,\dot{Mg}^3 + \frac{1}{2}\,\dddot{\bar{Fe}})^2\,\ddot{Si}^3$, etc. The symbol R is used, in the manner above explained, in writing a general formula for the group containing these and other related compounds; as $(\frac{1}{2}\,\dot{R}^3 + \frac{1}{2}\,\dddot{\bar{R}})^2\,\ddot{Si}^3$. So $\dot{R}\,\ddot{C}$ is a general symbol for any carbonate of a protoxyd—whether of lime, magnesia, oxyd of zinc, or any other base.

11. In the preceding table, and throughout this volume, except under the sulphur compounds, As, Sb, Bi, Ni, P, in formulas under the old system, would be more correctly written As_2, Sb_2, Bi_2, Ni_2, P_2, or $\bar{As}$, $\bar{Sb}$, $\bar{Bi}$, $\bar{Ni}$, $\bar{P}$. The atomic weights of these elements in the table are double the value which is often given them in the old system.

12. *Binary compounds* are those consisting of elements of two kinds, those of one kind negative to the other: *e. g.*, magnesia, $Mg O$, consisting of magnesium and oxygen; water, $H O$; silicic acid, or silica, $Si O^2$; pyrite, $Fe S^2$.

Ternary compounds (called also *salts* and *double binaries*) consist of elements of three kinds, (1) *basic*, (2) *acidic*, (3) *acidific*. Thus a silicate of lime and magnesia (or calcium and magnesium) contains (1) calcium and magnesium, (2) silicon, (3) oxygen; sulphate of lead contains (1) lead, (2) sulphur, (3) oxygen; the sulphantimonite, jamesonite, contains (1) lead and iron, (2) antimony, (3) sulphur.

13. *Polymeres* are distinct substances that are atomically multiples of a common type. Thus the compounds $2\,\Theta H^2$, $3\,\Theta H^2$, $4\,\Theta H^2$ (generally written $\Theta^2 H^4$, $\Theta^3 H^6$, $\Theta^4 H^8$), are polymeres of ΘH^2.

14. The following principle is of great importance in connection with the chemical constitution of inorganic compounds, and although explained briefly elsewhere (pp. 1–3 and 202), deserves to be formally stated in this place:

The replacing power of the elements is in proportion to their combining power, this combining power being reckoned in number of atoms of oxygen (or sulphur, or the acidific element, whatever it may be).

The line A, below, contains the formulas of the different kinds of oxyds; B, the same, divided each by its number of atoms of oxygen (that is, severally, for the successive members, by 1, 3, 2, 5, 3, 7, 4), by which division they are reduced to the protoxyd form; C, the basic elements without the oxygen:

A.	$R O$	$R^2 O^3$	$R O^2$	$R^2 O^5$	$R O^3$	$R^2 O^7$	$R O^4$
B.	$R O$	$R^{\frac{2}{3}} O$	$R^{\frac{1}{2}} O$	$R^{\frac{2}{5}} O$	$R^{\frac{1}{3}} O$	$R^{\frac{2}{7}} O$	$R^{\frac{1}{4}} O$
C.	R	$R^{\frac{2}{3}}$	$R^{\frac{1}{2}}$	$R^{\frac{2}{5}}$	$R^{\frac{1}{3}}$	$R^{\frac{2}{7}}$	$R^{\frac{1}{4}}$

According to the above law, the R, $R^{\frac{2}{3}}$, $R^{\frac{1}{2}}$, etc., in the last line are mutually replaceable, 1 for 1, although in atomic weight there is a variation from 1 to $\frac{1}{4}$. They represent different states in which elements may exist, and have, to a certain extent, independent element-like relations. In some cases, as in iron, four of these states are represented in a single element, the compounds (1) $Fe O$, $Fe S$, (2) $Fe^2 O^3$, (3) $Fe S^2$, (4) $Fe O^3$, containing this metal in the four states Fe, $Fe^{\frac{2}{3}}$, $Fe^{\frac{1}{2}}$, $Fe^{\frac{1}{3}}$.

These different states of elements are best designated in the symbol by the letters of the Greek alphabet, as thus the confusion arising from the conflicting numbers for atomic weights and combining relations are avoided. The above lines A, B, C, thus written, will become:

A.	$\alpha R O$	$3\,\beta R O$	$2\,\gamma R O$	$5\,\delta R O$	$3\,\epsilon R O$	$7\,\zeta R O$	$4\,\eta R O$
B.	$\alpha R O$	$\beta R O$	$\gamma R O$	$\delta R O$	$\epsilon R O$	$\zeta R O$	$\eta R O$
C.	αR	βR	γR	δR	ϵR	ζR	ηR

In each table the line B is like C, except in the addition of O; and the line A is equivalent to B multiplied for the successive members by the number of atoms of oxygen in the oxyds, that is, severally, by 1, 3, 2, 5, 3, 7, 4. Examples of the use of these symbols are unnecessary here, as they occur on the pages referred to, and throughout the volume.

15. In the statements of analyses throughout this volume, the use of brackets enclosing figures implies that the substance referred to was determined by the loss.

New System of Chemistry. In the new system of Chemistry many of the elements have their atomic weights of double the value given in the preceding table, and their symbols are accordingly written with a barred letter, as follows:

16. *Table of Atomic Weights according to the New System.*

Aluminum, Al	27·5	Glucinum, Be	9·4	Rhodium, Rh	104·32
Antimony, Sb	122	Gold, Au	196	Rubidium, Rb	85·4
Argentum, Ag	108	Hydrargyrum, Hg	200	Ruthenium, Ru	104·32
Arsenic, As	75	Hydrogen, H	1	Selenium, Se	79
Aurum, Au	196	Iodine, I	127	Silicon, Si	28
Barium, Ba	137	Iridium, Ir	198	Silver, Ag	108
Beryllium, Be	9·4	Iron, Fe	56	Sodium, Na	23
Bismuth, Bi	210	Lanthanum, La	92·8	Stannum, Sn	118
Boron, Bo	11·0	Lead, Pb	207	Stibium, Sb	122
Bromine, Br	80	Lithium, Li	7	Strontium, Sr	87·5
Cadmium, Θd	112	Magnesium, Mg	24	Sulphur, S	32
Cæsium, Cs	133	Manganese, Mn	55	Tantalum, Ta	182
Calcium, Θa	40	Mercury, Hg	200	Tellurium, Te	128·28
Carbon, Θ	12	Molybdenum, Mo	92	Thallium, Tl	203
Cerium, Θe	92	Nickel, Ni	59	Tin, Sn	118
Chlorine, Cl	35·40	Nitrogen, N	14	Titanium, Ti	50
Chromium, Θr	52·48	Osmium, Θs	199	Tungsten, W	184
Cobalt, Θo	59	Oxygen, Θ	16	Uranium, U	118·8
Columbium, Θb	188	Palladium, Pd	106	Vanadium, V	137
Copper, Θu	63·4	Phosphorus, P	31	Yttrium, Y	64·36
Erbium, Eb	112·6	Platinum, Pt	197·88	Zinc, Zn	65
Ferrum, Fe	56	Plumbum, Pb	207	Zirconium, Zr	89·6
Fluorine, F	19	Potassium, K	39·1		

The elements in the preceding table whose atomic weights are not doubled (or which have not barred letters in the symbols), are hydrogen; gold, silver; the alkali metals, potassium, etc.; the arsenic group, arsenic, antimony, bismuth, nitrogen, phosphorus, with boron; the chlorine group, chlorine, bromine, iodine.

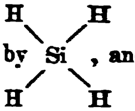
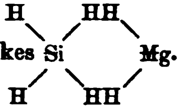
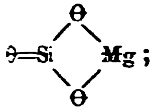
17. In the combinations between elements of the former series occur, hydrogen being taken as the unit, the ratios 1 : 1, 1 : 3, 1 : 5; and, with reference to the *odd* numbers 1, 3, 5, these elements are called *perissads.* While in the combinations between elements of the latter series occur, taking the same unit, the ratios 2 : 2, 2 : 4, 2 : 6; and these, in view of the *even* numbers, are called *artiads.* The words περισσός and ἄρτιος were the words for *odd* and *even* numbers in ancient arithmetic.

18. As oxygen is one of the doubled elements, a protoxyd of a perissad must contain 2 of the latter; and water, accordingly, has the formula $H_2Θ$, potash $K_2Θ$, soda $Na_2Θ$, etc. But the protoxyds of elements of the other series have simply the symbols Mg Θ for magnesia, Θa Θ for lime, etc.

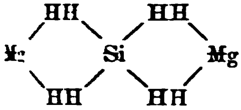
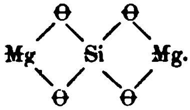
19. In the formulas of the salts, or *ternaries*, instead of dividing the oxygen between the acidific and basic elements (thus making the acid and base in the compound distinct, as in the old system), the symbol of each of the elements is placed separately. Thus, $\dot{M}g^2\ddot{S}i$ becomes $Si\,Mg_2\,Θ_4$; or, in the method of writing adopted in this work, $Si\|Θ_4\|Mg_2$.

20. It is held that in some classes of compounds only part of the oxygen serves to unite the acidic element (Si) to the basic. For example, for $\dot{M}g\,\ddot{S}i$ the formula is $Si\,Θ|Θ_2|Mg$, only two of the three of oxygen being regarded as *uniting* oxygen. To explain:

20. As silicon combines with 2Θ, and 2Θ are equivalent to 4 H; and magnesia, or any protoxyd, with 1Θ, which equals 2 H; the combining character of silicon is repre-

sented by  , and that of magnesium by H—Mg—H, silicon having *four* bonds of attraction (being therefore a *tetrad*), and magnesium *two* (it being a *dyad*). Combining the two makes . Substituting Θ for 2 H in the diagram, it becomes  ; in which only *two* Θ unite the Mg and Si, *one* Θ being combined alone with the Si. Hence the form of the above formula, $\mathrm{Si}\,\Theta|\Theta_2|\mathrm{Mg}$.

If the silica is combined with two of magnesia (using the language of the old system), the diagram becomes

 ; and, substituting oxygen as before, . Here all the oxygen is *uniting* oxygen, and the formula is accordingly $\mathrm{Si}|\Theta_4|\mathrm{Mg}_2$.

21. The number of atoms of *uniting* oxygen is *equal to the number of bonds of attraction in the basic or acidic element, according as the former or latter has the smaller number.* If, in the case of a compound containing *one* of silica, the base is *one* of a protoxyd (on the old system), there are two bonds of attraction in the protoxyd, and therefore Θ_2 is the uniting oxygen, one Θ remaining with the Si. If the base is two of a protoxyd there are four bonds of attraction in the basic element (as well as the acidic), and the uniting oxygen is Θ_4. If the base is three of a protoxyd, or one of a sesquioxyd, the silica then has the *smaller* number of bonds of attraction, namely but *four*, and the uniting oxygen will be Θ_4, the rest being united with the basic element and not the silicon; and it cannot exceed this, however much the amount of base be increased, *it being determined by the greatest number of bonds of attraction common to the two, the basic and acidic elements.* With two of silica the bonds of attraction will be *eight*, and so on.

22. The rule above given may be also stated in terms of the oxygen of the base and acid in the old system: the number of atoms of uniting oxygen is double the number of atoms of oxygen of the base, unless the number of atoms of the base is greater than that of the acid; and in this latter case it is double the number of atoms of oxygen in the acid. In the former case the formula should have the non-uniting Θ after the symbol of the acidic element (after Si in a silicate, S in a sulphate, etc.); in the latter, it is written after that of the basic element. In the former, the acidic element makes the *left* part of the formula; in the latter the formula is turned about, and it makes the *right* part. See for examples of the latter, p. 362.

23. For the *sulphur, selenium*, and *tellurium compounds* (that is, sulphids, etc.), the formulas are like those of the oxygen compounds, except that S, Se, or Te is substituted for Θ. So also for ternary fluorids. In some oxygen compounds (topaz, etc.) Θ is replaced in part by F_2 (or, as the symbol for fluorine may then be written, F; and in a few others, by Cl_2.

24. In the new system the expressions on p. xv, βR, γR, δR, εR, etc., become βɌ, γɌ, δɌ, εɌ; or, in the case of perissads, $\beta\mathrm{R}_2$, $\gamma\mathrm{R}_2$, etc. As, $\bar{\ddot{\mathrm{A}}}\mathrm{s}$, and $\dddot{\mathrm{B}}$ of the old system become $\mathrm{As}_2\,\Theta_3$, and $\mathrm{B}_2\,\Theta_3$ in the new, and As and B are not monads, these formulas are equivalent under the new system to 3 βAs Θ, 3 βB Θ.

25. The classification in this work is based on the following classification of the elements, a partial exhibition of which is presented beyond on pages 1–3, and 202

Classification of the Elements.

Series I.	**Series II.**	**Series III.**
A. *Perissads.*	A. *Perissads.*	A. *Perissads.*
Potassium, Sodium, Cæsium, Rubidium, Lithium, Thallium, Hydrogen, Silver, Gold.	Nitrogen, Phosphorus, Arsenic, Antimony, Bismuth, Columbium, Tantalum, in the δR state. Boron?	Chlorine, Bromine, Iodine.
B. *Artiads.*	B. *Artiads.*	B. *Perissad* (or *Artiad*).
1. IRON-ALUMINUM GROUP.	1. SULPHUR GROUP.	Fluorine.
a. IRON SUB-GROUP.—Platinum, etc., Copper, Lead, etc., Iron, Cobalt, Zinc, Cadmium, Nickel, Manganese, Chromium, Tungsten, etc., Cerium, Yttrium, etc., Magnesium, Calcium, Strontium, Barium; also H_2, K_2, Na_2, etc.		C. *Artiad.*
b. ALUMINUM SUB-GROUP.—Aluminum (βA̶l): also βF̶e, βM̶n, βC̶r, βB, etc.	Sulphur (εS), Selenium, Tellurium, Molybdenum; also εF̶e, εC̶r, εM̶n, εV̶, εW̶.	Oxygen.
2. TIN GROUP.	2. CARBON-SILICON GROUP.	
Tin, Titanium. Zirconium, Thorium; also γH_2, γF̶e, γM̶n, γC̶o, γP̶b, γC̶u, etc.	Carbon, Silicon; also γS̶, γS̶e, γT̶e, etc.	

This classification assumes that the metal iron, for example, when in the deutoxyd state, is of the same group with titanium or tin in the deutoxyd state; that chromium, molybdenum, etc., in the tritoxyd state, belong to the same group with sulphur, selenium, boron, etc., in the tritoxyd state; and further, that while silicon and the elements of the tin group are unquestionably allied, the latter are basic to the former in all combinations of the two.

In the earlier part of the volume, the formulas on the new system are not given. Examples of the several kinds under each of the subdivisions are here presented, and from them the student will easily supply those here omitted.

26. *Sulphids*, *Tellurids*, *Selenids*, *Arsenids*, *Antimonids*, *Bismuthids*. The following are the formulas of species from the lists on pages 26, 34, 84, 85, each being indicated by its number instead of its name. The atomic weights of the sulphur and arsenic groups in the new system are *relatively the same* with those that are used in the sections beyond on the Sulphids, those of the arsenic series employed in these sections being half less than are given in the table on pages xii, xiii.

1.	26. As$_2$ S̶$_2$	27. As$_2$ S$_3$	34. M̶o S$_2$
2, I.	35. Ag$_4$ Sb	36. Ag$_{12}$ Bi	37. C̶u$_3$ As$_2$
2, II.	40. Ag$_2$ S̶	46. (P̶b, C̶u) S̶e	56. Z̶n S̶
	41. (Ag$_2$, P̶b) S̶	47. (P̶b, H̶g) S̶e	58. Ag$_2$ T̶e
	44. P̶b S̶	48. P̶b T̶e	61. C̶u S̶
	45. P̶b S̶e	49. (C̶u, F̶e) S̶	62. (C̶u, Ag$_2$) S̶

2, III. 75. $\mathrm{Fe\,S_2}$, or $\gamma\mathrm{Fe_2\,S_2}$
81. $2\,\text{Ɵo}\,\mathrm{S}+\text{Ɵo}\,\mathrm{S_2}$, or $(\text{Ɵo}, \gamma\,\mathrm{Co})_2\,\mathrm{S_2}$
83. $(\text{Ɵo}, \mathrm{Fe}, \mathrm{Ni})\,\mathrm{As_2}$, or $\gamma\mathrm{R_2\,As_2}$
85. $\text{Ɵo}\,(\mathrm{S}, \mathrm{As})_2$, or $\gamma\text{Ɵo}_2\,(\mathrm{S}, \mathrm{As})_2$
86. $\mathrm{Ni}\,(\mathrm{S}, \mathrm{As})_2$, or $\gamma\mathrm{Ni_2}\,(\mathrm{S}, \mathrm{As})_2$
94. $\mathrm{Fe}\,(\mathrm{S}, \mathrm{As})_2$, or $\gamma\mathrm{Fe_2}\,(\mathrm{S}, \mathrm{As})_2$
98. $(\mathrm{Ag_2\,Au_2})\,\mathrm{Te_2}$
100. $\text{Ɵu}\,\mathrm{S}$

3. 101. $\mathrm{Sb_2\,S_2|S_2|}\text{Ɵu}$
102. $\mathrm{Bi_2\,S_2|S_2|}\text{Ɵu}$
104. $\mathrm{Sb_2\,S_2|S_2|Fe}$
105. $\mathrm{As_2\,S_2|S_2|Pb}$
108. $\mathrm{Sb_2\,S_2|S_2|Ag_2}$
110. $\mathrm{As_2\,S_{\frac{3}{2}}|S_2|}\text{Ɵu}_{\frac{3}{2}}$
111. $\mathrm{Sb_2\,S|S_4|(Pb, Ag_2)_2}$
113. $\mathrm{As_2\,S|S_4|\,Pb_2}$
117. $\mathrm{Sb_2|S_6|(Ag_2)_3}$
118. $\mathrm{As_2|S_6|(Ag_2)_3}$
119. $\mathrm{Sb_2|S_6|}(\text{Ɵu}, \mathrm{Pb})_3$
121. $\mathrm{Bi_2|S_6|}\text{Ɵu}_3$
122. $\mathrm{Sb_2|S_6|Pb_3}$
123. $\mathrm{(Bi_2,Sb)|S_6|Pb_3}$
125. $(\text{Ɵu}, \text{etc.}, \mathrm{S|S_6|(Sb_2, As_2)}$
127. $(\text{Ɵu}, \mathrm{Fe})_4\,\mathrm{S|S_6|As_2}$
128. $\mathrm{(Pb_4\,S|S_6|Sb_2}$
129. $\mathrm{Pb_5\,S_2|S_6|(Sb_2, As_2)}$
130. $\mathrm{(Ag_2)_6\,S_2|S_6|Sb_2}$
131. $(\mathrm{Ag_2}, \text{Ɵu})_{10}\,\mathrm{S_7|S_6|(Sb_2+As_2)}$
132. $\mathrm{As_2\,S_2|S_6|}\text{Ɵu}$

27. *Chlorids, Bromids, Iodids.* For the Chlorids, Bromids, Iodids, p. 110, the following are examples of the new formulas:

136. $\mathrm{Hg_2\,Cl_2}$
137. $\mathrm{K\,Cl}$
138. $\mathrm{Na\,Cl}$
139. $\mathrm{N\,H_4\,Cl}$
140. $\mathrm{Ag\,Cl}$
142. $\mathrm{Ag\,Br}$
143. $\mathrm{Ag\,I}$
144. $\mathrm{Hg_2\,I_2}$
145. $\mathrm{Pb\,Cl_2}$
146. $\mathrm{Fe_2\,Cl_6}$
147. $(\mathrm{K_2}, \mathrm{Mg})\,\mathrm{Cl_2}+4\,\mathrm{aq}$
148. $(\text{Ɵa}, \mathrm{Mg})\,\mathrm{Cl_2}+4\,\mathrm{aq}$
150. $\mathrm{Pb}\,(\frac{1}{2}\,\mathrm{Cl_2}+\frac{1}{2}\,\Theta)$
151. $\mathrm{Pb}\,(\frac{1}{3}\,\mathrm{Cl_2}+\frac{2}{3}\,\Theta)$

28. *Fluorids.* Under the Fluorids, if fluorine is taken as a perissad, among the formulas of p. 123, $\mathrm{Ca\,F}$=in the new system, $\text{Ɵa}\,\mathrm{F_2}$; $\mathrm{Ce\,F}=\text{Ɵe}\,\mathrm{F_2}$; $3\,\mathrm{Na\,F}+\mathrm{Al^2\,F^3}=\mathrm{Na_6\,Al_2\,F_{12}}$; $(\mathrm{Ca}, \mathrm{Na})_2\,\mathrm{F}+\mathrm{Al^2\,F^3}=(\text{Ɵa}, \mathrm{Na_2})_2\,\mathrm{Al_2\,F_{10}}$.

29. *Oxyds.* A. For the *Anhydrous Oxyds*, pp. 131, 132, examples of the formulas are:

1. 173. $\mathrm{Mg}\,\Theta$
175. $\mathrm{H_2}\,\Theta$
176. $\mathrm{Zn}\,\Theta$

2. 179. $\mathrm{Al_2}\,\Theta_3$, or $\beta\mathrm{Al_3}\,\Theta_3$
180. $\mathrm{Fe_2}\,\Theta_3$, or $\beta\mathrm{Fe_3}\,\Theta_3$
181. $(\mathrm{Fe}, \beta\mathrm{Fe}, \gamma\mathrm{Ti})_3\,\Theta_3$
182. $(\text{Ɵa}, \gamma\mathrm{Ti})_3\,\Theta_3$

3. 1. 183. $(\frac{1}{4}\,\mathrm{Mg}+\frac{3}{4}\,(\beta\mathrm{Al}, \beta\mathrm{Fe}))_4\,\Theta_4$
184. $(\frac{1}{4}\,\mathrm{Fe}+\frac{3}{4}\,\beta\mathrm{Al})_4\,\Theta_4$
186. $(\frac{1}{4}\,\mathrm{Fe}+\frac{3}{4}\,\beta\mathrm{Fe})_4\,\Theta_4$
187. $(\frac{1}{4}\,\mathrm{Mg}+\frac{3}{4}\,\beta\mathrm{Fe})_4\,\Theta_4$
188. $(\frac{1}{4}\,(\mathrm{Zn}, \mathrm{Fe}, \mathrm{Mn})+\frac{3}{4}\,(\beta\mathrm{Fe}, \beta\mathrm{Mn}))_4\,\Theta_4$
189. $(\frac{1}{4}\,(\mathrm{Fe}, \mathrm{Mg}, \text{Ɵr})+\frac{3}{4}\,\beta\mathrm{R})_4\,\Theta_4$

3, 2. 191. $(\frac{1}{4}\,\mathrm{Be}+\frac{3}{4}\,\beta\mathrm{Al})_4\,\Theta_4$

4. 192. $\mathrm{Sn}\,\Theta_2$, or $\gamma\mathrm{Sn_2}\,\Theta_2$
193. $\mathrm{Ti}\,\Theta_2$, or $\gamma\mathrm{Ti_2}\,\Theta_2$
195. $(\frac{1}{2}\,\mathrm{Mn}+\frac{1}{2}\,\gamma\mathrm{Mn})_2\,\Theta_2$
197. $(\frac{1}{2}\,\mathrm{Pb}+\frac{1}{2}\,\gamma\mathrm{Pb})_2\,\Theta_2$

The general formula for the Spinel group is $(\frac{1}{4}\,\mathrm{R}+\frac{3}{4}\,\beta\,\mathrm{R})_4\,\Theta_4$.

The spinel formula written, as ordinarily done under the new system, without the Greek symbol, would be $(\mathrm{R}+\mathrm{R_2})\,\Theta_4$. But this formula contains the fiction of $2\,\mathrm{R}$ in $\mathrm{R_2}\,\Theta_3$; when, in fact, while there are $2\,\mathrm{R}$ in atomic weight, there are actually $3\,\mathrm{R}$ in replacing power, as already explained (p. xv). Some additional sign is therefore required to make the formula tell the truth, and this is afforded either by adding other numbers to the barred letters, or by the use of the Greek letters as here adopted.

30. B. For the *Hydrous Oxyds*, p. 167, the formulas become, if the species are regarded as only oxyds:

202. $(\frac{1}{4}\,\mathrm{H_2}+\frac{3}{4}\,\beta\mathrm{Fe})_3\,\Theta_3$
203. $(\frac{1}{4}\,\mathrm{H_2}+\frac{3}{4}\,\beta\mathrm{Al})_3\,\Theta_3$
204. $(\frac{1}{4}\,\mathrm{H_2}+\frac{3}{4}\,\beta\mathrm{Fe})_3\,\Theta_3$
205. $(\frac{1}{4}\,\mathrm{H_2}+\frac{3}{4}\,\beta\mathrm{Mn})_3\,\Theta_3$
206. $(\frac{1}{3}\,\mathrm{H_2}+\frac{2}{3}\,\beta\mathrm{Fe})_3\,\Theta_3$
207. $(\frac{2}{3}\,\mathrm{H_2}+\frac{1}{3}\,\beta\mathrm{Fe})_3\,\Theta_3$

208. $(\frac{2}{5}\mathrm{H}_2+\frac{3}{5}(\beta\mathrm{Fe}, \beta\mathrm{Al}))_3\,\Theta_3$
209. $(\frac{2}{5}\mathrm{H}_2+\frac{3}{5}(\beta\mathrm{U}, \beta\mathrm{Fe}))_3\,\Theta_3$
210. $(\frac{1}{2}\mathrm{H}_2+\frac{1}{2}\mathrm{Mg})_3\,\Theta_3$
211. $(\frac{1}{2}\mathrm{H}_2+\frac{1}{2}\mathrm{Mn})_3\,\Theta_3$
212. $(\frac{1}{2}\mathrm{H}_2+\frac{1}{2}\beta\mathrm{Al})_3\,\Theta_3$
213. $(\frac{1}{2}\mathrm{H}_2+\frac{1}{2}\beta\mathrm{Fe})_3\,\Theta_3$
214. $(\frac{1}{2}\mathrm{H}_2+\frac{1}{2}(\frac{1}{4}\beta\mathrm{Al}+\frac{3}{4}\mathrm{Mg}))_3\,\Theta_3+2\,\mathrm{aq}$
215. $(\frac{1}{2}\mathrm{H}_2+\frac{1}{2}(\frac{1}{4}\beta\mathrm{Fe}+\frac{3}{4}\mathrm{Mg})_3\,\Theta_3+3\,\mathrm{aq}$
216. $(\frac{1}{2}\mathrm{H}_2+\frac{1}{2}(\beta\mathrm{U}, \beta\mathrm{Fe}))_3\,\Theta_3$

But if ternaries (or salts), as generally admitted, the formulas are:

202. $\beta\mathrm{Fe}_2\,\Theta_6|\Theta_2|\mathrm{H}_2$
203. $\beta\mathrm{Al}_2\,\Theta_2|\Theta_2|\mathrm{H}_2$
204. $\beta\mathrm{Fe}_2\,\Theta_2|\Theta_2|\mathrm{H}_2$
205. $\beta\mathrm{Mn}_2\,\Theta_2|\Theta_2|\mathrm{H}_2$
206. $\beta\mathrm{Fe}_6\,\Theta_3|\Theta_6|\mathrm{H}_6$
or $\beta\mathrm{Fe}_2\,\Theta\,|\Theta_2|\mathrm{H}_2$
207. $\beta\mathrm{Fe}_3\,\Theta|\Theta_4|\mathrm{H}_4$
208. $\beta(\mathrm{Al}, \mathrm{Fe})_3\,\Theta|\Theta_4|\mathrm{H}_4$
209. $\beta(\mathrm{U}, \mathrm{Fe})_3\,\Theta|\Theta_4|\mathrm{H}_4$
210. $\mathrm{Mg}|\Theta_2|\mathrm{H}_2$
or $\mathrm{Mg}_3|\Theta_6|\mathrm{H}_6$
or $3\,(\mathrm{Mg}|\Theta_2|\mathrm{H}_2)$
211. $\mathrm{Mn}|\Theta_2|\mathrm{H}_2$
212. $\beta\mathrm{Al}_2|\Theta_6|\mathrm{H}_6$
213. $\beta\mathrm{Fe}_2|\Theta_6|\mathrm{H}_6$
214. $(\beta\mathrm{Al}, \mathrm{Mg})_2|\Theta_6|\mathrm{H}_6$
215. $(\beta\mathrm{Fe}, \mathrm{Mg})_2|\Theta_6|\mathrm{H}_6$
216. $\beta(\mathrm{U}, \mathrm{Fe})_2|\Theta_6|\mathrm{H}_6$

31. C. For the Oxyds of Elements of the Arsenic Group, etc., p. 138, the formulas are:

219. $\mathrm{As}_2\,\Theta_3$
220. $\mathrm{Sb}_2\,\Theta_3$
222. $\mathrm{Bi}_2\,\Theta_3$
223. $\mathrm{Bi}_2\,\Theta_3+\mathrm{Q}$
224. $\mathrm{Mo}\,\Theta_3$ (or, $\mathrm{Mo}_2\Theta_3$)
226. $\mathrm{Sb}_2\,(\Theta, \mathrm{S})_3$

The hydrated species are properly ternaries; but there is still some doubt over their composition.

3. Physical and Blowpipe Characters.

1. In the descriptions of the physical characters of minerals, H. stands for hardness, and G. for specific gravity.

2. The scale of hardness is as follows, crystallized varieties of the minerals mentioned being meant: 1, Talc; 2, Gypsum; 3, Calcite; 4, Fluorite; 5, Apatite; 6, Orthoclase; 7, Quartz; 8, Topaz; 9, Corundum; 10, Diamond.

3. In crystallized minerals of the Isometric system, the physical characters are the same in the directions of the three axes, and in the directions of lines situated symmetrically with reference to these axes. In the Tetragonal and Hexagonal systems, these characters in a vertical direction differ from those in a horizontal or transverse. The optical axis has the direction of the vertical axis.

4. In crystals of the remaining systems there are two axes of polarization. A line bisecting the acute, or the obtuse, angle between these optical axes is called a *bisectrix;* that bisecting the acute angle is the *acute bisectrix*, or *the bisectrix*, as the term is employed in the descriptions beyond; that bisecting the obtuse angle (and which is at right angles to the acute) is the *obtuse* or *conjugate bisectrix.*

5. In the Orthorhombic system, the two bisectrices are parallel to the crystallographic axes; and, consequently, the plane of the optical axes (the optic-axial plane) is parallel to one of the diametric sections of the crystal, and is at right angles to the other two.

By a *diametric plane* or section, as here used, is meant a plane passing through any two of the crystallographic axes; that is, one through each *a* and *b*, *a* and *c*, or *b* and *c*.

6. In mineral species, the position of the bisectrix is constant, or nearly so, while the optic-axial angle often varies widely. The angles mentioned in the descriptions are those taken in the air, unless it is otherwise stated.

7. Under Blowpipe characters, B.B. stands for *before the blowpipe;* O.F. for *oxydizing flame;* R.F. for *reducing flame.* A *closed tube* is a small glass tube closed at one end.

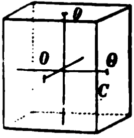
The following is the scale of fusibility adopted (that of von Kobell): 1, **Gray Antimony**; 2, **Natrolite**; 3, **Almandine** (var. of garnet); 4, **Green Actinolite** 5, **Orthoclase**; 6, **Bronzite.**

4. Crystallography.

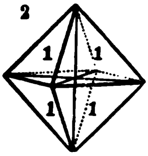
1. The systems of crystallization are as follows:

1. *Having the axes equal.* The **Isometric** system.
2. *Having only the lateral axes equal.* The **Tetragonal** and **Hexagonal.**
3. *Having the axes unequal.* The **Orthorhombic, Monoclinic,** and **Triclinic.**

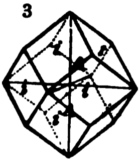
1



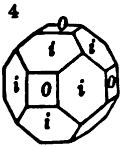
2



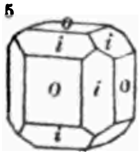
3



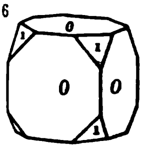
4



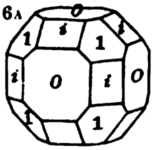
5



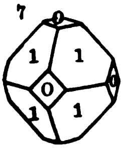
6



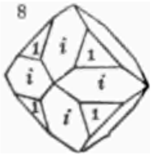
6A



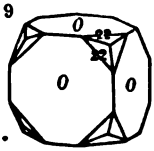
7



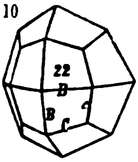
8



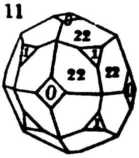
9



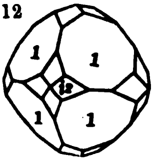
10



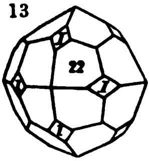
11



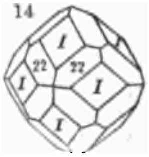
12



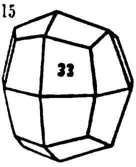
13



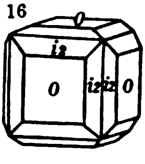
14



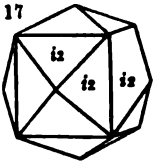
15



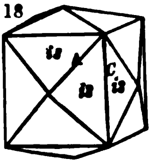
16



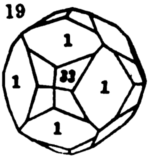
17



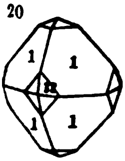
18



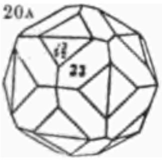
19



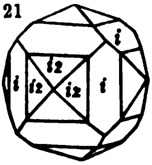
20



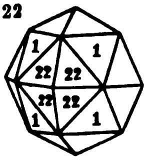
20A



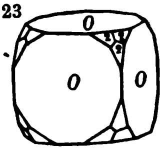
21



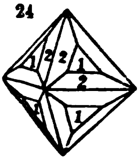
22



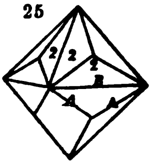
23



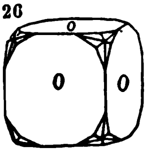
24



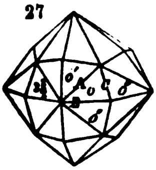
25



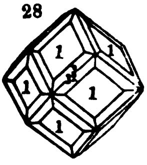
26



27



28



The names Monometric, Dimetric, and Trimetric, used in former editions of this work, have been set aside for the above for two reasons: (1) the fact that the names want precision, the hexagonal system being as much *dimetric* as the tetragonal, and the monoclinic and triclinic much *trimetric* as the orthorhombic; (2) the desire to promote uniformity in the language science. The names employed appear to be the best that have been proposed, and those mo generally used; and hence those that have the best claim for universal adoption.

A. *Isometric System.* 2. Some of the simpler isometric forms are represented figures 1 to 50. Fig. 1, a cube (with three equal axes); 2, an octahedron (or reg lar octahedron); 3, a dodecahedron (or rhombic dodecahedron); 4, 5, combinati of cube and dodecahedron; 6, 7, cubo-octahedron; 8, combination of octahedr and dodecahedron (by noting the lettering, like planes being lettered alike throug out, the several combinations are easily read off); 10, a trapezohedron (24-face solid); 15, id., another variety; 31, a tetrahedron; 47, 48, the pentagonal dodec hedron in different positions.

3. The following are some of the angles among isometric forms; adjacent plan are to be understood, unless it is stated otherwise:

O ∧ *O*=90°, f. 1.
O ∧ 1=125 16′, f. 6, 7.
O ∧ *i*=135, f. 4, 5.
O ∧ *i*-$\frac{20}{19}$=
O ∧ *i*-$\frac{4}{3}$=143 8
O ∧ *i*-$\frac{6}{5}$=140 11
O ∧ *i*-$\frac{5}{4}$=141 20
O ∧ *i*-$\frac{3}{2}$=146 19
O ∧ *i*-2=153 26, f. 16, 17.
O ∧ *i*-$\frac{7}{3}$=156 48
O ∧ *i*-$\frac{5}{2}$=158 12
O ∧ *i*-3=161 34
O ∧ *i*-4=165 58
O ∧ *i*-5=168 41
O ∧ *i*-40=178 34
O ∧ $\frac{4}{3}$-$\frac{4}{3}$=133 19
O ∧ $\frac{3}{2}$-$\frac{3}{2}$=136 45
O ∧ 2-2=144 44, f. 9, 10.
O ∧ $\frac{5}{2}$-$\frac{5}{2}$=150 30
O ∧ 3-3=154 46, f. 15.
O ∧ $\frac{9}{4}$-$\frac{9}{4}$=147 15
O ∧ $\frac{3}{2}$, ov. 1,=115 14
O ∧ 2, " =109 28, f. 23.
O ∧ 3, " =103 16
O ∧ 2-$\frac{4}{3}$=164 46
O ∧ 3-$\frac{3}{2}$=143 18, f. 26, 27.
O ∧ 4-2=150 48
O ∧ 5-$\frac{5}{3}$=147 41
O ∧ 7-$\frac{7}{3}$=155 42
O ∧ $\frac{11}{3}$-$\frac{11}{5}$=152 4
1 ∧ 1=109 28, f. 2.
1 ∧ 1, top,=70 32
1 ∧ *i*=144 44, f. 8.
1 ∧ *i*-$\frac{5}{4}$=144 15
1 ∧ *i*-$\frac{4}{3}$=143 56
1 ∧ *i*-$\frac{3}{2}$=143 11
1 ∧ *i*-2=140 16, f. 12.
1 ∧ *i*-$\frac{5}{2}$=138 58
1 ∧ *i*-3=136 54
1 ∧ *i*-4=134 26
1 ∧ *i*-5=132 48
1 ∧ $\frac{3}{2}$-$\frac{3}{2}$=168 41

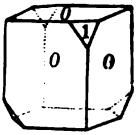
1 ∧ 2-2=160° 32′, f. 11.
1 ∧ $\frac{9}{4}$-$\frac{9}{4}$=157 25
1 ∧ 3-3=150 30, f. 20.
1 ∧ $\frac{3}{2}$=169 49
1 ∧ 2=164 12, f. 24.
1 ∧ 3=158
1 ∧ 3-$\frac{3}{2}$=157 45
1 ∧ 4-2=151 52
1 ∧ 5-$\frac{5}{3}$=151 25
1 ∧ 7-$\frac{7}{3}$=145 46
1 ∧ $\frac{11}{3}$-$\frac{11}{5}$=151 47
i ∧ *i*=120, f. 3.
i ∧ *i*, ov. top,=90
i ∧ *i*-$\frac{5}{4}$=173 39
i ∧ *i*-$\frac{4}{3}$=171 52
i ∧ *i*-$\frac{3}{2}$=167 42
i ∧ *i*-2=161 34, f. 21.
i ∧ *i*-$\frac{5}{2}$=156 48
i ∧ *i*-3=153 26
i ∧ *i*-4=149 2
i ∧ *i*-5=146 18
i ∧ 2-2=150
i ∧ 3-$\frac{3}{2}$=160 54
i ∧ 3-3=148 31
i ∧ 4-$\frac{4}{3}$=166 6
i ∧ 5-$\frac{5}{3}$=162 58$\frac{1}{2}$
i ∧ $\frac{21}{5}$-3=150 45
2-2 ∧ 2-2, B,=131 49, f. 10.
2-2 ∧ 2-2, C,=146 27
2-2 ∧ 2-2, ov. top,=109 28
$\frac{9}{4}$ ∧ $\frac{9}{4}$, B,=135 48
$\frac{9}{4}$ ∧ $\frac{9}{4}$, C,=119 38
3-3 ∧ 3-3, B,=144 54, f. 15.
3-3 ∧ 3-3, C,=129 31
i-$\frac{20}{19}$ ∧ *i*-$\frac{20}{19}$, A,=121 43
i-$\frac{20}{19}$ ∧ *i*-$\frac{20}{19}$, C,=177 3$\frac{1}{2}$
i-$\frac{5}{4}$ ∧ *i*-$\frac{5}{4}$, A,=127 34
i-$\frac{5}{4}$ ∧ *i*-$\frac{5}{4}$, C,=167 19
i-$\frac{4}{3}$ ∧ *i*-$\frac{4}{3}$, A,=129 47
i-$\frac{4}{3}$ ∧ *i*-$\frac{4}{3}$, C,=163 44
i-$\frac{3}{2}$ ∧ *i*-$\frac{3}{2}$, A,=133 49
i-$\frac{3}{2}$ ∧ *i*-$\frac{3}{2}$, C,=157 23

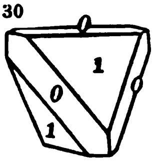
i-2 ∧ *i*-2, A,=143° 8′, f. 17.
i-2 ∧ *i*-2, C,=143 8
i-2 ∧ *i*-2, ov. top,=126 52
i-2 ∧ *i*-3=171 52
i-2 ∧ 2-2=155 54
i-3 ∧ *i*-3, A,=154 9, f. 18.
i-3 ∧ *i*-3, C,=126 52
2 ∧ 2, A,=152 44, f. 25.
2 ∧ 2, B,=141 3$\frac{1}{2}$
3 ∧ 3, A,=142 8
3 ∧ 3, B,=153 28$\frac{1}{2}$
3-$\frac{3}{2}$, A,=158 13
3-$\frac{3}{2}$, B,=149
3-$\frac{3}{2}$, C,=158 13
4-2, A,=162 15
4-2, B,=154 47$\frac{1}{2}$
4-2, C,=144 3
2-$\frac{4}{3}$, A,=164 54$\frac{1}{2}$
2-$\frac{4}{3}$, B,=136 24
2-$\frac{4}{3}$, C,=164 54$\frac{1}{2}$
5-$\frac{5}{3}$, A,=152 20
5-$\frac{5}{3}$, B,=160 32
5-$\frac{5}{3}$, C,=152 20
7-$\frac{7}{3}$, A,=158 47
7-$\frac{7}{3}$, B,=165 2
7-$\frac{7}{3}$, C,=136 47
$\frac{9}{2}$-$\frac{9}{4}$, A,=163 49
$\frac{9}{2}$-$\frac{9}{4}$, B,=157 3$\frac{1}{2}$
$\frac{9}{2}$-$\frac{9}{4}$, C,=138 48
$\frac{11}{3}$-$\frac{11}{5}$, A,=166 57
$\frac{11}{3}$-$\frac{11}{5}$, B,=152 7
$\frac{11}{3}$-$\frac{11}{5}$, C,=140 9
4-$\frac{4}{3}$, A,=147 48
4-$\frac{4}{3}$, B,=157 23
4-$\frac{4}{3}$, C,=164 3$\frac{1}{2}$
5-$\frac{5}{3}$, A,=152 20
5-$\frac{5}{3}$, B,=160 32
5-$\frac{5}{3}$, C,=152 20
$\frac{21}{5}$-3, A,=172 51
$\frac{21}{5}$-3, B,=154 33
$\frac{21}{5}$-3, C,=128 16

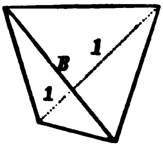
The angles A, B, C, above, are those over the edges so lettered in the figure referre to, or over the corresponding edges in related forms.

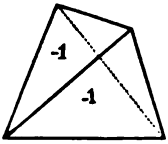
4. Figures 29 to 49 represent *hemihedral* forms, or those having for some or all th

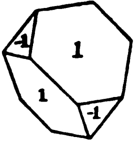
planes *half* the number which complete symmetry requires. In f. 29 the plane 1 occurs on only *half* the 8 solid angles, and 31, the tetrahedron, results from the extension of these planes; and so for the rest. Figures 29 to 40 are of *inclined* hemihedrons; and 41–49 of *parallel* hemihedrons. Some of the angles are as follows; many are the same as for the preceding forms.

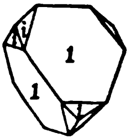
29


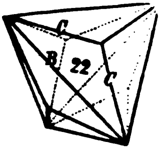
30


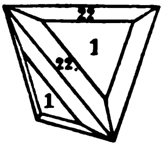
31


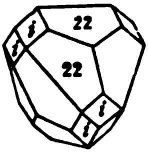
31A


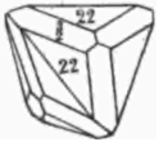
32


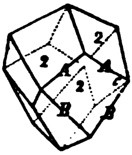
33


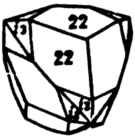
34


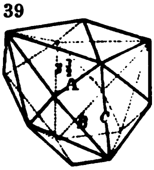
35


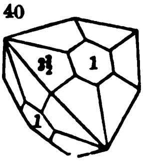
36


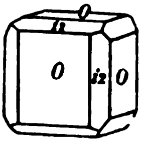
37


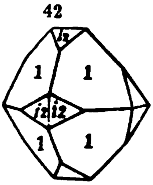
37A


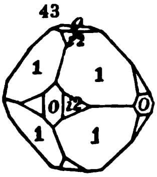
38


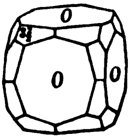
39


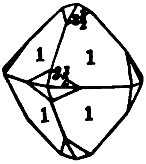
40


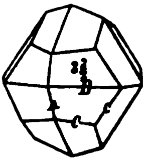
41


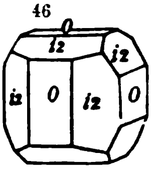
42


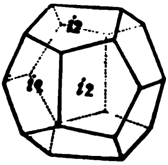
43


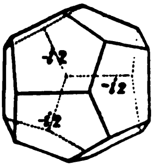
44


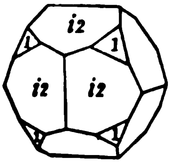
45


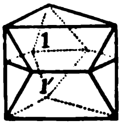
45A


46


47


48


49


50


1 ∧ 1 = 70° 32′, f. 31, 31A.
$\frac{3}{2}$ ∧ $\frac{3}{2}$, A, = 162 39½
$\frac{3}{2}$ ∧ $\frac{3}{2}$, B, = 82 10
2 ∧ 2, A, = 152 44
2 ∧ 2, B, = 90, f. 37A.
3 ∧ 3, A, = 142 8
3 ∧ 3, B, = 99 5
$\frac{3}{2}$-$\frac{3}{2}$ ∧ $\frac{3}{2}$-$\frac{3}{2}$, B, = 93 22
$\frac{3}{2}$-$\frac{3}{2}$ ∧ $\frac{3}{2}$-$\frac{3}{2}$, C, = 160 15
2-2 ∧ 2-2, B. = 109 28, f. 34.
2-2 ∧ 2-2, C, = 146 26½
3-3 ∧ 3-3, B, = 124 7
3-3 ∧ 3-3, C, = 134° 2′
3-$\frac{3}{2}$ ∧ 3-$\frac{3}{2}$, A, = 158 13, f. 39.
3-$\frac{3}{2}$ ∧ 3-$\frac{3}{2}$, B, = 110 55½
3-$\frac{3}{2}$ ∧ 3-$\frac{3}{2}$, C, = 158 13
4-2 ∧ 4-2, A, = 162 15
4-2 ∧ 4-2, B, = 124 51
4-2 ∧ 4-2, C, = 144 3
i-$\frac{3}{2}$ ∧ *i*-$\frac{3}{2}$, A, = 112 37
i-$\frac{3}{2}$ ∧ *i*-$\frac{3}{2}$, C, = 117 29
i-2 ∧ *i*-2, A, = 126 52, f. 47, 48.
i-2 ∧ *i*-2, C, = 113 35
i-3 ∧ *i*-3, A, = 143 8
i-3 ∧ *i*-3, C, = 107° 27½′
i-4 ∧ *i*-4, A, = 151 56
i-4 ∧ *i*-4, C, = 103 36½
4-2 ∧ 4-2, A, = 128 15
4-2 ∧ 4-2, B. = 154 47½
4-2 ∧ 4-2, C, = 131 49
3-$\frac{3}{2}$ ∧ 3-$\frac{3}{2}$, A, = 115 23, f. 45A
3-$\frac{3}{2}$ ∧ 3-$\frac{3}{2}$, B, = 149
3-$\frac{3}{2}$ ∧ 3-$\frac{3}{2}$, C, = 141 47
5-$\frac{5}{3}$ ∧ 5-$\frac{5}{3}$, A, = 119 3½
5-$\frac{5}{3}$ ∧ 5-$\frac{5}{3}$, B, = 160 32
5-$\frac{5}{3}$ ∧ 5-$\frac{5}{3}$, C, = 131 5

In the forms *i*-$\frac{3}{2}$, *i*-2 (f. 47), *i*-3, *i*-4, A is the angle at the longer edge, and C that at either of the others.

50A

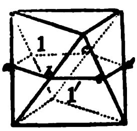


Fig. 50 represents a common twin or compound crystal in the isometric system; and 50A illustrates that it corresponds to an octahedron cut across the middle parallel to an octahedral face, with one half revolved 60 or 180 degrees.

B. *Tetragonal System.* (Also called Quadratic, Pyramidal, Monodimetric, Dimetric, Zwei-und-einaxige.) 5. In the Tetragonal system the *lateral* axes (b) are equal, being the diameters or diagonals of a square, while the *vertical* (a) is either longer or shorter than the lateral.

6. Owing to the *square* form, the planes of a kind are in *fours* or *eights*. The like planes on the four solid angles make a 4-sided pyramid, and those of the two extremities combined a square octahedron. For any species one such octahedron may be assumed to have the vertical axis $1a$; and then the other octahedral planes on the same angles, with shorter or longer vertical axes, have the vertical axis a multiple or submultiple of a; as $\frac{1}{2}a$, $\frac{1}{3}a$, etc., $2a$, $\frac{3}{2}a$, $3a$, etc.; and the planes of such octahedrons are accordingly lettered 1, $\frac{1}{2}$, $\frac{1}{3}$, 2, $\frac{3}{2}$, 3, etc.

7. So again like planes on the four edges of each base make an octahedron, but of an intermediate series, called the diametric, the planes being parallel to a lateral axis or diagonal. The vertical axis varies by simple ratios, as in the other series; but in the lettering, as the planes are parallel to a lateral axis (and would therefore meet it only at an infinite distance), this parallelism is expressed by adding the letter i, initial of infinity. Thus $\frac{1}{2}$-i, 1-i, 2-i, 3-i, etc.

8. With the lengthening of the octahedron in each series, the numeral becomes larger and larger, until the octahedron is merged in a *vertical square prism*, its planes parallel to the vertical axis. This parallelism, expressed by the letter i again, as just explained, gives for the lettering of the square prism of the first or fundamental series, i or I; and for that of the second or diametric, i-i. The figures on pages 277, 273, are examples of these forms, and also of the double 8-sided pyramids and 8-sided prisms which occur in this system.

9. The angles between the planes on the vertical edges and I, or i-i, are the same as those having similar symbols in the isometric system, noting only this difference in the lettering, that O in the cube is i-i in the square prism; thus $O \wedge i$-2 in the cube or other isometric form is the same with i-$i \wedge i$-2 in the tetragonal system; and so on.

10. The length of the vertical axis a is calculated from the supplement (S) of the angle $O \wedge 1$-i. A line drawn vertically on the plane 1-i (f. 260, p. 277), that is, at right angles to the lower or upper side, is the hypothenuse of a right-angled triangle, the basal side of which triangle is parallel to a lateral axis b, and the vertical parallel to the vertical axis a. These sides have the ratios, therefore, of the two axes; and taking b=unity, $a=\tan A$ (or angle of triangle at base, or opposite a). This angle A equals the supplement of $O \wedge 1$-i; and therefore, calling this supplement S, $a=\tan S$.

11. The value of the axis may also be obtained from the supplement (S') of the angle $O \wedge 1$, by the equation:

$$a=\tan S' \div \sec 45^\circ; \text{ whence } \log a=\log \tan S'-10{\cdot}1505150.$$

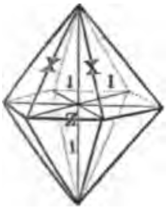
C. *Hexagonal System.* 12. This system differs from the Tetragonal in having *three* equal lateral axes (b) instead of two; the vertical (a) is at right angles to the lateral (fig. A).

13. In the Hexagonal section of the system the symmetry of the crystals is by sixes and twelves, as in figs. A to D; f. 440, p. 530; f. 527, p. 627. In f. B, 1 corresponds to a hexagonal pyramid of the fundamental series, and 1-2, $\frac{4}{3}$-2, 2-2, to similar pyramids of the intermediate series; I is the hexagonal prism of the former series, and i-2 that of the intermediate prism. $I \wedge I=120^\circ$, $I \wedge i$-$2=150^\circ$, i-$2 \wedge i$-2, ov. I,$=120^\circ$.

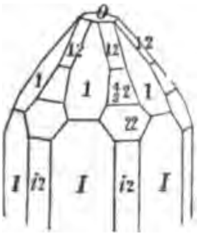
14. In the Rhombohedral section of the system, the planes 1, 2, 3, $\frac{1}{2}$, etc., are

planes of rhombohedrons, having for the vertical axis 1*a*, 2*a*, 3*a*, ½*a*, etc., 1*a* being the value of the axis in the fundamental rhombohedron, (*R*) (figs., p. 6). The angle of a rhombohedron mentioned is always that over a *terminal* edge, as that between the upper planes *R* of figure 141, p. 141. On gradually shortening the rhombohedron in fig. 141, it may become ½*R*, ¼*R*, and so on, till the length becomes 0,

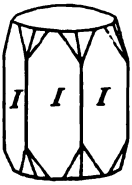
A



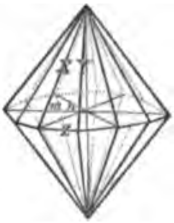
B



C



D



and the rhombohedron is reduced to a flat plane. Hence, starting from this plane (which corresponds to the basal plane of the rhombohedron or hexagonal prism), the rhombohedron as it elongates reaches the form of fig. 141; and continuing the elongation, the vertical axis doubles, trebles, and so on, till finally it becomes infinite, and the rhombohedron is then a six-sided prism. If a diminution in length now commences by planes inclined to the opposite extremities of the vertical axis, these planes correspond to another series of rhombohedrons which are distinguished by a minus (—). The planes

$$O\ldots\tfrac{1}{4}\ldots1\ldots2\ldots I\ (\text{or}\ \infty)\ \ldots-2\ldots-1\ldots-\tfrac{1}{2}\ldots O,$$

lie in a single vertical zone. Figs. 550, 551, p. 670, represent the forms *R*, $-\frac{1}{2}$, -2, $-\frac{5}{4}$, 4, 13.

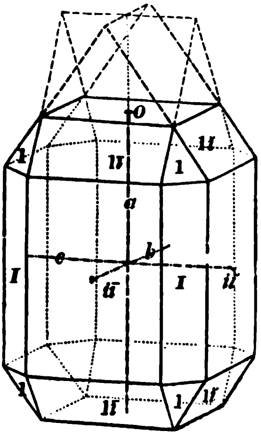
15. The value of the vertical axis *a* is obtained from the supplement:

Of $O \wedge 1\text{-}2$ (S) by the equation $a = \tan S$.
Of $O \wedge 1$ (S') by the equation $a = \tan S' \div \sec 30°$.
The latter gives $\log a = \log \tan S' - 10{\cdot}0624694$.

D. *Orthorhombic System.* (Also called Rectangular, Prismatic, Trimetric, Ein und-einaxige.) 16. In the Orthorhombic system the three axes are unequal and intersect at right angles; and the three diametric planes, or those containing the axes, are consequently rectangular in intersection.

The annexed figure represents a rectangular prism with replaced edges and angles.

E



17. *a*, *b*, *c*, are the axes, of which *a* is the vertical, *b* the shorter lateral or *brachydiagonal*, *c* the longer lateral or *macrodiagonal*. *O* is the *basal* plane of the prism; *i-ī* the larger lateral plane, parallel to the *longer* lateral axis; *i-ĭ* the smaller lateral plane, parallel to the *shorter* lateral axis.

18. *I* are planes on the edges of the rectangular prism, which when extended would form a vertical rhombic prism, having its axes *b* and *c* in the ratio of 1*b* : 1*c*. It is therefore the *unit* or *fundamental vertical prism*.

19. 1-ī are planes parallel to the *longer* lateral axis, and having for the axes *a*, *b*, the ratio 1*a* : 1*b*; extended upwards they form a *dome* (so named from *domus*, a house), which is called the *macrodome*. The planes 1-ī

in a similar manner form what is called a *brachydome*, they being parallel to the *shorter* lateral axis; its axes a, c, have the ratio $1a : 1c$, that is, the two diagonals of this horizontal prism have this ratio. These two domes are therefore the *unit domes* Their summit angles are of course supplements of their basal angles (or those over the vertical planes *i-ī*, *i-ĭ*).

20. If the axis $b=1$; half the obtuse angle of the prism I be called X; half the summit angle of the macrodome 1-ī, Y, and half the basal of the same Z; then we have for the values of the other axes a and c:

$$a = \cot Y = \tan Z. \quad c = \tan X.$$

$$\text{Further, } X = i\text{-}\bar{\imath} \wedge I - 90^\circ; \quad Y = O \wedge 1\text{-}\bar{\imath} - 90^\circ; \; Z = i\text{-}\bar{\imath} \wedge 1\text{-}\bar{\imath} - 90^\circ.$$

20. The planes 1 on the eight angles are planes of an octahedron, having for the axes a, b, c, the ratio $1a : 1\breve{b} : 1c$. It is therefore the unit or fundamental octahedron (1). Its pyramidal edges, if the octahedron were completed (as in f. 55, p. 20), would be of two kinds, two at each extremity opposite to the axis c, the longer lateral axis, and two opposite to b, the shorter lateral axis. The former is the macrodiagonal edge, the latter the brachydiagonal.

21. By doubling the length of the vertical axis, the lateral being fixed, we form the octahedron 2; by trebling it, the octahedron 3; by halving it, the octahedron ½; and so for the domes, doubling the vertical axis we have the dome 2-ī or 2-ĭ; by halving the same, the dome ½-ī or ½-ĭ, and so on. The letter *i*, as before explained, stands for infinity, and means that the plane is parallel to one of the axes; ī, that it is parallel to the longer lateral axis; ĭ, that it is parallel to the shorter lateral axis. *i* or *I* alone, or as the initial letter in a symbol, signifies that the plane is parallel to the vertical axis. A plane *i-ī* is parallel both to the vertical and longer lateral; *i-ĭ*, both to the vertical and shorter lateral.

22. The octahedrons alluded to above have for the axes b, c, the ratio $1b : 1c$, and belong to what is called the *fundamental* series. But others may exist with different ratios for b and c, and any value for a. If the ratio for b, c, is $1b : 2c$, then, as c is the *longer* lateral axis, if the vertical axis is $1a$, the octahedron is 1-2̄; or if the vertical axis is $3a$, the plane is 3-2̄; or if $\frac{1}{2}a$, it is ½-2̄. So for the ratio $3b : 1c$; if the vertical axis is $1a$, the octahedron is 1-3̆; or if $2a$, it is 2-3̆; and if the vertical axis is infinite, the plane is *parallel* to the vertical axis, and the symbol is *i*-3̆. The first figure or letter in these symbols always refers to the vertical axis, and the second to one of the lateral axes.

23. The planes may thus be viewed as lying in vertical *zones*, a different zone for every ratio of the lateral axes $b : c$. Each series, or zone, terminates *above* in the basal plane of the prism, for which $a=0$, and *below* in a vertical prism, for which a is infinite. By taking the planes *i-ī*, *i-ĭ*, successively, for the basal plane O, there may be similar series of zones for each. The planes of a *zone* have their mutual intersections parallel to one another; and wherever a series of planes exists having such parallel intersections, the series is called a *zone*.

The small tables inserted in connection with the crystalline forms of some of the species of this and other systems of crystallization (pp. 27, 35, 338) consist of the vertical *zones* of occurring planes. The planes of a vertical zone have mutual *horizontal intersections* in the crystal. Consequently in a crystal not oblique the inclination of the basal plane, O, on any plane in a zone, subtracted from 270°, gives the inclination of the prismatic plane of the same zone on that plane, and the tangents of the supplemental angles of O on the planes of a zone vary as the coefficient of the vertical axis for each plane. Thus, suppose there are the planes 1-ī, 2-ī, 3-ī, take the supplement of $O \wedge 1$-ī (which, if $O \wedge 1$-ī is 124°, equals $180^\circ - 124^\circ = 56^\circ$); then the tangent of this angle, *doubled*, will be the tangent of the supplement of $O \wedge 2$-ī, and *trebled*, of the supplement of the angle of $O \wedge 3$-ī. The same for the planes 1, 2, 3, or 1-2̆, 2-2̆, 3-2̆, and so on; and if *i*-ī be made the base, then in the same manner the angles may be calculated for similar zones of planes terminating in *i*-ī; or if *i*-ĭ be made the base, for zones of planes terminating similarly in *i* ĭ. So if the angles are given, the relations of the axes may be calculated by reversing the process

24. Making the brachydiagonal *b*=unity :

a=tan. suppl. *O* ∧ 1 ī; and calling the angle *I* ∧ *I*, over *i*-ī, *X*:
c=tan $\frac{1}{2}$*X*.

E. *Monoclinic System.* (Also called Hemiprismatic, Clinorhombic, Monoclinohedral, Zwei-und-eingliederige.) 25. In this system two of the axial intersections are rectangular, and one is oblique. In other words, the lateral axes are at right angles to one another; but one is *oblique* to the vertical axis, and the other at right angles to it.

26. If figure E on page xxv be taken as representing a monoclinic form in its usual position, then *a* will be the *vertical* axis; *b* the *inclined* lateral, called the *clinodiagonal*; *c* the other lateral, called the *orthodiagonal.* The angle *a* ∧ *b*, or the inclination of the vertical axis, is called the angle *C*.

27. The section of the crystal in which *b*, the clinodiagonal, and *a* lie is the *clinodiagonal section;* and that in which *c* and *a* lie is the *orthodiagonal section.* The vertical plane *i*-ī, of f. E, is parallel to the orthodiagonal section, and is lettered simply *i*-*i*; and the plane *i*-ĭ, of the same figure, is parallel to the clinodiagonal section, and is lettered *i*-ì. The angle *O* ∧ *i*-*i*=*C*, or the inclination of the vertical axis; while *O* ∧ *i*-ì=90°, and *i*-*i* ∧ *i*-ì=90°. The clinodiagonal section is *the plane of symmetry.*

28. The domes having the planes parallel to the clinodiagonal are called *clinodomes*, and are lettered with an accent over the ì, thus, 1-ì (1-ĭ in f. E), 2-ì.

29. The domes parallel to the orthodiagonal are *hemidomes*, the planes in front at top being unlike in inclination those in front below, each being a *hemidome;* one series is opposite the *acute* intersection of the axes, and is the *plus* series, lettered 1-*i*, 2-*i*, etc.; the other is opposite the *obtuse*, and is lettered −1-*i*, −2-*i*, etc.

30. The *octahedral* planes are all *hemioctahedral*, and + and — are used in the symbols in the same manner as in the symbols of the hemidomes. Thus in fig. E, if the angle between the upper *O* and the front plane *i*-*i* is obtuse, then the upper planes 1, 1, in front would be −1, −1, and the corresponding planes below, +1, +1, written usually 1, 1.

31. If the clinodiagonal *b*=1; half the front angle of the prism *I* (over *i*-*i*) be called *X*, half the summit angle of the clinodome 1-ì, *X′*; the supplement of *i*-*i* ∧ 1-*i* (=*O* ∧ 1-*i*—*C*) be called μ; and supplement of *O* ∧ 1-*i* be ν; and *C* be used as above explained; then,

c=sin *C* tan *X*. *a*=*c*÷sin *C* tan *X′*=sin ν÷sin μ=sin (*C*—μ)÷sin μ.

F. *Triclinic System.* (Also called Doubly Oblique, Tetartoprismatic, Anorthic, Ein-und-eingliederige.) 32. The three axes are unequal, and obliquely and unequally inclined. Angles of 90° and 135° are not met with in Triclinic crystals. Examples, figures on pp. 297, 338, 349.

33. The crystallographic symbols used in this work are essentially those of Naumann, the author of the system of crystallography which is followed. The only difference is that *i*, the initial of infinity, is substituted for the symbol ∞, and the *P* is dropped, it being in almost all cases unessential. Thus, *P*, 2*P*, 4*P*2, ∞*P*∞, ∞*P*, ∞*P*2, 3*P̆*2, of Naumann, are *P* or 1, 2, 4-2, *i*-*i*, *i* (or *I*), *i*-2̆, 3-2̆, of this work. And in the rhombohedral section of the hexagonal system, for *R*, 2*R*, 3*R*, R^2, $2R^2$, of Naumann, are here written, *R*, 2, 3, 1^2, 2^2. Moreover *O* or *o* is written for the basal plane. The distinction of capital or small letter in the symbols is mathematically of no importance.

34. In the orthorhombic system the *shorter* lateral axis is made the *unit* in this work. The axes are lettered *a*, *b*, *c*, in different systems, except in that of Miller (or

properly Whewell's), who uses the letters *h*, *l*, *k*, as "indices" referring to the axes, in the order here written:

	Vertical.	Brachydiagonal.	Macrodiagonal
In this work	*a*	*b*	*c*
In Naumann	*a*	*c*	*b*
In Weiss and Rose	*c*	*a*	*b*
In Miller	*k*	*l*	*h*

For the tetragonal system the axes are the same, except that $b=c$. In the monoclinic:

	Vertical.	Clinodiagonal.	Orthodiagonal.
Naumann and this work	*a*	*b*	*c*
Weiss and Rose	*c*	*a*	*b*
Miller	*k*	*l*	*h*

The following are convenient simple rules for use in connection with crystallographic measurements and calculations:

35. If a plane, *p*, replaces the edge between any other two, *s*, *t*, making parallel intersections, the sum of the angles between *p* and the two planes *s*, *t*, equals 180 *plus* the inclination of *s* on *t*. If the planes *s*, *t*, meet at 90°, the sum of these angles equals $180°+90°=270°$; and if the angles are equal, each is 135°; if the planes *s*, *t*, meet at 110°, the sum of the two angles equals $180°+110°=290°$; and if one is 130°, the other will be 160°.

36. On p. xxvi, the relation between the symbols and the tangents of the inclinations of planes lying in zones between rectangular axes (which zones can be made to be vertical zones in one position or another of the crystal) is pointed out. The same method holds for all vertical zones in the tetragonal system, and for those that become vertical on putting the crystal on its plane *i-i*; also for all the zones which are made vertical by placing a monoclinic prism on its face *i-i*, that is the zone of clinodomes, the zone of vertical prisms, and all zones, then vertical, of hemioctahedrons; also for all the vertical zones of the hexagonal prism, and hence for the zone of rhombohedrons of any species, or vertical zones of scalenohedral planes.

37. For the transfer of *h l k* of Miller's system into the system of this work, take the reciprocals. Thus if symbol is 212, the reciprocals are $\frac{1}{2}$, 1, $\frac{1}{2}$, the last $\frac{1}{2}$ referring to the vertical axis. As the relation of the lateral axes should be in whole numbers, double the whole and it gives 1 : 2 : 1; whence the plane is that which would be here designated 1-2. So 1 : 1 : 3 becomes 1 : 1 : $\frac{1}{3}$, whence the symbo $\frac{1}{3}$; or 315 becomes $\frac{1}{3}$, 1, $\frac{1}{5}$, or 1, 3, $\frac{3}{5}$; whence $\frac{3}{5}$-3; and in the orthorhombic system the 3 in $\frac{1}{5}$-3 would have the short mark, or be written $\frac{3}{5}$·3; while 135 would give the symbol $\frac{3}{5}$-3.

38. In hexagonal forms the change is less simple, and the method for it is hardly intelligible to one not knowing something of both systems. The axes of Miller, instead of being those of fig. A, p. xxv, are lines drawn through the centre normal to (that is, at right angles to) the alternate faces of the pyramid; they are therefore *three* in number, and the planes are thus referred to axes parallel to the rhombohedral edge. The planes in fig. A, according to Naumann's system, are all of one kind in the *hexagonal* section of the hexagonal system, but of two kinds, *R* and $-R$ (or 1 and -1) in the *rhombohedral* section. In Miller's system they are of two kinds in both sections, the distinction between the two sections not being entertained.

The axes *a*, *b*, *c*, of any plane in the hexagonal system of Naumann, have the following values in terms of *h k l* of Miller:*

---

* Furnished the author for this place by Prof. J. P. Cooke, of Harvard.

$$a=\frac{1}{h+k+l}\sqrt{\frac{3\,(1+2\cos\gamma)}{2\,(1-\cos\gamma)}}\qquad b=\frac{1}{l-k}\qquad c=\frac{1}{l-h}$$

But in using these equations strict attention must be paid to the signs, as is illustrated in the examples below. The angle γ is the angle between the axes in Miller's system, which equals the facial angle of the rhomb face at the vertex of the rhombohedron *R*.

The equations give the true ratios of Naumann's axes; but these ratios often have to be reduced to whole numbers, or otherwise modified, to obtain precisely the values used in Naumann's symbol. The second member in the equation for *a* gives the length of the axis *ma* in any form; the *first* member in it is all that is required for the value of *m* in the symbol, while the second is the value of *a*.

The following are some examples:

In f. 564 (p. 672), plane *R*, which is 100 of Miller, gives, on substituting the values of *h k l*, and working the equations, $a : b : c = 1 : i$ (infinity) : −1. The parameters of the plane in Naumann's system for the vertical and three lateral axes are $1 : 1 : 1 : i$.

The plane *i*, to the right, is $2\bar{1}\bar{1}$ of Miller; whence $a : b : c = i : i : -3$, which, since *a* and *b* are each infinity, is equivalent to $i : i : -1$.

The plane −2, to the right, is $1\bar{1}1$ of Miller; whence $a : b : c = 1 : \frac{1}{2} : i = 2 : 1 : i$; the Naumann ratio for this plane is $2 : 1 : 1 : i$.

Plane $-\frac{5}{4}$ is 332 of Miller; whence $a : b : c = \frac{1}{4} : \frac{1}{5} : -\frac{1}{5} = \frac{5}{4} : -1 : -1$.

The left upper plane 1^3 is $20\bar{1}$ in Miller; whence $a : b : c = 1 : -1 : -\frac{1}{3} = 3 : -3 : -1$, giving the Naumann symbol 3-3, from which comes its equivalent scalenohedral symbol 1^3.

The left upper plane $\frac{1}{4}^3$ is Miller's 310; whence $a : b : c = \frac{1}{4} : -1 : -\frac{1}{3} = \frac{3}{4} : -3 : -1$; giving the Naumann symbol $\frac{3}{4}$-3, and its equivalent $\frac{1}{4}^3$.

The right upper of the two adjoining planes, $\frac{1}{4}^3$ in f. 564, is 301 of Miller; whence $a : b : c = \frac{1}{4} : 1 : -\frac{1}{2}$. This is apparently a different result from the last. But calculating the length of the fourth of Naumann's parameters, it gives $h = n + (n-1) = \frac{1}{3} + (-\frac{1}{2} - 1) = \frac{1}{3}$, from which it follows that the parameters of the plane are $\frac{1}{4} : 1 : \frac{1}{3} : -\frac{1}{3}$; and on calculating the fourth parameter in the preceding, $\frac{1}{3}$ would be obtained, proving that both are really the same plane.

5. NOMENCLATURE.

1. The termination *ites* or *itis* (the original of *ite*) was used, according to system, among the Greeks, and from them among the Romans, in the names of stones, it being one of the regular Greek suffixes. It was added (as *ite* in these recent times) to the word signifying a *quality*, *constituent*, *use*, or *locality* of the stone.

Some of the examples are: *Hæmatites*, from the red color of the powder *Chloritis*, from the green color; *Steatites*, from the greasy feel; *Dendritis*, from a resemblance to a tree or branch; *Alabastritis*, for the stone out of which a vase called an *alabastron* was made; *Basanites*, from the word for touchstone; *Siderites*, from the word for iron; *Argyritis*, from the Greek for silver; *Syenitis*, from the *locality*, Syene in Egypt; *Memphitis*, for a marble from Memphis in Egypt.

2. The only modern kind of name not in vogue in Pliny's time is that after persons.

Werner appears to have been the first to introduce personal names into mineralogy. The earliest example, as far as ascertained, was his naming what von Born had called *Green Mica* (Mica viridis), *Torberite*, after its investigator, the chemist Torber Bergmann (more correctly written *Torbernite* by some mineralogists of last century, as Bergmann wrote his name in Latin, the language of his scientific works. Torbernus Bergmann). The name encountered objections; and Werner, in view of Bergmann's announcement (after some incorrect trials) that the mineral was a *copper* ore, substituted in 1789 the name *Chalcolite*. He, however, immediately afterward (early in 1790) showed that he saw nothing bad in the style of name by designating other new species *Prehnite* and *Witherite*, the former after Col. Prehn, the discoverer, and the latter after Dr. Withering, the discoverer and analyst of the species. The same year Estner, a mineralogist of Vienna, issued a pamphlet against the Werner school, with the title "Freymüthige Gedanken über Herrn Inspector Werner's Verbesserungen in der Mineralogie," etc. (64 pp. 16mo, 1790), in which he makes light of Werner's labors in the science, and under the head of *Prehnite* ridiculed this method of creating a paternity, and providing the childless with children to hand down their names to posterity (p. 25). Such names were, however, too easily made, too pleasant, as a general thing, to give and receive, and withal too free from real objection, to be thus stopped off, and they have since become numerous, even Vienna contributing her full share toward their multiplication.

As a part of the history of mineralogical nomenclature, it may be here added that Werner, when it was proved that his *chalcolite* was an ore of uranium with but little copper, instead of a true ore of copper, dropped the name entirely, and called the mineral simply *Uranglimmer* (Uranium mica); and Karsten, in his reply to Abbé Estner (Berlin, 1793, 80 pp. 12mo), makes out of the necessary rejection of chalcolite an argument against chemical names, and in favor of names after persons, as the latter could never turn out erroneous in signification.

Werner, in an article written in defence of his introduction of this class of names (Bergm. J., i. 103, 1790), mentions the case of *Obsidian* (more properly *Obsian*) as a precedent from Pliny, Obsian being, as Pliny states, the reported discoverer of the substance in Ethiopia. But this is not strictly an example. For Pliny uses *Obsian* not as a substantive, but as an adjective; the mineral was not *Obsian*, but *Obsian glass* or *Obsian stone; vitrum obsianum, lapis obsianus*, and *obsiana* [vitra], occurring in the course of the paragraph. The addition of the termination *ite* to Obsian would, according to mineralogical method, make a name equivalent to Pliny's *lapis obsianus.* Names of persons ending in *an* (as Octavian, Tertullian) were common among the Romans; and this is so far reason for avoiding the termination in names of stones.

Some critics question the existence of the reputed Obsius, and reject Pliny's explanation.

3. The ancient origin of this termination *ite*, its adoption for most of the names in modern mineralogy, its distinctive character and convenient application, make it evidently the true basis for uniformity in the nomenclature of the science.

4. If any other termination in addition is to be used, it should be so only *under system;* that is, it should be made characteristic of a particular natural group of species, and be invariably employed for the names in that group; and its use should not be a matter of choice or fancy with describers of species.

As a matter of fact, several other terminations are in use, but wholly without reference to any such system. The most common of them is *ine;* but it has not been employed for any particular division of minerals, and it could not now be so restricted; it belongs by adoption and long usage to chemistry, and should be left to that science.

5. In order then that the acquired uniformity may be attained, changes should be made in existing names, when it can be done without great inconvenience.

Names like *Quartz*, *Garnet*, *Gypsum*, *Realgar*, *Orpiment*, with the names of the metals and gems, which are part of general literature, must remain unaltered. *Mica* and *Feldspar*, equally old with Quartz, have become the names of *groups* of minerals, and are no longer applied to particular species. *Fluor* was written *fluorite* last century by Napione. *Blende*, although one of the number that might be allowed to stand among the exceptions, has already given place with some mineralogists to *Sphalerite*, a name proposed by Haidinger (because blende was applied also to other species) in 1845, and signifying *deception*, like Blende. Galena was written *Galenite* by von Kobell some years since. Orthoclase, Loxoclase, Oligoclase might be rightly lengthened to *Orthoclasite*, etc. But the termination *clase* (from the Greek for *fracture*) is peculiar to names of minerals, and the abbreviated form in use may be allowed to stand for species of the Feldspar group. It seems better that it be avoided elsewhere. Many other examples will be found by the reader in the pages of this volume.

In the course of the last century, when the science of minerals was taking shape, and progress in chemistry was helping it forward, there was an effort on one side to introduce, under the influence of Linnæus, the double names of Botany and Zoology; and on the other, under the influence of Cronstedt and Bergmann, names expressive of chemical composition, as far as it was ascertained; and the two methods have had their advocates till late in the present century. But, at the same time, the necessity of single names was recognized by most of the early mineralogists; and in the spirit of the system which had made its appearance among the Greeks and Romans out of the genius of the Greek language, they almost uniformly adopted for the new names the termination *ite*.

Thus we have from Werner the names Torberite, Chalcolite, Graphite, Prehnite, Witherite, Boracite, Augite, Pistacite, Pinite, Aragonite, Apatite, Leucite, Cyanite (Kyanite); and from other sources in the same century, Zeolite, Actinolite, Tremolite, Coccolite, Arendalite, Baikalite, Melanite, Staurolite, Lepidolite, Cryolite, Chiastolite, Collyrite, Agalmatolite, Sommite, Moroxite, Pharmacolite, Strontianite, Delphinite, Titanite, Ceylanite, Gadolinite, Rubellite, Sahlite, Wernerite, Scapolite, Mellite, etc.

The termination *ine* was also adopted for a few names, as Tourmaline, Olivine, Mascagnine, Serpentine; and *an* in Vesuvian; but the great bulk of the names were systematically terminated in *ite*.

With the opening of the present century (in 1801), Haüy came forward with his great work on Crystallography, and in it he brought out a variety of new names that defy all system, having nothing of the system of the earlier science, and no substitute of his own. Forgetting that the unity of law which he had found in nature should be a feature of scientific language, he gave to his names the following terminations:

ane, in Cymophane; *ase*, in Euclase, Idocrase, Anatase, Dioptase; *aste*, in Pleonaste; *age*, in Diallage; *ene*, in Disthene, Sphene; *gene*, in Amphigene; *ide*, in Staurotide; *ime*, in Analcime; *ole*, in Amphibole; *ome*, in Aplome, Harmotome; *ose*, in Orthose; *ote*, in Actinote, Epidote; *yre*, in Dipyre; *ype*, in Mesotype. And the true mineralogical termination *ite* he admitted only in the few following: Axinite, Meionite, Pycnite, Stilbite, Grammatite.

Haüy had commanded so great and so general admiration by his brilliant discoveries in crystallography, and by the benefits which he had thus conferred on mineralogical science, that his names with their innovations were for the most part immediately accepted even beyond the limits of France, although a number of them were substitutes for those of other authors. Some of Werner's names were among the rejected; and a break was thus occasioned between German and French mineralogy, which will not be wholly removed until the rule of priority, properly restricted, shall be allowed to have sway.

The *substitutes* among Haüy's names in the 1st edition of his Crystallography (1801) are the following:

Amphibole, for *Hornblende* of last century and earlier.

Orthose, for *Feldspar*.

Pyroxene, for *Augite* of Werner, and *Volcanite* of Delamétherie. [Delamétherie was a contemporary of Haüy at Paris, the author in 1792 of an edition of Mongez's *Manuel du Minéralogiste* (after Bergmann's Sciagraphia); in 1797, of an ambitious speculative work entitled *Théorie de la Terre*, the first two volumes of which consisted of a Treatise on Mineralogy; in 1811, 1812, of *Leçons de Minéralogie*, in 2 vols., and for a number of years principal editor of the *Journal de Physique*. He gave offence to Haüy by some of his early publications. Haüy's mineral Euclase is described in full by Delamétherie in the *Journal de Physique* for 1792 (some years in advance of Haüy's description of it), without crediting the name or anything else to Haüy; but five years later, in his *Théorie de la Terre*, he inserts the species with full credit to Haüy.]

Cymophane, for *Chrysoberyl* of Werner.

Idocrase, for *Vesuvian* of Werner.

Pleonaste, for *Ceylanite* of Delamétherie.

Disthene, for *Cyanite* of Werner.

Anatase, for *Octahedrite* of de Saussure, and *Oisanite* of Delamétherie.

Sphene, for *Titanite* of Klaproth.

Nepheline, for *Sommite* of Delamétherie.

Triphane, for *Spodumene* of d'Andrada.

Amphigene, for *Leucite* of Werner.

Actinote, for *Actinolite* of Kirwan, and *Zillerthite* of Delamétherie.

Epidote, for *Thallite* of Delamétherie, *Delphinite* of de Saussure, and *Arendalite* of Karsten

Axinite, for *Yanolite* of Delamétherie.

Harmotome, for *Andreolite* of Delamétherie.

Grammatite, for *Tremolite* of Pini.

Staurotide, for *Staurolite* of Delamétherie, and *Grenatite* of de Saussure.

And. later, *Paranthine*, for *Scapolite* of d'Andrada, and *Rapidolite* of Abildgaard.

Part of the changes were made with good reason; but others were wholly unnecessary. Haüy was opposed to names from localities, and hence several of the displacements. He objected also to names based on variable characters, and characters not confined to the species. Moreover, as his pupil, Lucas, observes (in giving reasons for rejecting the name *Scapolite* and substituting *Paranthine*), "le vice du mot *lite*, qui s'applique à toutes les pierres, ne pouvoient plus convenir à cette substance du moment où elle seroit reconnue pour un espèce." Haüy's own names are remarkable, in general, for their indefiniteness of signification, which makes them etymologically nearly as good for one mineral as another. and very bad for almost none; as. for example, *Diallage*, which is from the Greek for *difference; Analcime*, from *weakness* in Greek; *Orthose*, from *straight* in Greek; *Epidote*, from *increase* in Greek; *Anatase*, from *erection* in Greek, interpreted by him as equivalent to *length*; *Idocrase*, from *I see mixture* in Greek, etc. His name *Pyroxene*, which he defines *hôte ou étranger dans le domaine du feu*, is an unfortunate exception, as often remarked, the mineral being the most common and universal constituent of igneous rocks.

Beudant succeeded Haüy, and had the same want of system in his ideas of nomenclature. Finding occasion to name various mineral species which till then had only chemical names, he adopted Haüy's method of miscellaneous terminations, but indulged in it with less taste and judgment, and with little knowledge of the rules of etymology. In his work we find the termination *ese*, in Apherese, Aphanese, Neoctese, Acerdese, Mimetese; *ise*, in Leberkise, Sperkise, Harkise (only German words Gallicized); Melaconise, Zinconise, Crocoise, Stibiconise, Uraconise; *ose*, in Argyrose, Argyrythrose, Psaturose, Aphthalose, Rhodalose, Siderose, Elasmose, Exanthalose, Cyanose, Melinose, Disomose; *ase*, in Neoptase, Discrase; *ime*, in Ypoleime; *ele*, in Exitele; while names ending in *ine* are greatly multiplied.

In Germany, the tendency has always been to uniformity through the adoption of the termination *ite*. Breithaupt has been somewhat lawless, giving the science his Plinian, Alumian, Sardinian, Asbolan, etc.; his Castor and Pollux; Glaucodot, Homichlin, Orthoclase, Xanthocon, etc.; still, far the larger part of his numerous names are rightly terminated. Haidinger's many names are always right and good.

6. In forming names from the Greek or Latin the termination *ite* is added to the genitive form after dropping the vowel or vowels of the last syllable, and any following letters. Thus, μέλας makes μέλανος (*melanos*) in the genitive, and gives the name *melanite*. The Greek language is the most approved source of names.

7. In compounding Greek words the same elision of the Greek genitive is made for the first word in the compound, provided the second word begins with a vowel; if not, the letter *o* is inserted. Thus, from πῦρ, genitive πυρός (*puros*), and ὀρθός (*orthos*), comes pyrorthite; and from the same and ξένος (*xenos*) comes pyroxene.

8. The liberty is sometimes taken in the case of long compounds to drop a syllable, and when done with judgment it is not objectionable; thus *melaconite* has been accepted in place of *melanoconite*. But *magnoferrite* (as if from the Latin *magnus*, great, and ferrum, *iron*), for a compound of *magnesia* and iron, or *calcimangite* for one containing lime and *manganese*, are bad.

9. In the transfer of Greek words into Latin or English, the κ (*k*) becomes *c*, and the υ (*u*) becomes *y*.

10. In the formation of the names of minerals, the addition of the termination *ite* to proper names in modern languages (names of places, persons, etc.), or names of characteristic chemical constituents, is allowable; but making this or any other syllable a suffix to *common* words in such languages is barbarous.

11. Names made half of Greek and half Latin are objectionable; but names that are half of Greek or Latin and half of a modern language are intolerable.

12. *Law of Priority.* The law of priority has the same claim to recognition in mineralogy as in the other natural sciences. Its purpose is primarily to secure the stability, purity, and perfection of science, and not to insure credit to authors.

13. *Limitations of the Law of Priority.* The following are cases in which a name having priority may properly be set aside:

a. When the name is identical with the accepted name of another mineral of earlier date.

b. When it is glaringly false in signification; as when a red mineral is declared in its name to be black; *e. g.*, *Melanochroite* (p. 630); or when a honey-yellow mineral is made to be ashen; *e. g.*, *Melinophane* (p. 263).

c. When it is put forth without a description.

d. When published with a description so incorrect that a recognition of the mineral by means of it is impossible; and in consequence, and because also of the rarity of specimens, the same species is described under another name without the describer's knowledge of the mineral bearing the former name. When, on the contrary, a badly described but well-known old mineral is redescribed correctly, there is no propriety in the new describer changing the old name.

According to this canon it might seem right that the name *Emerylite* should have been substituted for *Margarite* (p. 506). Yet margarite, though incorrectly described, was a species well known in cabinets, and Dr. Smith manifested his appreciation of the true interests of science—the end of all canons—in adopting the old name so soon as he had ascertained by further research the identity of his species with margarite.

e. When the name is based on an uncharacteristic variety of the species. Thus *Sagenite* was properly set aside for ***Rutile*** (p. 159).

f. When the name is based upon a variety so important that the variety is best left to retain its original name; particularly where this and other varieties of the species, introduced originally as separate species, are afterwards shown by investigation to belong to a common species. Thus, the earlier name *Augite* is properly retained as the name of a variety, and Haüy's later name ***Pyroxene*** accepted for the group, as explained on p. 214.

g. When a name becomes the designation of a group of species: as ***Mica***, ***Chlorite***.

h. When the name is badly formed, or the parts are badly put together: as when the terminal *s* of a Greek word is retained in the derivative; *e. g.*, *aphanese* from ἀφανής; ***Melaconise*** from the Greek for ***black*** and χόνις; ***Rhodalose*** from the Greek for ***rose-colored*** and ἅλος (halos), the genitive of ἅλς, ***salt***. The last word is bad not only in termination but in wanting an *h* before the *a*, and strictly an *o* after the *d*. Also ***Siderose*** (spathic iron), ***Argyrose*** (silver glance), ***Chalcosine*** (copper glance), from, respectively, σίδηρος, ἄργυρος, χαλκός. The ancient Greeks showed us how the derivatives from these words should terminate by writing them ***Sideritis***, ***Argyritis***, ***Chalcitis***.

Ignorance or carelessness should not be allowed to give perpetuity to its blunders under any law of priority.

i. When a name is intolerable for the reasons mentioned in §§ 10, 11, as Harkise, from the German Haarkies (hair pyrites); ***Kupaphrite***, from the German ***Kupferschaum***; ***Bleinierite***, from the German ***Blei-Niere***.

j. When a name has been lost sight of and has found no one to assert its claim for a period of more than fifty years; especially if the later name adopted for the species has become intimately incorporated with the structure of the science, or with the nomenclature of rocks. Thus, although ***Thallite*** and ***Delphinite*** antedate ***Epidote***, it is not for the good of science that Epidote should be thrown aside. But where a name has not this importance, and is unexceptionable, the law of priority may be allowed to have its course.

The right to recognition, under this canon, where the names are those of the original describer of the species, is strong. But with regard to names introduced for well-known old species to replace earlier chemical or provincial names, the claim is feebler; and if the names are not strictly according to rule, or are unsatisfactory in mode of publication, they may be more freely modified, abbreviated if desirable, or rejected altogether. Prof. Chapman's "Practical Mineralogy," published in England in 1843, affords examples of the latter kind, and has occasioned some embarrassment. The work was by an author at that time unknown in the science (the preface says, an engineer, and "a very young man"); it was small, of limited circulation, and practical in its object, and therefore one in which new names for old species would not naturally be looked for. In 1845, Haidinger, then already a veteran in the science, the author of several works on mineralogy, and of numerous researches in its various departments, issued his "Handbuch," in which also a number of old species were provided with mineralogical names. Through Chapman's publication, Haidinger's *Breithauptite* is anticipated two years by Chapman's *Hartmannite*; his *Freieslebenite*, by the latter's *Donacargyrite*; his *Chromite*, by the latter's *Chromoferrite*; his *Cuprite*, by *Ruberite*; and so on. Chapman's names have ever since remained unknown or forgotten; while Haidinger's have had general acceptance among the mineralogists of Europe, and are now the current names. It has seemed that, after so long a period of oblivion, it would be doing no good to science to displace the latter, and a useless endeavor to attempt it. The later English Mineralogies of Nicol (1849), Brooke & Miller (1852), and Greg & Lettsom (1858), contain none of Chapman's names.

k. Where the adopted system of nomenclature in the science is not conformed to. In accordance with this last principle, the author, believing that the system demands that the names of species should have as far as possible, as above explained, the common termination *ite*, has changed, accordingly, a number of the names in the course of this volume.

14. It has appeared desirable that the names of rocks should have some difference of form from those of minerals. To secure this end, the author has written the final syllable *ite* of such names with a *y;* thus Diorite, Eurite, Tonalite, etc., are written *Dioryte, Euryte, Tonalyte.* The *y* is already in the name *Trachyte.* The author has allowed Granite and Syenite to remain as they are ordinarily written, since they are familiar names in common as well as in scientific literature.

See further, on Nomenclature, the excellent Mineral-Namen of v. Kobell.

6. BIBLIOGRAPHY.

The following catalogue contains the titles of the works which are referred to in the following pages, with their abbreviated titles. As the value of these references, and of the various historical conclusions deduced, depends on their having been derived from the original publications themselves, the abbreviated titles of the Journals and other works which the author has had by him for consultation are put in black letter; while the rest, that is of those he has not seen, are in small capitals. Some titles also are added of works consulted, but not referred to. Many other titles might have been inserted, a considerable number from the author's library; but they would swell the list without increasing much its value.

The abbreviations of the more important words in the abbreviated titles, and of the names of the States in the United States (some of which are in the titles and other in the observations on minerals), are as follows:

Abbreviated words.—*Am.*, American; *Can.*, Canada; *Ch.*, Chemistry, Chemical, Chemie, Chimie; *Fr.*, French; *G.*, Geological, Geology, Geologie, Geologischen; *Germ.*, German; *J.*, Journal; *M.*, Mines; *Min.*, Mineralogy, Mineralogie, Mineralogical; *pt.*, in part; *Q.*, Quarterly; *Sc.*, *Sci.*, Science; *Soc.*, Society; *Z S.*, Zeitschrift.

Abbreviated names of the United States.—*Ala.*, Alabama; *Ark.*, Arkansas; *Cal.*, California; *Ct.*, *Conn.*, Connecticut; *Del.*, Delaware; *Ga.*, Georgia; *Ill.*, Illinois; *Ind.*, Indiana; *Kan.*, Kansas; *Ky.*, Kentucky; *Me.*, Maine; *Mass.*, Massachusetts; *Md.*, Maryland; *Mich.*, Michigan; *Minn.*, Minnesota; *Miss.*, Mississippi; *Mo.*, Missouri; *N. Car.*, North Carolina; *N. H.*, *N. Hamp.*, New Hampshire; *N. J.*, New Jersey; *N. Y.*, New York; *O.*, Ohio; *Penn.*, Pennsylvania; *R. I.*, Rhode Island; *S. Car.*, South Carolina; *Tenn.*, Tennessee; *Va.*, Virginia; *Vt.*, Vermont.

Other abbreviations are explained below. The catalogue is divided into three parts: 1. Periodicals not issued by Scientific Societies; 2. Publications of Scientific Societies; 3. Independent works or publications.

In giving abbreviations of the publications of Societies, *the name of the place where the Society is established is in all cases stated*, and, for the sake of uniformity, it is made the *last* word in the abbreviated title, a method which it were well if always followed. For the prominent journals, and the serials of some societies, the time of publication of the successive volumes, or of the volumes of every successive five years, is stated.*

---

* A very useful table, giving the date of publication of each volume of the journals here referred to, might easily be constructed from the facts stated. It may be made on paper ruled in squares,

1. *Periodicals not issued by Scientific Societies.*

Afh., or Afhandl. Afhandlingar i Fisik, Kemi och Mineralogie, etc., utgifne af Hisinger & Berzelius. Vol. 1, 1806; 2, '07; 3, '10; 4, '15; 5, 6, '18.

Am. J. Sci. American Journal of Science and Arts. 1st series, 50 vols., 8vo; conducted by B. Silliman, 1818–1839; with B. Silliman, Jr., from 1840. Four numbers to vol. 1, and two to subsequent vols. Vol. 1, No. 1, Aug., 1818; No. 2, Jan., '19; No. 3, Mar., '19; No. 4. June, '19; vol. 2, Ap., Nov., '20: 3, Feb., May, '21; 4, Oct., Feb., '21, '22; 5, June, Sept. '22; 6, Jan., May, '23; 7, Nov., Feb., '23, '24; 8, May, Aug., '24; 9, Feb., June, '25; 10, Oct., Feb., '25, '26; 11, June, Oct., '26; 12, 13, Mar., June, Sept., Dec., '27; afterward regularly on the first of April, July, Oct., Jan.: vols. 14, 15, in '28, '28–'29; 24, 25, in '33, '33–'34; 34, 35, in '38, '38–'39; then regularly, Jan., May, July, Oct., 36, 37, in '39; 38, 39, in '40; 48, 49, in '50; 50, Index volume.

2d ser., by the same and James D. Dana, until 1865, after which, by B. Silliman and James D. Dana; from 1851, aided by A. Gray and W. Gibbs; '53 to '66, by L. Agassiz; from '63, by G. J. Brush and S. W. Johnson; from '64, by H. A. Newton. 2 vols ann.; 1, 2, 1846; 11. 12, '51; 21, 22, '56; 31, 32, '61; 41, 42, '66; whence, 49, 50, 1870. An index to 10 vols. in each vols. 10, 20, 30, etc.

Ann. Ch. Annales de Chemie. 8vo. Paris, vols. 1-3, 1789; 4–7, '90; 8–11, '91; 12–15, '92; 16–18, '93; 19–24, '97; 25–27, '98; 28–31, '99; then regularly 4 v. ann.; 32–35, 1800; 52–55, '05; 72–75, '10; 92–95, 96, '15, an Index to vols. 31 to 60 inclusive. Continued in the Ann. Ch. Phys. (q. v.).

Ann. Ch. Pharm. Annalen der Chemie und Pharmacie; by Wöhler and Liebig; from vol. 77, by Wöhler, Liebig, and Kopp, and called *new series*. 8vo, Leipzig and Heidelberg, 4 vols. ann. Vol. 1–4, 1832; 13–16, '35; 33–36, '40; 53–56, '45; 73–76, '50; 93–96, '55; 113–116, '60; 133–136, '65; 153–156, '70. Supplementband, 1, 1861; 2, '62, '63; 3, '64; 4, '65, '66.

Ann. Ch. Phys. Annales de Chemie et de Physique; at first by Gay Lussac et Arago. 8vo, Paris; 3 vols. ann.; 1–3, 1816; 16–18, '21; 31–33, '26; 46–48, '31; 61–63, '36; 73–75, '40. Vols. 67–75 made 2d ser., and numbered 1–9. 3d ser., 1–3, '41; 16–18, '46; 31–33, '51; 46–48, '56; 61–63, '61; 67–69, '63. 4th ser., 1–3, 1864; 16–18, '69.

Ann. d. M. Annales des Mines. 8vo, Paris. Begun in 1816 as sequel to Journal des Mines; 1 vol. a year until 1825, and subsequently 2 vols. a year. Vol 1, 1816; 6, '21; 10, 11, '25; 12, 13, '26. 2d ser., 1, 2, '27; 9, 10, '31. 3d ser., 1, 2, '32; 19, 20, '41. 4th ser., 1, 2, '42; 19, 20, '51. 5th ser., 1, 2, '52; 19, 20, '61. 6th ser., 1, 2, '62.

ANN. MUS. D'HIST. NAT. Annales du Muséum d'histoire naturelle par les Professeurs de cet établissement, MM. Haüy, Fourcroy, Vauquelin, Desfontaines, A. L. de Jussieu, Geoffroy, Lacepède, etc. 4to, Paris; vols. 1–20, 2 a year, 1803-1815.

Ann. Phil. Annals of Philosophy. 2 vols. ann., 8vo, Edinburgh. 1st ser. by Thos. Thomson; vols. 1, 2, 1813; 11, 12, '18; 15, 16, '20. 2d ser., vols. 1, 2, 1821; 11, 12, '26. Then merged in Phil. Mag. (q. v.).

B. H. Ztg. Berg- und hüttenmännische Zeitung. 4to, Liepzig, 1 vol. ann. Begun by Hartmann, and sometimes called Hartmann's Zeitung. Now edited by B. Kerl and F. Wimmer. Vol. 1, 1842; 4, '45; 9, '50; 14, '55; 19, '60; 24, '65; 29, '70.

BAUMG. ZS. Zeitschrift f. Physik und Mathematik; edited by Baumgartner and Ettingshausen. 10 vols, 8vo, 1826–1832, Wien.

Bergm. J. Bergmännisches Journal; ed. by A. W. Köhler. 12mo, Freyberg, Sax. 1, 2, 1788; 1, 2, '89; so to '92; 1, 2, '93, by Köhler and Hoffmann. Afterward, Neues Bergm. J., of K. & H.; 1, 1795; 2, '98; 3, 1802; 4, '16. Contains papers by Werner, Hoffmann, Klaproth, and much on mineralogy.

Bibl. Univ. Bibliothèque Universelle de Genève. Begun in 1816. In 1846, 4th series of 36 vols. commenced, and the scientific part of the Review takes the title, Archives des Sciences physiques et Naturelles. 5th series commenced in 1858.

Bruce Am. Min. J. The American Mineralogical Journal; conducted by Archibald Bruce, M.D. Only 1 vol., 8vo. Begun Jan., 1810; No. 1, 62 pp., 1810, and 2, to p. 126, '10; 3, to p. 190, '11; 4, to end, p. 270, '13.

Can. Nat. Canadian Naturalist and Geologist. 8vo, Montreal. Vol. 1, 1856; 5, '61; 8, '63; 2d ser., vol. 1, '64; 2, '65; 3, '66.

---

having the years in succession, beginning with 1770, at the top of the columns of squares, the titles of the several journals to the left, and the number of the volume or volumes of each issued each year in the column for that year. Such a table was constructed by the author, with reference to the preparation of this edition. It would be a vast benefit to science if a series of such tables, containing all journals of importance, and also the publications of societies, could be made out and engraved, and thus placed within the reach of students in science.

Can. J. Canadian Journal of Industry, Science, and Art. Toronto, Canada; 2d ser., vol. 1, 1856; 5, '60; 10, '65; 11, '66, '67.

Ch. Gaz. Chemical Gazette, by W. Francis. 8vo, London; 1 vol. ann. after vol. 1, of 1842, 3

Ch. News. Chemical News; edited by W. Crookes. Sm. 4to, London, 2 v. ann; vols. 1, 2, 1860; 11, 12, '65; 21, 22, '70.

Crell's Ann. Chemische Annalen: by L. Crell. 40 vols., 12mo, Helmstadt u. Liepzig; vols. numbered 1, 2, for each year, from 1784 to 1803 inclusive.

Dingler J. Polytechnisches Journal; by J. G. & E. M. Dingler. 3 vols. ann., 8vo, Augsburg. Begun in 1820; vol. 187, in 1868.

Dublin Q. J. Sci. Dublin Quarterly Journal of Science; edited by Rev. S. Haughton. 6 vols, 8vo, 1861–'66, Dublin.

Ed. J. Sci. Edinburgh Journal of Science; edited by D. Brewster (often called Brewster's J.). 8vo, Edinburgh, 2 vols. ann. 1st ser., vol. 1, 1824; 2, 3, '25; 6, 7, '27; 10, '29. 2d ser., vol. 1, 1829; 2, 3, '30; 4, 5, '31; 6, '32. Merged in Phil. Mag.

Ed. Phil. J. Edinburgh Philosophical Journal; edited by Brewster and Jameson. 8vo, 2 vols. ann.; vol. 1, 1819; 2, 3, '20; 6, 7, '22; 10, '24; edited by Jameson alone, 11, 1824; 12, 13, '25; 14, '26. Becomes Ed. N. Phil. J. (q. v.).

Ed. N. Phil. J. Edinburgh New Philosophical Journal; edited by Prof. Jameson (often called Jameson's Journal). 8vo, 2 vols. ann. 1st ser., vol. 1, 1826; 2, 3, '27; 12, 13, '32; 22, 23, '37; 32, 33, '42; 42, 43, '47; 52, 53, '52; 56, 57, '54. 2d ser., vols. 1, 2, 1855; 11, 12, '60; 19, 20, '64. Here ends.

ERMAN'S ARCH. Archiv für wissenschaftliche Russland. Begun in 1841; 1 vol. ann. Vol. 1, 1841; 11, '51; 21, '61, etc.

Gehlen's J. Neues allg. Journal der Chemie; by A. F. Gehlen. 6 vols., Berlin; 1, 1803; 2, 3, '04; 6, '06. 2d ser., under the title Journal für die Chemie und Physik und Mineralogie, 9 vols., Berlin; 1, 2, 1806; 5, 6, '08; 9, '10. Afterward, Schweigger's Journal (q. v.) began at Nuremberg.

Gilb. Ann. Annalen der Physik; conducted by L. W. Gilbert. 8vo, Leipzig, 30 vols.; 1st series, 1799–1808; then 30 vols., 2d ser., 1809–'18; then Annalen d. Phys. und der Physikalischen Chemie, 16 vols., 3d ser., 1819–'23. The vols of the several series usually counted consecutively; 1, 2, 1799; afterward 3 vols. a year, 3–6, 1800; 13–15, '03; 28–30, '08; 43–5, '13; 58–60, '18; 73–5, '23; 76, '24. Afterward continued as Poggendorff's Annalen (q. v.).

J. d. M. Journal des Mines. 8vo, Paris. In monthly nos. 2 v. ann.; 1, 2, 1797; 11, 12, 1802; 21, 22, '07; 31, 32, '12; 37, 38, '15. Continued after in Annales des Mines (q. v.).

J. de Phys. Journal de Physique. 4to, Paris, 2 vols. ann. Edited by Abbé Rozier (and hence called Rozier's J.), for vols. 1–43 (for a time with also Mongez, Jr.); by Delametherie for vols. 44–84; and afterward by Blainville. Two introductory vols., 1771, 1772; vols. 1, 2, 1773; 11, 12, '78; 22, 23, '83; 32, 33, '88; 42, 43, '93; 44, 45, '94 (French Revolution); 46, 47, '98; 56, 57, 1803; 66, 67, '08; 76, 77, '13; 86, 87, '18; 94, 95, '22; 96, 1823.

J. pr. Ch. Journal für praktische Chemie. 8vo, Leipzig, 3 vols. ann. Begun in 1834; first edited by Erdmann & Schweigger-Seidel (see Schweigger J.); from 1838 by E. & Marchand; from 1852, by E. & Werther. Vols. 1–3, 1834; 19–21, '40; 34–36, '45; 49–51, '50; 64–66, '55; 79–81, '60; 94–96, '65; 109–111, '70. Preceded by J. f. pr. und Œkonomische Chemie, 18 vols. 8vo, 3 vols. ann., begun in 1828.

Jahrb. Min. Jahrbuch für Mineralogie, Geognosie, Geologie, und Petrefaktenkunde; edited by K. C. v. Leonhard & H. G. Bronn. 8vo, Heidelberg, 1 vol. ann. 1830–32, 4 Nos. a year; after '32, 6 Nos., and called Neues Jahrbuch etc. Vol. 1, 1830; 6, '35; 11, '40; 16, '45; 21, '50; 26, '55; 31, '60; 36, '65; 41, '70.

Arsb. } Arsberättelser om framstegen i Kemi och Mineralogi, af Jac. Berzelius. In German,
Jahresb. } Jahresbericht über die Fortschritte der Chemie und Mineralogie. 8vo; usually designated by the year. Commenced with 1821. Vol. 1, 1821; 11, '31; 21, '41; 30, 1850; the last three vols by Svanberg. Continued in the Giessen Jahresbericht, issued by Liebig & Kopp, from 1847 to '56; by F. Zamminer, '57; Kopp & Will, in '58; and Will alone from '63 on. The first vol. covers the years 1847, '48.

Karst. Arch. Min. Archiv für Mineralogie, Geognosie, Bergbau und Hüttenkunde. 26 vols. 8vo, 1829–1855, Berlin. Edited for vols. 1–10 by C. J. B. Karsten; later by Karsten & v. Dechen.

KASTN. ARCH. NAT. Archiv. für die gesammte Naturlehre; edited by K. W. G. Kastner. 8vo, Nuremberg. 27 vols., 3 vols. ann., 1824–'35.

Kell. & Tiedm. Nordamerikanischer Monatsbericht für Natur- und Heilkunde; edited by Dr. W. Keller & Dr. H. Tiedemann. 4 vols., 8vo, Philadelphia. Vol. 1, 1850; 2, 3, '51 4, '52.

Lempe's Mag. Magazin für die Bergbaukunde, by J. F. Lempe. Dresden, vols., 8vo, 1, 1785; 2, 3, '86; 4, '87; then 1 vol. ann. till 11, '94; 12, '98; 13. '99.

L'Institut. L'Institut, a weekly journal in small fol., Paris, 1 vol. ann.; begun in 1832. 36th year or vol. in 1868.

MAG. NAT. HELVET. Magazin für die Naturkunde Helvetiens; herausg. A. Höpfner, Zurich. Begun in 1787.

Moll's Efem. Efemeriden der Berg- und Hüttenkunde; edited by C. E. von Moll. 5 vols.; 1, 1805, at München; afterward at Nürnberg, 2, '06; 3, '07; 4, '08; 5, '09. Preceded by v. Moll's Jahrb. f. B. H., Salzburg, 5 vols., 1797–1801; and Annalen id., Salzburg, 3 vols., 1802–'04.

Nicholson's J. Journal of Natural Philosophy, Chemistry, and the Arts; by Wm. Nicholson London, 1st ser., 5 vols., 4to, vol. 1, 1797; 5, 1801. 2d ser., 36 vols. 8vo, vol. 1, 1802; 36, 1813.

NYT MAG. Nyt Magazin for Naturvidenskaberne; by C. Langberg. 8vo, Christiania.

Phil. Mag. Philosophical Magazine. 8vo, London. 1st ser. by Tilloch, 2 or 3 vols. a year; 1, 2, 1798; 3–5, '99; 6–8, 1800; 21–23, '05; 30–32, '08; 33, 34, '09 (thence 2 v. ann.); 35–36, '10; 45, 46, '15; 55, 56, '20; 65, 66, '25; 67, 68, '26. 2d ser., or Philosophical Magazine and Annals of Philosophy, 2 v. ann.; 1, 2, 1827; 11, '32 3d ser., London & Edinburgh Phil. Mag.; 1, 1832; 2, 3, '33; 12, 13, '38; 22, 23, '43; 32, 33, '48; 36, 37, '50. 4th ser., L., E. & Dublin Phil. Mag., 1, 2, 1851: 11, 12, '56; 21, 22, '61; 31, 32, '66.

Pogg. or **Pogg. Ann.** Annalen der Physik und Chemie; edited by J. C. Poggendorff. 8vo, Leipzig, 3 vols. ann. Preceded by Gilbert's Annalen (q. v.). Vols. 1, 2, 1824; 3–5, '25; 18–20, '30; 27–29, '33; 30, Index vol.; 31–33, '34; 34–36, '35; 49–51, '40; 63–66, '45; 79–81, '50; 94–96, '55; 109–111, '60; 124–126, '65; 139–141, '70.

Q. J. Sci. Brandes' Quarterly Journal of Science. 8vo, 2 vols. ann. after 1819. Published by the Royal Institution. Vol. 1, 1816; 2, 3, '17, '17–'18; 4, 5, '18; 6, 7, 8, '19; 9, 10, '20; 19. 20, '25; 27, 28, '29.

Rec. Gen. Sci. Records of General Science; by Thos. Thomson. 4 vols., 8vo, Edinburgh. Vols. 1, 2, 1835; 3, 4, '36.

Revista Minera. Revista Minera, Periodico cientifico é industrial redactado por una Sociedad de Ingenieros. 2 vols., 8vo, Madrid. Vol. 1, 1850; 2, '51.

Scherer's J. Allgemeines Journal der Chemie; conducted by A. N. Scherer. 10 vols., Leipzig und Berlin; 1, 1798; 2, 3, 1799; 6, 7, 1801; 10, '03. Continued as Gehlen's Journal (q. v.).

Schweigg. J. Journal für Chemie und Physik; conducted by J. S. C. Schweigger. Nürnberg, 8vo. Also under the title Jahrbuch der Chemie und Physik. 3 vols. a year; 1–3, 1811; 16–18, '16; 28–30, '20; afterward issued by Schweigger & Meinecke; then by J. S. C. Schweigger & Fr. W. Schweigger-Seidel; then by Fr. W. Schweigger-Seidel; 31–33, 1821; 46–48, '26; 61–63, '31; 67–69, '33. The next year began the J. pr. Ch. (q. v.), by Erdmann & Schweigger-Seidel.

Tasch. Min. Taschenbuch für die gesammte Mineralogie, von C. C. Leonhard. 18 vols., 12mo, Frankfurt a. M., 1 vol. ann. Vol. 1, 1807; 4, '10; 9, '15; 14, '20; 18, '24.

2. *Transactions, etc., of Scientific Societies.*

Abh. Ak. Berlin. Abhandlungen der königlichen Preuss. Akademie der Wissenschaften zu Berlin. 4to, Berlin. Vol. 1 (for 1804–1811) issued in 1815.

ABHANDL. SENK. GES. FRANKFURT. Abhandlungen von d. Senkenbergischen naturforschenden Gesellschaft zu Frankfurt. Begun in 1854. Vol. vii. in 1868.

Ak. H. Stockholm. K. Vet.-Academinens Handlingar, Stockholm.

Amer. Assoc. Proceedings of the American Association for the Advancement of Science. 8vo. Vol. 1, meeting at Philadelphia in 1848; 2, at Cambridge in '49; 3, at Charleston in '50; 4, at N. Haven, '50; 5, at Cincinnati, '51; 6, at Albany, '51; 7, at Cleveland, '53; 8, at Washington, '54; 9, at Providence, '55; 10, at Albany, '56; 11, at Montreal, '57; 12, at Baltimore, '58; 13, at Springfield, '59; 14, at Newport, '60; 15, at Buffalo, '66; 16, at Burlington, '67.

Ann. Lyc. N. Hist. N.Y. Annals of the Lyceum of Natural History of New York. Begun in 1824. Vol. 8 unfinished in 1868.

Anzeig. Ak. Wien. Anzeiger der K. K. Akad. d. Wissenschaften. 8vo, Wien. Begun in 1864. 1 vol. ann.

Ber. Ak. München. Sitzungsberichte der K. bayerischen Akad. der Wiss. zu München (Munich). 8vo.

Ber. Ak. Wien. Sitzungsberichte der K. K. Akad. der Wiss., Wien (Vienna). Commenced in 1848, 8vo.

Ber. Ak. Berlin. Monatsberichte der. K. Preuss. Akad. der Wissenschaften zu Berlin. 8vo Begun in 1836.

Ber. nied. Ges. Bonn. Sitzungsberichte der niederrheinischen Gesellschaft in Bonn. Issu with Verh. nat. Ver. Bonn.

Ber. sächs Ges. Leipsic. Berichte der K. sächs. Gesellschaft der Wiss, Leipsic.

Bull. Ac. St. Pet. Bulletin Scientifique de l'Acad. Impériale des Sciences de St. Petersb. 4 St. Petersburg. Vol. 1, 1858; 10, 1867. Preceded by the two Bulletins, B. physic mathematique, 17 vols., 4to, and B. historico-philologique, 16 vols., 4to; and these tw preceded by the one Bull. Scientifique, 10 vols., 4to.

Bull. Soc. Ch. Bulletin mensuel de la Société Chemique de Paris. 8vo, 1 vol. ann. 2d ser. begun in 1860. Vol. 9 in 1868.

Bull. Soc. G. Bulletin de la Société Géologique de France. 8vo, Paris. 1st ser., vol. 1, 183 '31; 2, '31–'32; 3, '32–'33; 4, '33–'34; 5, '34; 6, '34–'35; 7, '35–'36; 12, '40–'41; 1 '42–'43. 2d ser., vol. 1, '43–'44; 6, '48–'49; 11, '53–'54; 16, '58–'59; 21, '63–'64; 2 '68–'69.

Bull. Soc. Imp. Nat. Moscou. Bulletin de la Soc. Impériale des Naturalistes de Moscou. 8v

C. R. Comptes Rendus des Séances de l'Académie des Sciences. 4to, 2 vols. ann.; vol. 1, 183 2, 3, '36; 12, 13, '41; 22, 23, '46; 32, 33, '51; 42, 43, '56; 52, 53, '61; 62, 63, '66.

Denkschr. Ak. Wien. Denkschriften der Kais. Akademie d. Wiss. in Wien.; Math.-Naturwis Classe. 4to, Wien. Begun in 1850; vol. 25 in 1866.

Forh. Vid. Selsk. Christiania. Forhandlingar i Videnskabs-Selskabet i Christiania. 8vo.

Haid. Ber. Berichte über die Mittheilungen von Freunden der Wiss. in Wien; edited by W Haidinger. 8vo 7 vols., 1846–'51.

Gel. Anz. Münch. Gelehrte Anzeige der K. bayerischen Akad. der. Wiss. zu München. 4t Vol. 1, 1835; 39, '54.

J. Ac. Philad. Journal of the Academy of Natural Sciences of Philadelphia. 1st. ser., 8vo, vols., 1817–'42. 2d ser., 4to, begun in 1847; vol. 6 finished in 1868.

J. Nat. Hist. Bost. Boston Journal of Natural History. 8vo, 7 vols., 1834–'63.

J. Ch. Soc. Journal of the Chemical Society. 1st ser., called Quarterly Journal, etc. 15 vols. one vol. (of 4 Nos.) a year; vol. 1, 1849; 6, '54; 11, '59; 15, '63. 2d ser., monthly vol. 1, 1864; 6, '69.

Jahrb. G. Reichs. Jahrbuch der Kaiserlich-Königlichen geologischen Reichsanstalt, Wie Begun in 1850, 1 vol. ann.

Jahresb. Wett. Ges. Hanau. Jahresbericht der wetterau'schen Gesellschaft für die gesammt Naturkunde. 8vo, Hanau, 1850–'53.

Mag. Ges. nat. Fr. Berlin. Magazin der Gesellschaft naturforschender Freunde. 8 vols. 4to 1, 1807; 2, '08; 3, '09; 4, '10; 5, '11; 6, '14; 7, '16; 8, '18. Afterward Verhandl. ib.

Mem. Acc. Torino. Memorie della reale Accademia delle Scienze di Torino. 4to, Turin; 1s ser., 40 vols., 1864,–'38; 2d ser. begun in 1839, and vol. 22, in '65.

Mem. Am. Ac. Bost. Memoirs of the American Academy of Arts and Sciences. 4to, Boston

Mem. Soc. Nat. Moscou. Begun in 1811.

Œfv. Ak. Stockh. Œfversigt af K. Vet-Akad. Förhandlingar, Stockholm. Commenced in 184 1 vol. ann., 8vo.

Overs. Vid. Selsk. Copenh. Oversigt over det Kongelige danske Videnskabernes Selskab Forhandlingar. Copenhagen, 8vo.

Phil. Trans. Transactions of the Royal Society of London. 4to. Vol. 1 contains transaction for 1665. '66.

Proc. Ac. Philad. Proceedings of the Acad. Nat. Sci., Philadelphia. 8vo. Begun in 1841.

Proc. Am. Phil. Soc. Philad. Proceedings of the American Philosophical Society, Philadelphia

Proc. N. Hist. Soc. Bost. Proceedings of the Nat. Hist. Society of Boston. 8vo. Begun in 1841

Proc. Roy. Soc. Edinb. Proceedings of the R. Soc. of Edinburgh. 8vo.

Phys. Arb. Fr. Wien. Physikalische Arbeiten der einträchtigen Freunde in Wien; publishe in Quartals; 1 qu., 1783; 2 qu., '84; 3, 4 qu., '85; 2d vol., 1 qu., '86; 2 qu., '87; 3 qu, '88.

Q. J. G. Soc. Quarterly Journal of the Geological Society. 8vo, London. Begun in 1845; 1 vol. ann.

Q. J. Ch. Soc. See J. Ch. Soc.

Rep. Brit. Assoc. Reports of the British Association. Begun in 1831.

Schrift. Ges. nat. Fr. Berlin. Schriften der Gesellschaft naturforschender Freunde in Berlin 11 vols. 8vo, the first 1 v. ann.; 1, 1780; 5, '84; 8, '86–7; 8, '88; 9, '89; 10, '92; 11, '9 (vols. 7–11, also as 1–5 of Beobachtungen und Entdeckungen, etc.). Next, Neue Schriften etc., 4 vols., 4to; 1, 1795; 2, '99; 3. 1801; 4, 1803–4. Afterward Magazin, etc. (q. v.).

Schriften Min. Ges. St. Pet. Schriften der russisch-kaiserlichen Gesellschaft für die gesammt Mineralogie. 1842. For continuation see Verh.

Soc. Sci. Fenn. Acta Societatis Scientiarum Fennicæ, Christiania, Norway.

Trans. Am. Phil. Soc. Philad. Transactions of the American Philosophical Society. 4to, Philadelphia.

Trans. Soc. Roy. Edinb. Transactions of the Royal Society of Edinburgh. 4to.

Verh. Min. Ges. St. Pet. Verhandlungen d. russisch-kaiserlichen mineralogischen Gesellschaft zu St. Petersburg.

Verh. nat. Ges. Basel. Verhandlungen der naturforschenden Gesellschaft in Basel. Begun in 1854.

Verh. nat. Ver. Bonn. Verhandlungen des naturhistorischen Vereines der preuss. Rheinlande und Westphalens. Begun in 1844.

ZS. G., or ZS. G. Ges. Zeitschrift der deutschen geol. Gesellschaft. 8vo, Berlin; a quarterly; 1 vol. ann.; vol. 1. 1849; 11, '59; 21, '69.

ZS. Nat. Ver. Halle. Zeitschrift für die gesammten Naturwissenschaften, von dem nat. Verein f. Sachsen und Thüringen in Halle. Begun in 1853.

3. *Independent Works.*

Agric., Ort. Caus. Subt. Georgius Agricola, de Ortu et Causis subterraneorum; preface dated 1543.

Agric., Foss. Id., de natura fossilium; pref. dated 1546; and De veteribus et novis metallis; pref., 1546.

Agric., Berm. Bermannus, sive De re metallica Diallogus; pref., 1529.

Agric., Interpr. Interpretatio Germanica vocum rei metallicæ; pref., 1546. The edition of Agricola's works, cited beyond, including the four preceding parts, is one in folio, 1 vol., Basileæ (Basle), 1558.

Agric., Metall. De re Metallica; by id. Preface dated 1550. Fol., Basileæ, 1557.

Aikin, Min. Manual of Mineralogy; by A. Aikin. 2d ed., 8vo, London, 1815. The 1st ed. appeared in 1814.

Albert. Magnus, Min. Albertus Magnus, De Mineralibus. Written after 1262.

Alger, Min. Treatise on Min. by Wm. Phillips; 5th ed. by R. Allan, with numerous additions; by F. Alger. 8vo, Boston, 1844.

Allan, Min. Manual of Mineralogy; by R. Allan. 8vo, Edinburgh, 1834. See also PHILLIPS.

Allan, Min. Nomencl. Mineralogical Nomenclature; by T. Allan. 8vo, Edinburgh, 1814.

Argenville, Oryct. L'Histoire Naturelle, etc.; by D. d'Argenville. 4to, Paris, 1755.

Arppe, Finsk. Min. Analyser af Finska Mineralier; by A. E. Arppe. Part I., 1855, from the Act. Soc. Fenn., iv. 561–578; II., 1857, ib., v. 467 (paged 1–51); III., 1859–1861, ib. vi. 580.

Aristotle. Aristotle's works; particularly the Μετεωρολογικά, or "Meteorology," and Περὶ Θαυμασίων ἀκουσμάτων, or "Wonderful Things Heard of." Works written about the middle of the 4th century B.C. A. born about 384 B.C. and d. 322 B.C.

B. de Boot. Lap. Gemmarum et Lapidum Historia. 4to, Jena, 1647; the 1st edit. published at Jena in 1609; the 2d, enlarged by A. Toll, Lugduni Bat., 8vo, 1636.

Beck, Min. N. Y. See Rep. Min. N. Y., beyond.

Beud., Tr., 1824, 1832. Traité élémentaire de Min.; by F. S. Beudant. 8vo, Paris, 1824; 2d ed., 2 vols., 1832.

Bergm., Opusc. Opuscula of Torbernus Bergmann. 1780.

Bergm., Sciagr. Sciagraphia Regni Mineralis (in Latin); by T. Bergmann. 8vo, 1782; reprint in London, 1783.

BERZ N. SYST. MIN. Neues System der Mineralogie; translated from the Swedish by Drs. Gmelin and Pfaff. Nürnberg, 1816.

Berz. N. Syst. Min. Nouveau Système de Minéralogie; by J. J. Berzelius. 8vo, Paris, 1819; translated from the Swedish.

Berz. Lothr. Die Anwendung des Löthrohrs, etc. Germ. Transl. by H. Rose. Nürnberg, 1821; 4th ed., 1844. American ed. by Whitney, 1845.

BLUMENBACH HANDB. Handbuch der Naturgeschichte. 8vo, 8th ed., Göttingen, 1807.

Born, Brief. Walschl. Briefe aus Wälschland (Italy); by I. v. Born. 8vo, Prague, 1773.

Born, Lithoph. Lythophylacium Bornianum; Index Fossilium quæ colligit, etc., Ignatius S. R. I. Eques a Born. 2 parts, Prague; part 1, 1772; 2, '75. A descriptive catalogue, but without notes.

Born, Cat. Foss. de Raab. Catalogue méthodique et raisonné de la collection des Fossiles de Mlle. Eleonore de Raab; by id. 4 vols., 8vo, Vienna, 1790.

BOURN. CAT. Catalogue de la Collection minéralogique particulière du Roi; by Comte de Bournon. 8vo, mit Atlas in fol., Paris, 1817.

Bourn. Min. Traité de Minéralogie; by Comte de Bournon. 3 vols., 4to, 1808.

Breith., Char. 1820. Kurze Charakteristik des Mineral-Systems; by A. Breithaupt. 8vo, Freiberg, 1820.

Breith., Char. 1823, 1832. Vollständige Char., etc.; by id. 8vo, Dresden, 1823; 2d ed., 1832.

Breith., Uib. 1830. Uibersicht des Mineral-System's; by A. Breithaupt. 8vo, Freiberg, 183

Breith., Handb. Vollständiges Handbuch der Mineralogie; by id. 8vo, Dresden and Leipzi vol. 1, introduct., 1836; 2, '41; 3, '47.

Brochant, Min. Traité de Minéralogie; by A. J. M. Brochant. Paris, 1808; an earlier edition 1800.

Bromell, Min. Herr Magni von Bromells Mineralogia. 2d ed., 16mo, Stockholm, 1739. 1 ed. pub'd in 1730.

Brongn., Min. Traité élémentaire de Minéralogie; by A. Brongniart. 2 vols., 8vo, Paris, 18

Brongn., Tabl. Tableau des Espèces Minérales; by id. 48 pp., 8vo, Paris, 1833.

Brooke, Cryst. Familiar Introduction to Crystallography; by J. Brooke. 8vo, London, 182

B. & M., Min. Introduction to Mineralogy, by the late Wm. Phillips; new edition, with exte sive alterations and additions, by H. J. Brooke and W. H. Miller. 8vo, London, 185 Prof. Miller is the author also of a Treatise on Crystallography, 8vo, Cambridge, 1839, gi ing the elements of the system adopted in the above work, a system first proposed Whewell, in Phil. Trans. for 1825.

Brückmann, Magnalia Dei in locis subterraneis. 2 parts, fol.; part 1, 1727; 2, '30.

Cæsius, Min. De Mineralibus; by Bernardius Cæsius. 656 pp., fol., Lugduni, 1636.

CAPPELLER, CRIST. Prodromus Cristallographiæ; Marc. Ant. Cappeller. 4to, Lucerne, 1723.

Cat. de Dree. Catalogue des huit Collections qui composent le Musée mineralogique de Et. Drée. 4to, Paris, 1811. Dufrénoy speaks of it as the work of M. Leman.

Chapman, Min. Practical Mineralogy; by E. J. Chapman. 8vo, London, 1843.

Chapman, Char. Min. Brief Description of the Characters of Minerals; by id. 12mo, Londo 1844.

Cleaveland, Min., 1816, 1822. Treatise on Mineralogy and Geology. 8vo, Boston, 1816; ed., 2 vols., 8vo, Boston, 1822.

Cronst., or Cronst. Min., 1758, 1781. Mineralogie, eller Mineral-Rikets Upstallning; by Cronstedt (but issued anonymously). 12mo, Stockholm, 1758; Brünnich's edit. in Danis Copenhagen, 8vo, 1770; 2d Swedish ed., Stockholm, 1781; Magellan's edit. in Englis 2 vols., 8vo, London, 1788.

Dana, Min. Boston. Outlines of the Mineralogy and Geology of Boston and its vicinity; by Freeman & S. L. Dana. 8vo, Boston, 1818.

Dana, Min. This work. Editions of 1837, 1844, 1850, 1854. Supplements 1 to 10 to last ed tion in the Am. J. Sci., 1855-1862, the last three by G. J. Brush.

Daubenton, Tabl. Tableaux méthodique des Minéraux. Paris, 1784. Only a classified catalogu Several subsequent editions were issued, the 6th in 1799.

Davila, Cab. Catalogue syst. et raisonné des Curiosités de la Nature et de l'Art qui compose le Cabinet de M. Davila. 3 vols., 8vo, Paris, 1767.

Delameth., Sciagr. New edition of Mougez's Sciagraphie (Fr. trl. of Bergmann's Sciagr., wit additions); by J. C. Delamétherie. 2 vols., 8vo, Paris, 1792.

Delameth., T. T. Théorie de la Terre; by id. 2d ed., 5 vols., Paris, 1797; vols. 1, 2, of th edition contain his Mineralogy.

Delameth., Min. Leçons de Mineralogie; by id. 8vo, vol. 1, 1811; 2, '12, Paris.

DE LISLE, CRIST., 1772. Essai de Cristallographie; by Romé de l'Isle. 8vo, Paris, 1772.

De Lisle, Crist., 1783. Cristallographie, ou Description des formes propres à tous les corps Regne minéral; by id. Called 2d edition of the preceding. 4 vols., 8vo, Paris, 1783.

Demeste Lettres. Lettres sur la Minéralogie; by Dr. Demeste. 2 vols., 16mo, 1779.

Descl., Min. Manuel de Minéralogie; by A. DesCloizeaux. 8vo, Paris, vol. 1, 1862.

Descl. Quartz. Mémoire sur la Cristallisation et la Structure intérieure du Quartz; by A. De cloizeaux. 212 pp., 4to, with 5 folded plates, Paris, 1858.

Dioscor. Dioscorides Περί ὕλης ἰατρικῆς (Materia Medica), written about A.D. 50. In the miner part treats especially of the medical virtues of minerals, but often gives also short descri tions. Not alluded to among the many references in Pliny, but evidently cited from.

Domeyko, Min., 1845, 1860. Elementos de Mineralogia; by I. Domeyko. 8vo, Chili, 1st ed Serena, 1845; 2d ed., Santiago, 1860.

Domeyko, Tratado de Ensayes; by id. 2d ed., 8vo, Valparaiso, 1858.

Dufr., Min., 1844, 1856–1860. Traité de Minéralogie; by A. Dufrénoy. 4 vols., 8vo (the las of plates), Paris, 1844; 2d ed., 5 vols.; 1, 2, 3, '56; 4, '59; 5, '60.

Emmerling, Min. Lehrbuch der Mineralogie; by L. A. Emmerling. 8vo, Giessen, 1st ed 1793-'97; 2d ed., '99, 1802.

Ercker, Aula Subt. Aula Subterranea (on Ores, Mining, and Metallurgy); by L. Ercke Written in 1574, published in 1595.

Erdmann, Min. Lärobok i Mineralogien; by A. Erdmann. 8vo, Stockh., 1853.

Erdmann, Dannemora Jernm. Dannemora Jernmalmsfält, etc.; by A. Erdmann. 12m Stockholm, 1851. Also Utö Jernm., 1856.

Estner, Min. Versuch einer Mineralogie. 3 vols. in 5 parts, 8vo, Wien, 1794–1804.

Estner, über Werner's Verbess. in Min. Freymüthige Gedanken über Herrn Inspector Werner's Verbesserungen in der Mineralogie, nebst einigen Bemerkungen über Herrn Assessor Karstens Beschreibung des vom sel. Leske Mineralien-Cabinetts; by Abbé Estner. 64 pp., 18mo, Wien, 1790.

Fabricius, Met. De rebus metallicis ac nominibus observationes variæ, etc., ex schedis Georgii Fabricii. Tiguri, 1566. Issued with an edition of Gesner's Foss.

Faujas, Volc. Viv. Recherches sur les Volcans éteints du Vivarais et du Velay; by Faujas de St. Fond. Fol., Grenoble et Paris, 1778. By the same, Minéralogie des Volcans, 8vo, Paris, 1784.

Fors., Min. Minerographia; by Sigfrid Avon Forsius. 16mo, Stockholm, 1643.

Gallitzin, Dict. Min. Recueil de noms par order alphabétique aproprîés en Mineralogie; by D. de Gallitzin. Sm. 4to, Brunswick, 1801.

Gesner, Foss. De omni rerum fossilium genere, Gemmis, Lapidibus, Metallis, etc.; opera Conradi Gesneri. Tiguri, 1565.

Glocker, Handb., 1831, 1839. Handbuch der Mineralogie; by E. F. Glocker. 8vo, Nürnberg, 1831; 2d edit., 1839.

Glocker, Syn. Generum et Specierum Mineralium secundum Ordines Naturales digestorum Synopsis; by id. 8vo, Halle, 1847.

GMELIN, MIN. Einleitung in die Mineralogie; by J. F. Gmelin. 8vo, Nürnberg, 1780. By the same, Grundriss einer Min. 8vo, Göttingen, 1790.

Greg & Lettsom, Min. Manual of the Mineralogy of Great Britain and Ireland; by R. P. Greg and W. G. Lettsom. 8vo, London, 1858.

Gurlt, Kunstl. Min. Uebersicht der pyrogenneten künstlichen Mineralien, namentlich der krystallisirten Hüttenerzeugnisse; by Dr. A. Gurlt. 8vo, Freiberg, 1857.

H., Tr., 1801, 1822. Traité de Minéralogie; by C. Haüy. A 4to ed. of 4 vols., with atlas in fol.; also an 8vo ed., Paris: 1801; 2d ed., 4 vols., 8vo, with fol. atlas, 1822.

H., Crist. Haüy Traité de Cristallographie; by id. 2 vols., 8vo, in 1822.

H., TABL. COMP. Tableau Comparatif des résultats de la Cristallographie et de l'analyse chimique relativement à la classification des Minéraux; by id. 8vo, Paris, 1809.

Haid., Min. Mohs. Treatise on Mineralogy, by F. Mohs; trl., with considerable additions, by Wm. Haidinger. 3 vols., 8vo, Edinburgh, 1825.

Haid., Min. Anfangsgründe d. Min.; by id. 8vo, Leipz., 1829.

Haid., Handb. Handbuch d. bestimmenden Mineralogie; by id. 8vo, Wien, 1845.

Haid., Ueb. Uebersicht der Resultate Mineralogischer Forschungen im Jahre 1843; by id. Erlangen, 1845.

Hausm., Versuch. Versuch eines Entwurfs zu eines Einleitung in die Oryktognosie; by J. F. L. Hausmann. 8vo, Braunschweig, 1805; Cassel, '09.

Hausm., Handb., 1813, 1847. Handbuch der Mineralogie; by id. 3 vols., 12mo, Göttingen, 1813; 2d ed., 1st vol., introductory, '28; 2d, in two parts, '47.

Henckel, Pyrit. Pyritologia, oder Kiess-Historie; by J. Fr. Henckel (of Saxony). 8vo, Leipzig, 1725.

Hessenberg, Min. Not. Mineralogische Notizen; by Fr. Hessenberg. 4to, with plates, Nos. 1–8, 1854–'68. (From the Abhandl. d. senkenbergischen naturforschenden Gesellschaft in Frankfurt a. M., vols. ii to vii.) No. 7 contains an index to the first seven.

HIÆRNE, ANLEDN. Kort Anledning til äskällige Malm och Bergarters, Mineraliers, etc; by Urban Hiaerne. Stockholm, 1694.

His., Min. Geogr. Swed. Mineralogisk Geografi öfver Sverige; by W. af. Hisinger. 8vo, Stockholm, 1808. **Also**

His. Min. Geogr. Wöhler. Versuch einer mineralogischen Geographie von Schweden, übersetzt von F. Wöhler. 8vo, Liepzig, 1826.

His. Handbok. Handbok för Mineraloger under Resor i Sverige; by W. Hisinger. 8vo, Stockholm, 1843.

Hill, Foss. Fossils arranged according to their obvious characters; by John Hill. 8vo, London, 1771. (De Lisle says it was not issued till 1772.)

Hoff, Mag. Magazin für die gesammte Min., etc.; by K. E. A. v. Hoff. 1 vol., 8vo, Leipzig, 1801.

Hofmann, Min. Handb. d. Mineralogie; by C. A. S. Hofmann. 4 vols., 8vo, Freiberg. Vol. 1, 1811; 2, part *a*, '12, *b*, '15; 3, parts *a*, *b*, '16; 4, part *a*, '17, *b*, '18. Work, after 2d vol., part *a*, issued by Breithaupt, Hofmann having died March, 1813. Vol. 4, part *b*, consists of notes and additions by Breithaupt, and includes also the Letztes Min. Syst. of Werner (1817).

Huot, Min. Manuel de Minéralogie; by J. J. N. Huot. 2 vols., 16mo, Paris, 1841.

Jameson, Min., 1804, 1816, 1820. A System of Mineralogy; by R. Jameson. 8vo, Edinburgh; 1st ed., 2 vols., 1804; 2d, 3 vols, '16; 3d, 3 vols, 1820.

Published also a Manual of Min., 8vo, in 1831; and Mineralogy according to the Natural System (from Encycl. Brit.), in 1837. Also, in 1805, a Treatise on the External Characters of Minerals, 8vo, Edinburgh.

Jasche, Kl. Schrift. Kleine min. Schriften; by C. F. Jasche. 12mo, Sondershausen, 1817.

John, Untersuch. Chemische Untersuchungen mineralischer, etc., Substanzen; by J. Fr. Joh 8vo, Berlin, Fortsetzung d. chem. Laboratoriums, Berlin, which makes vol. 1 of series vol. 2, 1810; 3, 1813; 4, 1816; 6, 1821.

Karsten, Mus. Lesk. Museum Leskeanum, Regnum minerale; by D. L. G. Karsten. 2 vols, 8v Leipzig, 1789.

Karst., Tab., 1791. Tabellarische Uebersicht der mineralogisch-einfachen Fossilien; by id. Fol Berlin, 1791.

Karst., Tab., 1800, 1808. Mineralogische Tabellen; by id. Fol., Berlin, 1800; 2d ed., fol. Berlin, 1708.

Karst., Wern. Verbess. Min. Ueber Herrn Werners Verbesserungen in der Mineralogie au Veranlassung der freimüthigen Gedanken, etc., des Herrn Abbé Estner; by id. 80 pp. 12mo, Berlin, 1793.

Kenng., Ueb. Uebersichte der Resultate mineralogischer Forschungen; by G. Ad. Kenngott For the years 1844–'49, Wien, 1852; for years 1850–'51, Wien, 1853; for '54, Wien, 1854; for '53, Liepzig, 1855; for '54, ib., 1856; for '55, ib., 1856; for '56, '57, ib., 1858; fo '58, ib., 1860; for '59, ib., 1860; for '60, ib., 1862; for '61, ib., 1862; for '62–'65, ib., 186 [The last was received just as this volume was leaving the press.]

Kenng., Min., 1853. Das Mohs'sche Mineralsystem; by id. 8vo, Wien, 1853.

Kirwan, Min. Elements of Mineralogy; by R. Kirwan. 2 vols., 8vo, London, 2d edition, 1794. 1st ed. was issued in 1784, 8vo.

Klapr., Beitr. Beiträge zur chemischen Kenntniss d. Mineralkörpers; by M. H. Klaproth. 8vo, vol. 1, 1795; 2, '97; 3, 1802; 4, '07; 5, '10; 6, '15.

Kob., Char. Charakteristik d. Mineralien; by Fr. von Kobell. 8vo, Nürnberg, Abth. 1, 1830; 2, 1831.

Kob., Min. Grundzüge d. Mineralogie; by id. 8vo, Nürnberg, 1838.

Kob., Taf., 1853. Tafeln zur Bestimmung d. Mineralien; by id. 5th ed., München, 1853. The 8th edit. appeared in 1864.

Kob. Min.-Namen. Die Mineral Namen; by id. 8vo, München, 1853.

Kob., Gesch. Min. Geschichte d. Min.; by id. 8vo, München, 1864.

Koksch., Min. Russl. Materialen zur Mineralogie Russlands; by N. v. Kokscharof. 8vo, St. Petersburg, vol. 1, 1853, '54; 2, '54–'57; 3, '58; 4, '61–'66; 5, still incomplete. Also by same author, Vorlesungen über Mineralogie. Vol. 1, 4to, St. Petersburg, 1865.

Kopp, Gesch. Ch. Geschichte d. Chemie; by H. Kopp. 4 parts, 8vo, Braunschweig, 1843–'4

Kronstedt. See Cronstedt.

Lampadius, Samml. Sammlung practisch-chemischer Abhandlungen; by W. A. Lampadius. 3 vols., 8vo, Dresden; vol. 1, 1795; 2, 1797; 3, 1800.

Lenz, Min. Versuch einer vollständigen Anleitung zur Kenntniss der Mineralien; by D. G. J. Lenz. 2 vols., 8vo, Leipzig, 1794. By the same, Tabellen, 1781; Handbuch, 1791; Grundriss, 1793; Mustertafeln, 1794; Tabellen, fol., 1806; System, 1800, 1809; Handbuch, 1822.

Leonh., Syst.-Tab. Systematisch-tabellarische Uebersicht und Char. d. Mineralkörper; by C. C Leonhard, K. F. Merz. and J. H. Kopp. Fol., Frankfurt a. M., 1806.

Leonh., Orykt. Handbuch der Oryktogonosie; by K. C. Leonhard. 8vo, Heidelberg, 1821. Also 2d ed., 8vo, Heidelberg, 1826.

Leonh., topogr. Min. Handwörterbuch d. topographischen Mineralogie; by G. Leonhard. Heidelberg, 1843.

Levy's Heuland. Description d'une collection de Minéraux, formée par M. Henri Heuland, et appartenant à M. Ch. H. Turner, de Rooksnest, dans le comté de Surrey en Angleterre; by A. Levy. 3 vols., 8vo, with an atlas of 83 pl., London, 1837.

Libavius, Alchem. Alchemia, A. Libaviæ. Frankfurt, 1597.

Linn., Syst. Nat. Systema Naturæ of Linnæus. 1st edit., 1735; 10th ed., T. 3, 1770.

Lucas, Tabl. Tableau méthodique des Espèces Mineraux; by J. A. H. Lucas. Part 1, 8vo, 1806; 2, 1813, Paris. The first part contains brief descriptions taken from Haüy's work, and also from his subsequent lectures and published announcements of his courses. The second includes in the main Haüy's Tabl., with many additional notes.

Ludwig's Min, or Ludwig's Wern. Handbuch d. Mineralogie nach A. G. Werner; by C. F. Ludwig. 2 vols., 8vo, Leipzig, 1803, '04.

Marx, Crystallkunde. Geschichte der Crystallkunde; by Dr. C. M. Marx. 8vo, Carlsruhe and Baden, 1825.

Matthesius, Sarepta. Berg Postilla, oder Sarepta; by J. Matthesius. Fol., Nürnberg, 1562.

Mohs, Null Kab. Des Herrn J. F. Null Mineralien-Kabinet, nach einem, durchaus auf äussere Kennzeichen gegründeten Systeme geordnet; by F. Mohs. 3 Abthl., 8vo, Wien, 1804.

Mohs, Char. Characteristic of the Natural History System of Mineralogy; by id. 8vo, Edinburgh, 1820.

Mohs, Min., 1822. Grund-Riss der Mineralogie; by id. 8vo, vols. 1, 2, 1822, '24, Dresden (Translated into English by W. Haidinger. See Haid.)

Mohs, Min., 1839. Anfangsgründe der Naturgeschichte des Mineralreichs; by F. Mohs Zweiter Theil bearbeitet von F. X. M. Xippe; 8vo, Wien, 1839 (Erster Theil, introductory, published in 1836). A first edition of this work in 1832.

Mont. & Cov., Min. Prodromo della Mineralogia Vesuviana; vol. 1, Orittognosia. 8vo, Napoli, 1825.

Napione, Min. Elementi di Mineralogia: by Napione. 8vo, Turin, 1779.

Naumann, Kryst. Lehrbuch der Krystallographie; by C. F. Naumann. 2 vols., 8vo, with numerous figs., Leipzig, 1829. Naumann has since published the smaller works, Anfangsgründe der Kryst., 8vo, 1854; Elemente der Theoretischen Kryst., 8vo, 1856.

Naumann, Min. Elemente der Mineralogie. 8vo, Liepzig, 1st ed., 1846; 2d., 50; 3d ed., '52; 4th, '55; 5th, '59; 6th, '64. Naumann published Lehrbuch der Min., 8vo, Berlin 1828.

Necker Min. Le regne minéral ramené aux méthodes de l'histoire naturelle; by L. A. Necker 2 vols., 8vo, Paris, 1835.

Nicol, Min. Manual of Mineralogy; by J. Nicol. 8vo, Edinb., 1849.

Nöggerath, Min. Stud. Geb. Nederrhein. Mineralogische Studien über die Gebirge am Niederrhein; by J. J. Nöggerath. 8vo, Frankfurt a. M., 1808.

A. E. Nordensk., Finl. Min. Beskrifning öfver de i Finland funna Mineralier; by A. E. Nordenskiöld. 8vo, Helsingfors, 1855. **Also** 2d ed., ib, 1863.

N. Nordensk., Finl. Min. Bidrag till närmare Kännedom af Finlands Mineralier och Geognosie; by Nils Nordenskiöld. 8vo, Stockholm, 1820.

N. Nordensk Verz. Verzeichn. d. in Finland gef. Min.; by id. Helsingfors, 1852.

Plattner, Probirk. Die Probirkunst mit dem Löthrohr; by C. F. Plattner. Last ed. by T. Richter, 8vo, 1865.

Plin. Historia Naturalis C. Plinii Secundi. First published A.D. 77. Latin ed. consulted, Sillig's, in 8 vols., 1851–'58; and English, that of Bostock & Riley, 5 vols., 12mo, London, 1855. Pliny's Natural History is divided into xxxvii Books; and these into short chapters. The numbering of the chapters differs somewhat in different editions; that stated in the references is from the English edition. The last five books are those that particularly treat of metals, ores, stones, and gems.

Phillips, Min., 1823, 1837. Elementary Introduction to Mineralogy. 8vo, 3d ed., London, 1823. 4th ed. by R Allan, 8vo, 1837. The 1st ed. appeared in 1816; and this was republished in New York, in 1818. For Alger's Phillips, see Alger.

Quenstedt, Min. Handbuch der Mineralogie; by F. A. Quenstedt. 8vo, Tübingen, 1853. **Also** 2d ed., ib., 1863.

Ramm., Handw. Handwörterbuch des chemischen Theils der Mineralogie; by C. F. Rammelsberg. 8vo, Berlin, 1841. Supplement 1, '43; 2, '45; 3, '47; 4, '49; 5, '53.

Ramm., Min. J. J. Berzelius's neues chemisches Mineralsystem; by id. 8vo, Nürnberg, 1847.

Ramm., Min. Ch. Handb. d. Mineralchemie; by id. 8vo, Leipzig, 1860.

Rashleigh, Brit. Min. Specimens of British Minerals selected from the cabinet of Philip Rashleigh (descriptions and colored plates). 4to, London. Part 1, 1797; 2, 1802.

Rep. G. Cal. Report on the Geology of California; by J. D. Whitney. Large 8vo, San Francisco, 1865.

Rep. G. Can. Annual Reports on the Progress of the Geological Survey of Canada; by Sir Wm. E. Logan. Containing reports on mineralogy by T. S. Hunt. 8vo, 1845–'59. In 1863 a General Report for the years 1843–'63.

Rep. G. Mass. Report on the Geology of Massachusetts; by E. Hitchcock. 1st Rep., 1833, 8vo; 2d ed., 1835. 2d Rep., 1841, 4to.

Rep. G. N. Y. Reports on the Geological Survey of New York. Annual Reports in 8vo, 1837–'41; final in 4to.

Rep. Min. N. Y. Report on the Mineralogy of the State of New York; by L. C. Beck. 4to, 1842.

Reuss, Min. Lehrbuch d. Mineralogie; by F. A. Reuss. 8vo, 1801–'05, Leipzig. Divided into parts, and the parts into vols. Pt. 1 and pt. 2, vol. 1, 1801; vol. 2, '02; vol. 3, 4, '03; 3d pt., vol. 1, 2, '05; 4th pt., including index, '06.

Rio, Orykt. Elementos de Oryktognosia, ó del Conocimiento de los Fósiles, dispuestos segun los principios de A. G. Werner; by A. M. del Rio. 4to, Mexico, 1795.

Rio, Min. Nuevo Sistema Minerale; by id. Mexico, 1827.

Rio, Tabl. Min. Tablas mineralogicas por D. L. G. Karsten; by A. M. del Rio. 4to, Mexico, 1804.

Robinson, Cat. Catalogue of American Minerals, with their Localities; by S. Robinson. 8vo, Boston, 1825.

Rose, Reis. Ural. Reise nach dem Ural, dem Altai, und dem Kaspischen Meere; by Gustav Rose. 8vo, Berlin; vol. 1, 1837; 2, '42.

Rose, Kryst.-Ch. Min. Das Krystallo-chemischen Mineral-System; by G. Rose. 8vo, Leipzig, 1852.

Sage, Min. Elémens de Minéralogie docimastique; by B. G. Sage. 2d ed., 2 vols., 1777. 1st ed. appeared in 1772.

Saussure, Voy. Alpes. Voyages dans les Alpes, par H. B. Saussure. 4 vols., 4to. Vols. 1, 2, 1779, '80: 3, 4, '96.

Scacchi, Mem. Min. e Geol. Memorie mineralogiche e geologiche; by A. Scacchi. 8vo, Napoli, 1841.

Scacchi, Crist. Quadri Cristallografici, e Distribuzione sistematica dei minerale; by id. 8vo, Napoli, 1842.

Scacchi, Mem. Geol. Campania. Memorie geologiche sulla Campania; by id. 4to, Napoli, 1849. By the same, Memoria sulla Incendio Vesuviano, 1855. Napoli, 1855. Polisimmetria dei Cristalli. 4to, 1864.

Schrauf. Atlas Kryst. Atlas der Krystall-Formen des Mineralreichs; by Dr. A. Schrauf. 4to, 1 Lief., Wien, 1865.

Schumacher, Verz. Versuch eines Verzeichnisses der in den Dänisch-Nordischen Staaten sich findenden einfachen Mineralien. 4to, Copenhagen, 1801.

Schutz, Nordamer. Foss. Beschreibung einiger Nordamerikanischen Fossilien; by A. G. Schütz, of Freyberg. 16mo, Liepzig, 1791. Contains the first notice of *celestine*, a mineral named by Werner from Schütz's American specimens.

Sella, Min. Sarda. Studii sulla Mineralogia Sarda; by Quintino Sella. 4to, Turin, 1856.

Shep., Min., 1832–1835, 1844, 1852, 1857. Treatise on Mineralogy; by C. U. Shepard. 1st part, 1 vol., 12mo, New Haven, 1832; 2d part, 2 vols., New Haven, 1835. **Also**, 2d ed. (with only the 1st part revised), New Haven, 1844. **Also**, 3d ed., 8vo, New Haven, No. 1, 1852; No. 2, '57.

Shep., Min. Conn. Report on the Geological Survey of Connecticut; by id. 8vo, N. Haven, 1837.

Steffens, Handb. Handb. d. Oryktognosie; by H. Steffens. 3 vols., 18mo, Halle; vol. 1, 1811; 2, '15; 3, '19.

Stromeyer, Unt. Untersuchungen über die Mischung der Mineralkörper, etc.; by Fr. Stromeyer. 8vo, Göttingen, 1821.

Theophr. Theophrastus Περί λίθων (on Stones); written about 315 B.C. Only a portion of the whole work is extant, but sufficient to show that the author was precise in his knowledge of minerals and careful in the statement of facts. T. born about 371 B.C., and d. 286 B.C.

Thomson, Min., 1802, 1836. Outlines of Mineralogy, Geology, and Mineral Analysis; by T. Thomson. 2 vols., 8vo, London, 1836. A treatise on Mineralogy published also with preceding editions of his Chemistry, the earliest in 1802.

Ullmann, Syst.-tab. Ueb. Systematisch-tabellarische Uebersicht der min.-einfachen Fossilien; by J. C. Ullmann. Small 4to, Cassel and Marburg, 1814.

Volger, Studien, etc. Studien zur Entwicklungsgeschichte der Mineralien; by G. H. O. Volger. 8vo, Zürich, 1854. Other works: Entwickl. der Min. d. Talk-Glimmer Familie, 1855; Arragonit und Kalcit, 1855; Monographie des Borazites, Hannover, 1855; Epidot und Granat, Beobachtungen über das gegenseitige Verhältniss dieser Krystalle, Zürich, 1855; Krystallographie, Stuttgart, 1854.

Vogl's Joach. Gangverhältnisse und Mineralreichthum Joachimsthals; by J. Fl. Vogl. 8vo, Teplitz, 1857.

Wall., or **Wall., Min.** Mineralogia, eller Mineralriket; by J. G. Wallerius. 12mo, Stockholm, 1747.

Wall., Fr. Trl. French edition of Wallerius's Min. of 1747. 2 vols., 8vo, Paris, 1753. Published anonymously.

Wall., Min., 1772, '75. Systema Mineralogicum. 8vo, Holmiæ, vol. 1, 1772; 2, '75.

Wall., Min., 1778. Syst. Min. 2 vols., 8vo, Vienna, 1778.

Waltersh., Vulk. Gest. Ueber die vulkanischen Gesteine in Sicilien und Island (Iceland), und ihre submarine Umbildung; by W. Sartorius v. Waltershausen. 8vo, Göttingen, 1853.

Watts Dict. Ch. Dictionary of Chemistry; by H. Watts. 4 vols., 1863, '64, '65, '66; a fifth yet to be issued.

Wern., Auss. Kennz. Foss. Von d. äusserlichen Kennzeichen d. Fossilien; by A. G. Werner. 8vo, Leipzig, 1774.

Wern., Ueb. Cronst. Kronstedt's Versuch einer Min. übersetzt und vermehrt von A. G. Werner. Vol. 1, part 1. Leipzig, 1780.

Wern., Min.-Kab. Pabst. Verzeichniss des Mineralien Kabinets des Herrn K. E. Pabst von Ohain; by A. G. Werner. 2 vols., Freiberg, 1791, '93.

Wern., Letzt. Min. Syst. Letztes Mineral-System. 8vo, Freiberg & Wien, 1817. A Catalogue with notes. Werner or his scholars issued, from time to time, a tabular synopsis of his Mineral system revised to the time of publication, on folio sheets, or published them in other works. The earliest after that of Werner's Cronstedt was issued by Hofmann in Bergm. J., 1789, vol. 1, p. 369. Emmerling's Min., i. 1799, contains the synopsis of 1798, and Ludwig's Min. contains that of 1800 and 1803. Leonhard's Tasch., iii. 261, that of 1809.

Westrumb, Kl. Phys.-Ch. Abh. Kleine physikalisch-chemische Abhandlungen; by J. F. Westrumb. 8vo, Leipzig, vol. 1, 1785; 2, '87; 3, '88; 4, '89; Hannover, 5, 6, '93; 7, '95; 8, '97.

Withering, Trl. Bergm. Sciagr. Outlines of Mineralogy, trl. from the original of Bergmann; by Wm. Withering. 8vo, 1783 (Reprinted in vol. 2 of Mem. and Tracts of the late Dr. Withering, London, 1822).

Whitney, Lake Sup. Report on the Geology of the Lake Superior Land District; by J. W. Foster and J. D. Whitney. 8vo, Part 1, 1850; 2, '51.

Whitney, Met. Wealth. The Metallic Wealth of the United States, described and compared with that of other countries; by J. D. Whitney. 8vo, Philadelphia, 1854.

Whitney, Miss. Lead Region. Report of a Geological Survey of the Upper Mississippi Lead Region; by id. (Made by authority of the State of Wisconsin.) 8vo, 1862.

Whitney, Rep. G. Cal. See Rep. G. Cal.

Whitney, Berz. Blowpipe. Berzelius on the Blowpipe; translated by J. D. Whitney. 8vo, Boston, 1845.

WOODWARD, FOSS. Fossils of all kinds digested into a Method suitable to their mutual Relation and Affinity. 8vo, London, 1728.

Zepharovich, Min. Lex. Mineralogisches Lexicon für das Kaiserthum Oesterreich; by V. R. v. Zepharovich. 8vo, Wien, 1859.

The works in the above catalogue which are most important for the study of the history of mineral species are the following, the order cited being that of time:

Theophrastus; Dioscorides; Pliny's Natural History; Agricola's works; Linnæus's Systema Naturæ, 1st ed., 1735; Wallerius's Mineralogy in the original Swedish, 1747 (the first systematic, descriptive work, following in its system of classification mainly the 1st edition of Linnæus, which the author alludes to in his preface, among other Swedish works by Forsius, Hiærne, Bromell, and Swedenborg); Cronstedt's Mineralogy, 1757 (a new chemical system); Linnæus's Systema Naturæ, 10th ed., 1768; Romé de Lisle's Crystallographie, 1772, 1783 (the first systematic effort to apply the principles of crystallography to the science); Wallerius's Min. of 1772, 1778 (the system and facts are little changed from the earlier edition); Werner on the External Characters of Minerals, 1774, and his Cronstedt, 1780; Bergmann's Opuscula, 1780, and Sciagraphia, 1782; Hofmann's exposition of Werner's system in the Bergm. J., 1789; Emmerling's Mineralogy, 1793–'97, and 1799–1802; Lenz's Mineralogy, 1794; Klaproth's Beiträge, 1795–1810; Karsten's Tabellen, 1800; Haüy's Treatise on Mineralogy, 1801; Reuss's Mineralogy, 1801–1806; Ludwig's Werner, 1803, 1804; Mohs's Null Kab., 1804; Karsten's Tabellen, 1808; Lucas's Tableau, part 1, 1806 (giving views of Haüy of 1801 and 1801 to 1806); Brongniart's Mineralogy, 1807; Haüy's Tableau comparatif, 1809; Hausmann's Handbuch, 1813; Hoffmann's Mineralogie, 1811–1817; Ullmann's Uebersicht, 1814; Jameson's Mineralogy, 1816, 1820; Werner's Last Mineral System (Letztes, etc.), 1817; Cleaveland's Mineralogy, 1816, 1822; Berzelius's Nouv. Système, 1819; Leonhard's Handbuch, 1821, 1826; Mohs's Mineralogy, 1822; Haidinger's translation of Mohs, 1824; Breithaupt's Charakteristik, 1820, 1823, 1832; Beudant's Treatise, 1824, 1832; Phillips's Min., 1823, 1837; Glocker's Min., 1831, 1839; Shepard's Min., 1832–'35, and later editions; von Kobell's Grundzüge, 1838; Mohs's Min., 1839; Breithaupt's Min., 1836–1847; Haidinger's Handbuch, 1845; Hausmann's Handbuch, 1847; Dufrénoy's Min., 1844–1847 (also 1856–1859); Glocker's Synopsis, 1847; Brooke & Miller, 1852; von Kobell's Tafeln, 1853; Rammelsberg's Handwörterbuch and Supplements, 1841–1853; Kenngott's Uebersicht, 1844–1865 DesCloizeaux's Mineralogy, 1862; von Kobell's Geschichte, 1864.

7. Annotated Index to the Useful Metals and Metallic Ores.

GOLD.—*Native Gold* (1).* Distinguished from all minerals it resembles by its flattening und a hammer; its cutting like lead, although considerably harder; its resisting the action of nitr acid, hot or cold; its high specific gravity.

Gold also occurs in *Gold Amalgam* (11), *Sylvanite* (98), *Nagyagite* (99), *Petzite* (58A), and *Cal verite* (Supplement). Also sometimes in traces in Pyrite, Galenite, Chalcopyrite. Native Telluriu

PLATINUM.—IRIDIUM.—PALLADIUM.—*Native Platinum* (3), the source of the platinu of commerce, is distinguished by the same tests as gold; and it is mainly on account of its ma leability that it occurs in flattened grains or scales. *Platiniridium* (4) is another ore somewha harder. *Iridosmine* (7) resembles platinum; but it scratches glass, and gives the reaction o osmium, besides being rather brittle. *Native Palladium* (5).

SILVER.—The important Silver minerals are: *Native Silver* (2), sectile and malleable like gol the only one that has a white color; *Argentite* or *Sulphuret of Silver* (40), blackish lead-gra cutting (unlike the following) nearly like pure lead, cubic in crystallization; *Pyrargyrite* an *Proustite* or Ruby Silver ore (117, 118), ruby red to black, always giving a bright red powder *Freieslebenite* or Gray Silver ore (114), steel-gray, rather brittle, and powder steel-gray; *Stephani* or Brittle or Black Silver ore (130), iron-black, and giving an iron-black powder; *Cerargyrite* o *Horn Silver* (140), resembling a dark-colored gray or greenish wax, and cutting like wax; *Embolite* or Chloro-bromid of Silver (141), like the last, but more greenish. These ores yield silve easily, when heated on charcoal. Besides these, *Tetrahedrite* or Gray Copper (125) is often valuable silver ore; *Galenite* (44), which, although seldom yielding over seventy-five ounces t the ton, affords a considerable part of the silver of commerce. For other rarer silver minerals see 35, 36, 41, 42, 58–60, 62, 63, 98, 99, 108, 111, 115, 116, 120, 131, 133, 142, 143.

COPPER.—The more valuable species are: *Native Copper* (12); *Chalcopyrite* or *Copper pyrite* (78), of a brass-yellow color, scratched easily with the point of a knife-blade, and giving a greenish black powder; *Barnhardtite* (79) and *Cubanite* (77), which are similar to the last, but paler; *Bornite* or *Purple Copper* (49), pale yellowish, with a slight coppery tinge, but tarnishing externally to purple, blue, and reddish tints, easily scratched with a knife-blade, and powder grayish; *Chalcocite* or *Vitreous Copper* (61), of a dark lead-gray color, and powder similar, resembling some silver ores, but yielding copper and not silver when heated on charcoal; *Tetrahedrite* or *Gray Copper* (125), of a somewhat paler steel-gray color and powder; *Red Copper* (172); *Black Copper* (178); *Malachite* or *Green Carbonate of Copper* (751), of a bright green color, sometimes earthy in the fracture and sometimes silky; *Azurite* or *Blue Malachite* (752), of a rich deep blue color, either earthy or vitreous in lustre. All the above are acted on by nitric acid, and the solution deposits a red coating of copper on a strip of polished iron; *Chrysocolla* (346), a silicate of copper, resembling the Green Carbonate, but paler green, and usually having a close texture (never fibrous), a smoother surface and somewhat waxy lustre, although occurring usually as an incrustation; *Atacamite* or Chlorid of Copper (153), of deeper green than Malachite; *Sulphate of Copper* (669). For rarer minerals containing copper, see 37, 38, 39, 42, 43, 46, 50, 51, 62, 80, 82, 100–103, 110, 119, 121, 124, 126, 154 (sulphids, arsenids, etc.); 218, 345 (silicates); 533–536, 538–548, 567, 583, 615, 622, 623, 636, 639, 644, 665, 670, 700, 705, 706, 708 (phosphates, arsenates, sulphates); 750, 755 (carbonates).

QUICKSILVER.—The only valuable ore is Cinnabar (64) of a bright red to brownish-black color, with a red powder, and affording quicksilver when heated in an open tube. There are also Native Quicksilver (8); Amalgam (9); Selenid (65); Chlorid and Iodid (136, 144). Tetrahedrite (125) sometimes contains this metal.

LEAD.—*Galenite* (44) is the only abundant lead ore; it is a lead-gray, brittle ore, yielding lead when heated with charcoal. The carbonate (cerussite, 729), phosphate (pyromorphite, 493), arsenate (mimetite, 494), and sulphate (anglesite, 633), are rarely worked as ores. For other lead minerals, see 41, 45, 46, 47, 99, 105–107, 111–114, 119, 122–124, 126, 128, 129 (sulphids, antimonids, etc.); 145, 150–152 (chlorids); 177, 197 (oxyds); 502, 539 (arsenates); 505 (antimonate); 556 (phosphate); 616 (tungstate); 617 (molybdate); 619–621, 623 (vanadates); 635, 636, 638, 641, 700 (sulphates); 642–645 (chromates); 712 (selenate); 715, 733 (carbonates).

---

* The numbers refer to the number of the species.

ZINC.—The most important ores are: 1, *Smithsonite* or *Carbonate of Zinc* (723), and 2, *Calamine* or *Silicate of Zinc* (361); they are alike in a white, grayish-white, or greenish-white color, commonly a slight waxy lustre and smooth look (often stalactitic or mammillary), yet sometimes earthy; and a hardness such that the surface is scratched with a knife-blade with some little difficulty. They differ in their action with muriatic acid; when the surface is drusy, the silicate shows projections of minute rectangular prisms. *Zincite* or *Red Zinc Ore* (176) is also important; it is bright red and very distinctly foliated. *Blende* or Sulphid of Zinc (56) is a common ore, having a yellow to black color and resinous lustre, and distinctly cleavable; the black varieties are sometimes a little metallic in lustre, but the powder is nearly or quite white. For other Zinc minerals, see 185, 188 (oxyds); 70 (sulphid); 57 (oxysulphid); 238, 241, 266, 270 (silicate); 634, 666 (sulphate); 500 (phosphate); 530, 537 (arsenate); 749, 750 (carbonate).

COBALT, NICKEL.—The ores of cobalt: *Smaltite* (83) and *Cobaltite* (85), both of nearly a tin-white color, with the powder grayish-black, color sometimes verging slightly to gray. The *Black Oxyd of Cobalt* (218), a kind of bog ore and very impure, is sometimes sufficiently abundant to be valuable. The useful ores of nickel are *Chloanthite* or the niccoliferous smaltite (83), *Gersdorffite* or *Nickel Glance* (86), *Niccolite* or *Copper Nickel* (71), distinguished by a pale copper-red color, and *Niccoliferous Pyrrhotite* (68), from which the larger portion of the nickel of commerce is extracted. For other ores of *Cobalt*, see 53, 81, 82, 84, 95, 97 (sulphids and arsenids); 618 (molybdate); 667 (sulphate); 526, 529, 530 (arsenate); 748 (carbonate); of *Nickel*, 54, 66 (sulphid); 74, 87, 88 (arsenical or antimonial); 416 (silicate); 668 (sulphate); 527, 529, 530 (arsenate); 747 (carbonate).

MANGANESE.—Common, as *Pyrolusite* (199) and *Psilomelane* (217), both black or grayish-black ores, and having little lustre, and a blackish streak or powder, in which last particular they are distinct from the iron ore called Limonite, with which they are often associated, and also from Hematite or Specular Iron. *Wad* (218) is an earthy bog manganese, sometimes abundant and valuable. *Manganite* (205) is abundant in certain mines, but is of little value in the arts, because of its containing so little oxygen (one-third less than Pyrolusite), to which fact Beudant alludes in his name for the species, *Acerdese;* it differs from pyrolusite in its reddish-brown powder. For other manganese ores, see 52, 76 (sulphid); 73 (arsenid); 195, 196 (oxyds); 241, 262, 263 269, 491 (silicates); 498, 499, 531 (phosphates); 532 (arsenate); 663, 679, 680 (sulphates); 717, 721, 722, 725 (carbonates).

CHROMIUM.—*Chromic Iron* (189), a grayish-black, little lustrous ore, occurring mostly in Serpentine, is the source of chrome in the arts. For different chromates, see p. 614.

IRON.—The important iron ores are: *Hematite* or *Specular Iron* (the αἱματίτης or *bloodstone* of Theophrastus) (180), characterized by its blood-red powder, and occurring either earthy and red, or metallic and dark steel-gray; in the latter condition very hard, a knife-point making no impression; *Magnetite* or *magnetic iron ore* (186), as hard as the preceding, but having a black powder, and being attractable by a magnet; *Franklinite*, an allied species, containing zinc and manganese (188); *Limonite*, called also brown hematite (206), a softer hydrous ore, affording a brownish-yellow powder, earthy or semi-metallic in appearance, and often in mammillary or stalactitic forms; nearly related to limonite are göthite (204), turgite (202), and limnite (213); *Siderite* or *Spathic Iron* (721), a sparry ore, of grayish, grayish-brown, and brown colors, very distinctly cleavable, turning brown to black on exposure. The common clayey iron ores are impure ores, either of Spathic Iron, Limonite, or Hematite; when the last they are red; when brown, reddish-brown, or yellowish-brown to black, they may be either of the two former. One of the most common iron minerals is *Pyrite* or sulphid of iron (75), a pale yellow, brass-like ore, hard enough to strike fire with steel, and thus unlike any copper ore, and all similar ores of other metals. It is frequently mined and utilized for the sulphur it contains. *Marcasite* (90) is similar, but is prismatic and often crested in its forms. *Pyrrhotite* or *Magnetic Pyrites* (68) is less hard and paler, or more grayish in color. *Leucopyrite* and *Mispickel* (91, 93, 94) are white, metallic, arsenical ores, somewhat resembling ores of cobalt. *Menaccanite* or *Titanic Iron* (181) resembles specular iron closely, but has not a red powder; it is abundant in some regions. For other iron minerals, see 260, 284, 334, 369, 435, 436, 467, 469 (silicates); 473–475 (columbates, tantalates); 498, 499, 524, 525, 553, 557, 558, 560, 567–570, 576 (phosphates, arsenates); 605 (borate); 610 (tungstate); 646, 662, 664, 665, 672, 675, 682–687, 692, 696 (sulphates); 717, 719, 720 (carbonates); 758 (oxalate).

TIN.—The only valuable ore is the *Oxyd of Tin* or *Cassiterite* (192), a very hard and heavy mineral of a dark brown to black color, sometimes gray or grayish-brown, without any metallic appearance; the crystals usually have a very brilliant lustre. Tin also occurs as a sulphid (80), and is sparingly found in ores of tantalum and some other mineral species.

TITANIUM.—The only ore of this metal of any value is Rutile (193).

ARSENIC.—*Native Arsenic* (17) is one source of arsenic, but it is too rare to be of much avail also *Orpiment* (27), a sulphur-yellow, foliaceous, and somewhat pearly mineral, and *Realgar* (26), bright red and vitreous. Arsenic is mostly derived for the arts from the arsenical ores of iron, cobalt, and nickel.

ANTIMONY.—*Stibnite* or *Gray Antimony* (29) is the source of the antimony of commerce. It is a lead-gray ore, usually fibrous or in prismatic crystals, and distinguished from a similar ore of manganese by its perfect diagonal cleavage and its easy fusibility. Native antimony (18), senarmontite (220), valentinite (221), are sometimes found in sufficient abundance to be mined. Antimony occurs also in numerous ores of lead, silver, and nickel; also as oxysulphid (226).

BISMUTH.—*Native Bismuth* (20), the source of the metal in the arts, is whitish, with a faint reddish tinge, has a perfect cleavage, and is very fusible. For other bismuth ores, see 30–33, 36, 102, 103, 121, 123, 124 (sulphids, tellurids); 222, 223 (oxyds); 336–338 (silicates); 753 (carbonate).

8. Abbreviations.

For explanations of the abbreviations **Var.**, **Comp.**, **Obs.**, **Alt.**, **Artif.**, as headings of sections in the descriptions of species, see p xi; of chemical symbols, pp. xi–xviii; of H., G., B.B., O.F., R.F., p. xx; of other abbreviations, p. xxxiv.

The fractional expression $\frac{2}{2}$, before the statement of an analysis signifies *a mean of two analyses*; $\frac{3}{3}$, a mean of *three*; and so on.

Q in a formula after the new system stands for an accessory ingredient in the compound, and the nature of this ingredient is to be learned from the formula after the old system in the same line.

In the statements of the angles of crystals, abbreviations are used as follows:

pyr., angle over a pyramidal edge.
bas., angle over a basal edge.
mac., angle over a macrodiagonal edge.
brach., angle over a brachydiagonal edge.
top, angle between opposite planes over the summit.
term., angle over terminal edge in a rhombohedron.
adj., angle between adjacent planes.
ov., over; *brachyd.*, brachydiagonal; *macrod.*, macrodiagonal.

DESCRIPTIVE MINERALOGY.

The following are the general subdivisions in the classification of minerals adopted in this treatise:

GENERAL SUBDIVISIONS.

I. NATIVE ELEMENTS.

II. COMPOUNDS: THE MORE NEGATIVE ELEMENT AN ELEMENT OF SERIES II (See next page.)
  1. Binary: SULPHIDS, TELLURIDS, OF METALS OF THE SULPHUR AND ARSENIC GROUPS (p. 26).
  2. Binary: SULPHIDS, TELLURIDS, SELENIDS, ARSENIDS, ANTIMONIDS, BISMUTHIDS, PHOSPHIDS, OF METALS OF THE GOLD, IRON, AND TIN GROUPS (p. 33).
  3. Ternary: SULPHARSENITES, SULPHANTIMONITES, SULPHOBISMUTHITES (p. 84).

III. COMPOUNDS: THE MORE NEGATIVE ELEMENT AN ELEMENT OF SERIES III., GROUP I. (See page 3.)
  1. CHLORIDS, BROMIDS, IODIDS (p. 110).

IV. COMPOUNDS: THE MORE NEGATIVE ELEMENT AN ELEMENT OF SERIES III., GROUP II.
  1. FLUORIDS (p. 123).

V. COMPOUNDS: THE MORE NEGATIVE ELEMENT AN ELEMENT OF SERIES III., GROUP III. Oxygen Compounds.
  1. Binary: OXYDS (p. 131).
  2. Ternary; the basic element an element of Series I.; the acidic of Series II. (as silicon, columbium, phosphorus, etc.); the acidific of Series III. (oxygen): 1, SILICATES (p. 202); 2, COLUMBATES, TANTALATES (p. 512); 3, PHOSPHATES, ARSENATES, ANTIMONATES, NITRATES (p. 526); 4, BORATES (p. 593); 5, TUNGSTATES, MOLYBDATES, VANADATES (p. 601); 6, SULPHATES, CHROMATES, TELLURATES (p. 612); 7, CARBONATES (p. 669); 8, OXALATES (p. 718).

VI. HYDRO-CARBON COMPOUNDS: MINERALS OF ORGANIC ORIGIN (p. 720).

I. NATIVE ELEMENTS.

ARRANGEMENT OF THE SPECIES.

Series I.

1. GOLD GROUP.

1. Gold.
2. Silver.

2. IRON GROUP.

3. Platinum.
4. Platiniridium.
5. Palladium.
6. Allopalladium.
7. Iridosmine.
   (1). Newjarskite.
   (2). Sisserskite.
8. Quicksilver.
9. Amalgam.
10. Arquerite.
11. Gold-Amalgam.
12. Copper.
13. Iron.
14. Zinc.
15. Lead.

3. TIN GROUP.

16. Tin.

Series II.

1. ARSENIC GROUP.

17. Arsenic.
18. Antimony.
19. Allemontite.
20. Bismuth.

2. SULPHUR GROUP.

21. Tellurium.
22. Sulphur.
23. Selensulphur.

3. CARBON-SILICON GROUP.

24. Diamond.
25. Graphite.

Two series of elements are here recognized; the *first* containing the more basic, and the *second*, one division of the more negative. These two series are parallel in their subdivisions, so that the arrangement is a natural one, whether read across, or up and down, the page. The *first* group of each contains elements whose compounds have an *odd* number of atoms of the negative element, as 1, 3, 5, or the *perissads* (p. xviii); the *other two* of each, an *even* number, as 2, 4, 6, or the *artiads*.

(1). To the Gold group of elements belong also *hydrogen*, *potassium*, *sodium*, *lithium*, *rubidium*, *cæsium*, *thallium*; the atomic ratio for the oxyds is 1 : 1, and the general formula of the same RO, or $\mathrm{R}^2\Theta$, in the new system of chemistry.

To the Arsenic group belong the elements *phosphorus*, *nitrogen*, *columbium*, *tantalum*, and probably *boron*. In all but boron, there are oxyds containing 3 and 5 atoms of oxygen; in boron, 3, but not 5.

(2). To the Iron group of elements belong *calcium*, *magnesium*, *aluminum*, *beryllium*, *copper*, *cobalt*, *nickel*, *zinc*, *chromium* (in part), *manganese* (in part), *lead* (in part), etc. Among the oxyds, the atomic ratio 2 : 2 occurs in the ordinary protoxyds, having the formula RO, as ordinarily written (and so written in this work), but $\text{Ɍ}\Theta$, in the new style of chemistry. The ratio 4 : 6 is represented in the sesquioxyds, $\mathrm{R}^2\mathrm{O}^3$ ($\text{Ɍ}^2\Theta^3$ in the new system).

To the Sulphur group of elements belong also *selenium*, *vanadium*, and probably *molybdenum*, in which the more prominent acid has the atomic ratio 2 : 6. Here also may be included that state of the metal *chromium* which exists in chromic acid (CrO^3, or $\text{Ꞓ}\mathrm{r}\Theta^3$), that of *manganese* in manganic acid, and that of *molybdenum* in molybdic acid.

(3). To the Tin group belong also *titanium*, *zirconium*, *thorium*. The prominent oxyd has the atomic ratio 2 : 4 (RO^2, or in the new system $\text{Ɍ}\Theta^2$). This group may contain also that state of *lead* which exists in the oxyd PbO^2 (or $\text{Ᵽ}\mathrm{b}\Theta^2$); and the same also of *manganese* existing in MnO^2 of platinum and palladium in the deutoxyd state.*

---

* The three states of a basic metal, corresponding to the protoxyd, sesquioxyd, and deutoxyd of the same (in which 1 part of metal balances, in its affinity, 1, 1½, and 2 parts of oxygen), may be

The Carbon-Silicon Group contains *Carbon* and *Silicon*. They are related to one another in the atomic ratio of their prominent acids (SiO^2, CO^2), but they are very widely unlike in many respects, and very strikingly so in the mineral compounds of the two acids.*

Series III.—Besides the above two series of elements, there is a *third*, consisting of the *eminently* negative elements (for the most part exclusively negative). The three groups of this Series III. are:

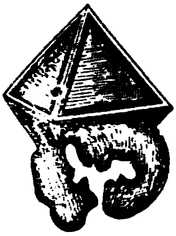
(1). CHLORINE, BROMINE, IODINE.
(2). FLUORINE.
(3). OXYGEN.

The first of these groups (like the same in Series I. and II.) includes elements of the *odd* division; the third of the *even;* while fluorine is of either.

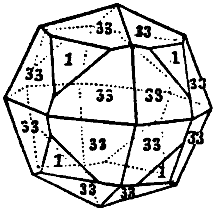
1. GOLD. Sol. *Alchem.* Gediegen Gold *Germ.* Or natif *Fr.*

Isometric. Observed planes *O*, *I*, 1, *i*-2, 3-3, 4-2. Figs. 1 to 8, 15, 17, and the following: the octahedron and dodecahedron (f. 2, 3), most common. Crystals sometimes acicular through elongation of octahedral or other forms; also passing into filiform, reticulated, and arborescent shapes; and occasionally spongiform from an aggregation of filaments; edges of crystals often salient (f. 51). Cleavage none. Twins: composition face octahedral, as in f. 50; and occurring also in trapezohedral and other forms. Also massive and in thin laminæ. Often in flattened grains or scales, and rolled masses in sand or gravel.

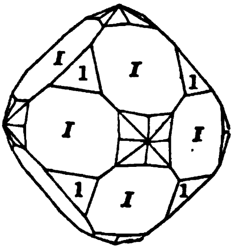
51



52



53



H.=2·5—3. G.=15·6—19·5; 19·30—19·34, when quite pure, G. Rose. Lustre metallic. Color and streak various shades of gold-yellow, sometimes inclining to silver-white. Very ductile and malleable.

Composition, Varieties.—Gold, but containing silver in different proportions, and sometimes also traces of copper, iron, palladium, rhodium.

Var. 1. *Ordinary.* Containing 0·16 to 16 p. c. of silver; or, the atomic ratio of gold to silver varying from 150 : 1 to 3 : 1. Color varying, accordingly, from deep gold-yellow to pale yellow; G.=19—15·5. Ratio for the gold and silver of 3 : 1 corresponds to 15·1 p. c. of silver; 4 : 1, 12 p. c.; 6 : 1, 8·4 p. c.; 10 : 1, 5·3 p. c. (*a*) In distinct crystals or groups of crystals; (*b*) arborescent or reticulated; (*c*) filiform; (*d*) spongy; (*e*) in laminæ; (*f*) rolled masses; (*g*) scales or grains.

2. *Argentiferous; Electrum.* (Λευκός χρυσός *Herod.*; Ἤλεκτρον *Homer*, *Strabo;* Electrum *Plin.* xxxiii. 23.) Color pale yellow to yellowish-white; G.=15·5—12·5. Ratio for the gold and silver

---

designated respectively (using the letters of the Greek alphabet) the *alpha*, *beta*, and *gamma* states. While the iron or Fe in FeO is closely related to magnesium, calcium, etc., that in Fe^2O^3 is as closely related to aluminum; and that in FeS^2, or Pb in PbO^2, or Mn in MnO^2, as closely related to tin and titanium, whose ordinary oxyd is RO^2. This relation is apparent in the crystallographic and chemical characters of the corresponding oxyds. See further on this subject a paper by the author in *Am. Jour. Sci.*, II. xliv., 1867, and Introd., p. xv.

* In strict system, the Silicates should come in classification next before the Carbonates, instead of where they are placed in this work. But as there are no analogies between the species of these two groups, the separation is without serious objection.

of 1 : 1 corresponds to 36 p. c. of silver (anal. 3, 4, 26, 27, 45); 1½ : 1, to 26 p. c. (anal. 15, 41–44); 2 : 1, to 21 p. c. (anal. 54, 55); 2½ : 1, to 18 p. c. (anal. 40). Pliny says that when the proportion of silver in the gold is one-fifth (=20 p. c.) it is called *electrum*. The word in Greek means also *amber*; and its use for this alloy probably arose from the pale yellow color it has as compared with gold.

An argentiferous gold from the Ophir Mine, Nevada, pale yellowish in color, gave Breithaupt (B. H. Ztg., xxv. 169) G.=13·25, 13·68. He observes that it contains more silver than gold, but gives no analysis.

3. *Palladium-Gold*, *Porpezite* Frobel, contains nearly 10 p. c. of palladium, besides some silver; color pale. From Porpez in Brazil. Another variety from Zacotinga and Condonga in Brazil contains 5 to 6 p. c. of palladium.

4. *Rhodium-Gold.* Contains, according to del Rio (Ann. Ch. Phys., xxix. 137), 34–43 p. c. of rhodium; G.=15·5—16·8; brittle. Requires reëxamination.

Analyses by Avdejef (Pogg, liii. 153); Boussingault (Ann. Ch. Phys., xxiv. 408); Forbes (Phil. Mag., IV. xxix. 129, and xxx. 142); T. H. Henry (Phil. Mag., III. xxxiv. 205); Hofmann (Ann. Ch. Pharm., lxx. 255); T. S. Hunt (Rep. G. Can, and Am. J. Sci., II. xx. 448); Kerl (B. H. Ztg., 1853, No. 3); Klaproth (Beitr., iv. 1); A. Levol (Ann. Ch. Phys., II. xxvii. 310); Mallet (J. G. Soc. Dublin, iv. 271); Marsh (Am. J. Sci., II. xxxiii. 190); Northcote (Phil. Mag., IV. vi. 390); Oswald (Pogg., lxxvii. 96); Pietzsch (Arch. Pharm., II. xcviii. 142); Rivot (Ann. d. M., IV. xiv. 67); G. Rose (Pogg., xxiii. 161); Terreil (C. R., lix. 1047); Teschemacher (Q. J. Ch. Soc., ii. 193); Thomas (Phil. Mag., IV. i. 261); E. W. Ward, at Mint of Sydney, N. S. W. (W. B. Clarke's Researches in Southern Gold Fields, Sydney, 1860, p. 276):

		Sp. gr.	Au	Ag	Fe	Cu	
1	Wicklow Co., Ireland	16·324	92.32	6·17	0·78	——	= 99.27 Mallet.
2.	Transylvania, Barbara		84·80	14·68	0·13	0·04	= 99·65 Rose.
3.	"		[64·52]	35·48	——	——	= 100 Bouss.
4.	" Vöröspatak		60·49	38·74	——	——	= 99.32 Rose
5.	Schabrovski (Kath.)	19·099	98·96	0·16	——	——	= 99.12 Rose.
6.	Katharinenburg	18·79	95·81	3·58	[0.61]		= 100 Avd.
7.	"	18·77—18·89	95·50	4·00	[0·50]		= 100 Avd.
8.	"		94·09	5·55	[0·36]		= 100 Avd.
9.	"		93·75	6·01	[0·24]		= 100 Avd.
10.	"		93·34	6·28	0·32	0·06	= 99·94 Rose.
11.	"		92·80	7·02	0·08	——	= 99·90 Rose.
12.	"	18·11—18·40	92·23	6·17	[1·60]		= 100 Avd.
13.	"	17·74—18·35	91·21	8·03	[0·76]		= 100 Avd.
14.	"	16·03	79·69	19·47	[0·84]		= 100 Avd.
15.	"	15·627	70·86	28·30	[0·84]		= 100 Avd.
16.	Czar. Nikolajevsk (Miask)		92·47	7·27	——	——	= 99·74 Rose.
17.	" " "	17·72	89·35	10·65	——	——	= 100 Rose.
18.	Perrov-Pavlovski (Kath.)		92·60	7·08	0·06	0·02	= 99·76 Rose.
19.	Boruschka (N. Tagilsk)	18·66	94·41	5·23	0·04	0·39	= 100 Rose.
20.	" "	17·74	90·76	9·02	——	——	= 99·78 Rose.
21.	" "		87·31	12·12	——	0·08	= 99·51 Rose.
22.	" "	17·06	83·85	16·15	——	——	= 100 Rose.
23.	Beresof		91·88	8·03	——	0·09	= 100 Rose.
24.	Alex. Andrejevsk (Miask)	17·54	87·40	12·07	——	0·09	= 99·56 Rose.
25.	Petropavlovski	17·11	86·81	13·19	[0·30]		= 100 Rose.
26.	Siränovski, Altai	14·55	60·98	38·38	——	0·33	= 99·69 Rose.
27.	Schlangenberg, Altai		64	36	——	——	= 100 Klaproth.
28.	Malacca		90·89	8·98	*tr.*	*tr.*	= 99.87 Terreil.
29.	Siam, Pachim		88·57	6·45	*tr.*	1·42	S̈i 3·33=97·77 Terreil
30.	Africa, Senegal		94·00	5·85	——	——	Pt 0·15=100 Levol.
31.	"		86·97	10·53	*und.*	*und.*	= 97·50 Darcet.
32.	"		86·80	11·80	——	0·90	= 99·50 Levol.
33.	"		84·50	15·30	——	0·20	= 100 Levol.
34.	Brazil		94·00	5·85	——	——	= 99·85 Darcet.
35.	Bolivia, Ancota	18·31	94·73	5·23	0·04	——	= 100 Forbes.
36.	" Romanplaya	18·672	94·19	5·81	——	——	= 100 Forbes.
37.	" Gritada	17·906	93·51	6·49	——	——	= 100 Forbes.
38.	" Tipuani	16·07	91·96	7·47	*tr.*	—	gangue 0·57=100 Forbes.
39.	N. Grenada, Bogota		92·00	8·00	——	——	= 100 Bouss.
40.	" Trinidad		82·40	17·60	——	——	= 100 Bouss.
41.	" Titiribi		74·00	26·00	——	——	= 100 Bouss.

		Sp. gr.	Au	Ag	Fe	Cu	
42.	N. Grenada, Titiribi		73·40	26·60	——	——	= 100 Bouss.
43.	“ Guamo		73·68	26·32	——	——	= 100 Bouss.
44.	“ Marmato	12·666	73·45	26·48	——	——	= 99·93 Bouss.
45.	“ Santa Rosa	14·15	64·93	35·07	——	——	= 100 Bouss.
46.	“ El Llano		88·54	11·42	——	——	= 99·96 Bouss.
47.	“ Malpaso	14·70	88·24	11·76	——	——	= 100 Bouss.
48.	“ Baia		88·15	11·85	——	——	= 100 Bouss.
49.	“ Rio Lucio	14·69	87·94	12·06	——	——	= 100 Bouss.
50.	“ Ojas Anchas		84·50	15·50	——	——	= 100 Bouss.
51.	“ El Llano		82·10	17·90	——	——	= 100 Bouss.
52.	Peru, Carabaya	18·43	97·46	2·54	——	——	= 100 Forbes.
53.	“ R. Chuquiaguillo	16·693	90·86	9·14	——	——	= 100 Forbes.
54.	“ Yungas	16·63	79·89	20·11	——	——	= 100 Forbes.
55.	“ “	16·54	78·69	21·31	——	——	= 100 Forbes.
56.	N. Scotia, Tangier	18·95	98·13	1·76	*tr.*	0·05	= 99·94 Marsh.
57.	“ Lunenburg	18·37	92·04	7·76	*tr.*	0·11	= 99·91 Marsh.
58.	California		96·42	3·58	——	——	= 100 Thomas.
59.	“		93·53	6·47	——	——	= 100 Thomas.
60.	“		92·70	6·90	——	0·40	= 100 Levol.
61.	“	16·33	92·00	7·00	——	——	= 99 Teschemacher.
62.	“		89·61	10·05	*und.*	*und.*	= 99·66 Hofmann.
63.	“	15·96	90·01	9·01	0·86		= 99·88 Henry.
64.	“ (17·48 fused)	14·60	90·70	8·80	0·38	——	= 99·88 Rivot.
65.	“	17·40	90·96	9·04	——	——	= 100 Oswald.
66.	“	15·63—16·43	86·57	12·33	0·54	0·29	= 99·73 Henry.
67.	“		75·86	20·67	——	—	quartz 2·44 = 98·97 Pietzsch.
68.	Canada, Chaudière	16·57	89·24	10·76	——	——	= 100 Hunt.
69.	“ “	17·60	87·77	12·23	——	——	= 100 Hunt.
70.	“ “		86·73	13·27	——	——	= 100 Hunt.
71.	Australia		99·28	0·44	0·20	0·07 Bi 0·01	= 100 Northcote.
72.	“		95·48	3·59	——	—	quartz 0·10 = 99·17 Kerl.
73.	“ Bathurst		95·68	3·92	0·16	——	= 99·76 Henry.
74.	“ Araluen		94·92	5·08	——	——	= 100 Ward
75.	“ Adelong		94·64	5·31	0·05		= 100 “
76.	“ “		93·67	6·23	1·10		= 100 “
77.	“ “		93·17	6·56	0·27		= 100 “
78.	“ Araluen		91·52	8·48	——	——	= 100 “
79.	“ “		89·59	10·51	——	——	= 100 “
80.	“ Mitta Mitta		89·57	10·43	——	——	= 100 “
81.	“ Omeo		85·23	14·77	——	——	= 100 “
82.	Tasmania, Giandara		92·77	7·23	——	——	= 100 “
83.	“ “		92·58	7·34	0·08		= 100 “
84.	“ “		93·35	6·56	0·09		= 100 “
85.	“ “		92·47	7·31	0·22		= 100 “
86.	“ “		92·62	7·27	0·11		= 100 “
87.	“ Bl'k Boy Flat		94·76	5·04	——	——	= 99·80 “
88.	“ “		94·95	4·66	0·08	*tr.*	= 99·69 “
89.	“ Nook, Fingal		92·55	7·10	0·17	*tr.*	= 99·82 “
90.	“ Fingal		90 89	8·02	——	*tr.* Sn, Pb, Co 1·0	Ward.

The average proportion of gold in the native gold of California, as derived from assays of several hundred millions of dollars worth, is 880 thousandths; while the range is mostly between 870 and 890 (Prof. J. C. Booth, of U. S. Mint, in a letter to the author, of May. 1867). The range in the metal of Australia is mostly between 900 and 960, with an average of 925.

The gold of the Chaudière, Canada, contains usually 10 to 15 p. c. of silver; while that of Nova Scotia is very nearly pure.

The Chilian gold afforded Domeyko 84 to 96 per cent. of gold and 15 to 3 per cent. of silver (Ann. d. Mines IV. vi.).

Porpezite afforded Berzelius (Jahresb. 1835) Gold 85·98, palladium 9·85, silver 4·17.

A mass of *electrum*, weighing 25 lbs., from Vöröspatak, consisting of large crystals (¼–½ in.), contained 25 p. c. of silver (Dingl. Polyt. J., clxvi. 396).

Pyrognostic and other Chemical Characters.—B.B. fuses easily. Not acted on by fluxes. Insoluble in any single acid; soluble in nitro-muriatic acid (aqua-regia).

Observations.—Native gold is found, when *in situ*, with comparatively small exceptions, in the quartz veins that intersect metamorphic rocks, and to some extent in the wall rock of these veins. The metamorphic rocks thus intersected are mostly chloritic, talcose, and argillaceous schist of dull green, dark gray, and other colors; also, much less commonly, mica and hornblendic schist, gneiss, diorite, porphyry; and still more rarely, granite. A laminated quartzite, called itacolumite, is common in many gold regions, as those of Brazil and North Carolina, and sometimes specular schists, or slaty rocks containing much foliated specular iron (hematite), or magnetite in grains.

The gold occurs in the quartz in strings, scales, plates, and in masses which are sometimes an agglomeration of crystals; and the scales are often invisible to the naked eye, massive quartz that apparently contains no gold frequently yielding a considerable percentage to the assayer. It is always very irregularly distributed, and never in continuous pure bands of metal, like many metallic ores. It occurs both disseminated through the mass of the quartz, and in its cavities. The larger masses and the finer crystallizations are mainly in the latter; and Prof. Wurtz has suggested that these have been formed by a slow aggregation and crystallization carried on through the solvent power, as regards gold, of persulphate of iron—this salt of iron being derived from the decomposition of the pyrite present in the quartz veins.

The associated minerals are: pyrite, which far exceeds in quantity all others, and is generally *auriferous;* next, chalcopyrite, galena, blende, mispickel, each frequently auriferous; often tetradymite and other tellurium ores, native bismuth, stibnite, magnetite, hematite; sometimes barytes, apatite, fluor, siderite, chrysocolla.

The quartz at the surface, or in the upper part of a vein, is usually cellular and rusted from the more or less complete disappearance of the pyrite and other sulphids by decomposition; but below, it is commonly solid. The enclosing schists are sometimes soft and easily removed in mining. In other cases, they are excessively tough, and the quartz, being a brittle mineral, yields the most easily to the drill.

The gold of the world has been mostly gathered, not directly from the quartz veins, but from the gravel or sands of rivers or valleys in auriferous regions, or the slopes of mountains or hills, whose rocks contain in some part, and generally not far distant, auriferous veins; and such mines are often called *alluvial washings;* in California *placer-diggings.* Pliny speaks of the "bringing of rivers from the mountains, in many instances for a hundred miles, for the purpose of washing the débris," and this method of hydraulic mining is now carried on in California on a stupendous scale. (See Silliman, in Am. J. Sci., II. xl. 10.) The auriferous gravel and earth have been derived from the disintegration or wearing down of auriferous rocks. The auriferous gravel beds in California are of vast extent; those of the Yuba, an affluent of Feather River, varying from 80 to 250 feet in depth, and averaging probably 120 feet. Most of the gold of the Urals, Brazil, Australia, and all other gold regions, has come from such alluvial washings.

The alluvial gold is usually in flattened scales of different degrees of fineness, the size depending partly on the original condition in the quartz veins, and partly on the distance to which it has been transported. Transportation by running water is an assorting process; the coarser particles or largest pieces requiring rapid currents to transport them, and dropping first, and the finer being carried far away—sometimes scores of miles. A cavity in the rocky slopes or bottom of a valley, or a place where the waters may have eddied, generally proves in such a region to be a *pocket* full of gold.

In the auriferous sands, crystals of zircon are very common; also garnet and kyanite in grains; often also monazite, diamonds, topaz, corundum, iridosmine, platinum. The zircons are sometimes mistaken for diamonds.

Gold is widely distributed over the globe, and occurs in rocks of various ages, from the Azoic to the Cretaceous or Tertiary. The schists that contain the auriferous veins were once sedimentary beds of clay, sand, or mud, derived from the wear of preëxisting rocks. Through some process, in which heat was concerned, the latter were metamorphosed into the hard crystalline schists, and at the same time upturned and broken, and often opened between the layers: and then, all the fissures (cutting across the layers) and the openings (made between the layers, and therefore conforming with the lamination) became filled with the quartz veins containing gold. The quartz was brought into the intersecting fissures, and the interlaminated open spaces, from the rocks either side by means of the permeating heated waters (such heated waters, at a temperature much above that of boiling water, having great decomposing and solvent power, and carrying into cavities whatever they can gather up from the rocks). Thus, the gold of the veins was derived from the rocks adjoining the openings, either directly adjoining, or above, or below it; and it must therefore have been widely distributed through these rocks before they were crystallized and the veins were made, although in so infinitesimal a quantity in a cubic foot, that the beds, without the metamorphism and the vein-making, would have been worthless mining ground.

As schists with auriferous quartz veins were made in Azoic time, so were they also in Paleozoic, especially at the great mountain-making epoch which closed the Paleozoic era; also later, in the Jurassic period, as in the Sierra Nevada; and still later in the Cretaceous and Tertiary periods, as in the Coast Mountains of California. But whatever the age of the schists and veins, the original source of all the Paleozoic and later gold deposits must be the azoic or original rocks of the globe, as they are the great source of the material shales and sandstones of all subsequent ages, excepting such as may have been derived from aqueous solution or chemical deposition. Auriferous quartz veins are in no case *igneous* veins—that is, veins filled by injection of melted matter from below.

Gold exists more or less abundantly over all the continents in most of the regions of crystalline rocks, especially those of the semi-crystalline schists; and also in some of the large islands of the world where such rocks exist. In Europe, it is most abundant in Hungary at Konigsberg, Schemnitz, and Felsobanya, and in Transylvania at Kapnik, Vöröspatak, and Offenbanya; it occurs also in the sands of the Rhine, the Reuss, the Aar, the Rhone, and the Danube; on the southern slope of the Pennine Alps from the Simplon and Monte Rosa to the valley of Aosta; in Piedmont; in Spain, formerly worked in Asturias; in many of the streams of Cornwall; near Dolgelly and other parts of North Wales; in Scotland, in considerable amount, near Leadhills, and in Glen Coich and other parts of Perthshire; in the county of Wicklow, Ireland; in Sweden, at Edelfors.

At the Transylvania mines of Vöröspatak, where one piece of 22 ozs. was found, the gold is obtained by mining, and the mines have been worked since the time of the Romans. The Rhine has been most productive between Basle and Manheim; the sands, where richest, contain only about 56 parts of gold in a hundred millions; yet sands containing less than half this proportion are worked. The whole amount of gold in the auriferous sands of the Rhine has been estimated at $30,000,000; but it is mostly covered by soil under cultivation.

In Asia, gold occurs along the eastern flanks of the Urals for 500 miles, and is especially abundant at the Beresov mines near Katharinenburg (lat. 56° 40′ N.); also obtained at Petropavlovski (60° N.); Nischne Tagilsk (59° N.); Miask, near Slatoust and Mt. Ilmen (55° N., where the largest Russian nugget was found), etc. Katharinenburg is the capital of the mining district. The Urals were within the territory of the ancient Scythians; and the vessels of gold reputed, according to Herodotus, to have fallen from the skies, were probably made from Uralian nuggets. But the mines were not opened until 1819; soon after this they became the most productive in the world, and remained so until the discoveries in California. They are principally alluvial washings, and these washings seldom yield less than 65 grains of gold for 4,000 lbs. of soil, and rarely more than 120 grains. At Beresov, there are workings in the parent rock. Siberian mines less extensive occur in the lesser Altai, in the Kolyvan mining region (about 1,500 miles east of Katharinenburg, near long. 100° E., between the Obi and Irtisch, and 1,500 miles west of the other great Siberian mining region, that of Nertschinsk, which is between 135° and 140° E., east of L. Baikal); among the localities are Schlangenberg and Siränovski, noted for affording the electrum (anal. 26, 27). Asiatic mines occur also in the Cailas Mountains, in Little Thibet, Ceylon, and Malacca, China, Corea, Japan, Formosa, Sumatra, Java, Borneo, the Philippines, and other East India Islands.

In Africa, gold occurs at Kordofan, between Darfour and Abyssinia; also, south of the Sahara in Western Africa, from the Senegal to Cape Palmas; in the interior, on the Somat, a day's journey from Cassan; along the coast opposite Madagascar, between 22° and 35° S., supposed by some to have been the *Ophir* of the time of Solomon.

In South America, gold is found in Brazil (where formerly the larger part of the annual produce of the world was obtained) along the chain of mountains lying nearly parallel with the coast, especially near Villa Rica, and in the province of Minas Geraes; in New Grenada, at Antioquia, Choco, and Giron; Chili; in Bolivia, especially in the valley of the Rio de Tipuani, east of Sorata: sparingly in Peru. Also in Central America, in Honduras, San Salvador, Guatemala, Costa Rica, and near Panama; most abundant in Honduras, especially along the rivers Guyape and Jálan, in Olancho, while found also in the department of Yoro, and in Southern Honduras.

In North America, there are numberless mines along the mountains of Western America, and others along the eastern range of the Appalachians from Alabama and Georgia to Labrador, besides some indications of gold in portions of the intermediate Azoic region about Lake Superior. They occur at many points along the higher regions of the Rocky Mountains, in Mexico, in New Mexico, near Santa Fé, Cerillos, Avo, etc.; in Arizona, in the San Francisco, Wauba, Yuma, and other districts; in Colorado, abundant, but the gold largely in auriferous pyrites; in Utah and Idaho. Also along ranges between the summit and the Sierra Nevada, in the Humboldt region and elsewhere. Also in the Sierra Nevada, mostly on its western slope (the mines of the eastern being principally silver mines). The auriferous belt may be said to begin in the Californian peninsula. Near the Tejon pass it enters California, and beyond for 180 miles it is sparingly auriferous, the slate rocks being of small breadth; but beyond this, northward, the slates increase in extent, and the mines in number and productiveness, and they continue thus for 200 miles or more. Gold occurs also in the Coast ranges in many localities, but mostly in too small quantities to be profitably worked. The regions to the north in Oregon and Washington Territory, and the British Possessions farther north, are at many points auriferous, and productively so, though to a less extent than California.

The mines of California were first made known in 1849. They were for some years solely alluvial washings, but since 1852 quartz mining has been on the increase. The quartz veins are often of great size. Some in the "Mariposa estate" average 12 feet, and in places expand to 40 feet in breadth. North of Mariposa county, the auriferous gravel, which has everywhere been a principal source of the gold thus far obtained, is very extensive. The thick deposits, often semi-indurated, are now washed down by vast streams of water thrown by the pressure of a column of water of 150 feet, that do the work of running off the earth and gravel, and gathering the gold in an incredibly short time. Much of the auriferous gravel formation is under a covering of volcanic rock, either tufa or lavas, which has to be underworked, in one way or another, to get out the gold, making what is called *table-mountain mining;* the flat tops of hard volcanic material giving a table-like look to the heights. (See J. D. Whitney's Geol. California; review of same in Am. J. Sci., II. xli. 231, 351, and B. Silliman, ib., xl. 1.)

In eastern North America, the mines of the Southern United States produced before the California discoveries about a million of dollars a year. They are mostly confined to the States of Virginia, North and South Carolina, and Georgia, or along a line from the Rappahannock to the Coosa in Alabama. But the region may be said to extend north to Canada; for gold has been found at Albion and Madrid in Maine; Canaan and Lisbon, N. H.; Bridgewater, Vermont; Dedham, Mass. Traces occur also in Franconia township, Montgomery Co., Pennsylvania. In *Virginia*, the principal deposits are in Spotsylvania county, on the Rappahannock, at the United States mines, and at other places to the southwest; in Stafford county, at the Rappahannock gold mines, ten miles from Falmouth, in the Culpepper county, at Culpepper mines, on Rapidan river; in Orange county, at the Orange Grove gold mine, and at the Greenwood gold mines; in Goochland county, at Moss and Busby's mines; in Louisa county, at Walton's gold mine; in Buckingham county, at Eldridge's mine. In *North Carolina*, the gold region is mostly confined to the counties of Montgomery, Cabarrus, Mecklenburg, and Lincoln. The mines of Mecklenburg are principally vein deposits; those of Burke, Lincoln, McDowell, and Rutherford, are mostly in alluvial soil; the Davidson county silver mine has afforded gold. In *Georgia*, the Shelton gold mines in Habersham county have long been famous; and many other places have been opened in Rabun and Hall counties, Lumpkin county, at Dahlonega, etc.; and the Cherokee country. In *South Carolina*, the principal gold regions are the Fairforest in Union district, and the Lynch's creek and Catawba regions, chiefly in Lancaster and Chesterfield districts; also in Pickens county, adjoining Georgia. There is gold also in eastern *Tennessee.*

In Canada, gold occurs to the south of the St. Lawrence, in the soil on the Chaudière (where first found in 1835), and over a considerable region beyond, having been derived probably from the crystalline schists of the Notre Dame range (T. S. Hunt), which is properly a continuation of the mountains of New England and the Appalachians to the southwest. In Nova Scotia, mines are worked near Halifax and elsewhere.

In Australia, which is fully equal to California in productiveness, and much superior in the purity of the metal, the principal gold mines occur along the streams in the mountains of N. S. Wales (S. E. Australia), and along the continuation of the same range in Victoria (S. Australia). It was discovered in N. S. Wales, near Bathurst, in the spring of 1851; and in August of the same year, the far richer deposits of Victoria became known. Some gold has also been obtained in Queensland, N. Australia, in the vicinity of Moreton bay. Prof. Booth states (in a letter to the author) that one lot of Australian gold worth about $4,000, submitted to him in 1853, consisted of grains from the size of a very large pea to small sand, all of which were more or less perfect dodecahedrons. Gold also occurs in Tasmania (Van Diemen's Land). In New Zealand, it has been found at Coromandel harbor, near Auckland, on the Northern island, and on the Middle island near Cook's Straits. Found also in New Caledonia.

Masses of gold of considerable size have been found in North Carolina. The largest was discovered in Cabarrus Co.; it weighed twenty-eight pounds avoirdupois ("steel-yard weight," equals 37 lbs. troy), and was 8 or 9 inches long by 4 or 5 broad, and about an inch thick. The largest mass yet reported from California weighed 20 pounds. A mass consisting of a congeries of crystals, and weighing 201 ozs. (value $4,000) was found in 1865, in California, 7 miles from Georgetown, in El Dorado county. In Paraguay, pieces from 1 to 50 pounds weight were taken from a mass of rock which fell from one of the highest mountains. Several specimens weighing 16 pounds have been found in the Ural, and one of 27 pounds; and near Miask, in the valley of Taschku Targanka, in 1842, a mass was detached weighing 96 pounds troy. This mass is now in the Museum of Mining Engineers at St. Petersburg. A mass found recently in Australia, called the "Blanch Barkley Nugget" had the enormous weight of 146 lbs., and only 6 ozs. of it were gangue; and one still larger, from Ballarat, weighed 184 lbs. 8 ozs., and yielded £8,376 10*s.* 6*d.* sterling of gold.

The yield of gold mines has very much increased in amount since the discovery of the mines of California. The mines of South America and Mexico were estimated by Humboldt, over 60 years since, to yield annually $11,500,000, which much exceeds the present proceeds. Brazil has furnished about 17,500 pounds troy per year. It is estimated that, between 1790 and 1830, Mexico produced $31,250,000 in gold, Chili $13,450,000, and Buenos Ayres $19,500,000, making an average annual yield of $16,050,000. The Russian mines in 1846 produced about $16,500,000; and in 1851, $15,000,000. The yield of California in 1849, the first year after the discovery of the gold, was $5,000,000. It rapidly increased from that year until 1853, when it was nearly $60,000,000. Since then it has diminished, and in 1866 the amount was but $27,000,000. Montana, Colorado, Idaho, and Nevada, raise the total from the United States for the year 1866 to $86,000,000, with $20,000,000 besides of silver. Australia produced $60.000,000 for a number of years; but for 1863, 1864, 1865, the average was not above $30,000,000, one-fourth to one-third of which came from the auriferous quartz.

The gold is obtained from the auriferous quartz by pulverizing, and then treating the finely-powdered quartz with mercury, a method well known to the ancients. This metal dissolves out the gold, producing an amalgam which, by straining and distillation, yields the gold. The auriferous pyrite is first powdered, and then roasted in an oven of peculiar construction until the sulphur is driven off. The residue, according to one process, pronounced the best, is treated with chlorine gas, and the metals thus converted into chlorids, of which the chlorid of gold is soluble. This is removed and then treated with protosulphate of iron, when the gold is deposited. According to another process, the residue is fused with litharge, and the gold is thus combined with lead, and afterward obtained from the lead by cupellation. By a third process, the auriferous pyrite, especially when cupriferous, is concentrated into a copper matt by partial roasting and fusion; the matt is then roasted, and the oxyd of copper taken up by dilute sulphuric acid, leaving the gold and silver in the residue.

2. SILVER. Luna *Alchem.* Gediegen Silber *Germ.* Argent natif *Fr.*

Isometric. Observed planes *O*, 1, *I*, *i*-2, *i*-4, 3-3. Figs. 1, 2, 6, 7, 15, 17. Cleavage none. Twins: composition face octahedral, like f. 50; but occurring also in the trapezohedron 3-3, and other forms. Commonly coarse or fine filiform, reticulated, arborescent; in the latter, the branches pass off either (1) at right angles, and are crystals (usually octahedrons) elongated in the direction of a cubic axis, or else a succession of partly overlapping crystals; or (2) at angles of 60°, they being elongated in the direction of a dodecahedral axis. Crystals generally obliquely prolonged or shortened, and thus greatly distorted. Also massive, and in plates or superficial coatings.

H.=2·5—3. G.=10·1—11·1, when pure 10·5. Lustre metallic. Color and streak silver-white; subject to tarnish, by which the color becomes grayish-black. Ductile.

Comp., Var.—Silver, with some copper, gold, and sometimes platinum, antimony, bismuth, mercury.

Var. 1. *Ordinary.* (*a*) crystallized; (*b*) filiform, arborescent; (*c*) massive.

2. *Auriferous; Küstelite.* (Güldisch-Silber *Hausm.*, Handb. 104, 1813. Küstelit *Breith.*, B. H. Ztg., xxv. 169, 1866.) Contains 10 to 30 p. c. of silver; color white to pale brass-yellow. There is a gradual passage to argentiferous gold (see GOLD).

The name *Küstelite* was given to an ore from Nevada, having the following characters: H.=2—2½; G.=11·32—13·10; color silver-white, somewhat darker than native silver on a fresh surface; Richter found in it silver, lead, and gold, the first much predominating. From the lode of the Ophir mine, Nevada, in bean-shaped grains.

3. *Cupriferous.* Contains sometimes 10 p. c. of copper.

4. *Antimonial.* John found in silver from Johanngeorgenstadt (Chem. Unt., i. 285) 1 p. c. antimony, and traces of copper and arsenic. (See further under Dyscrasite.)

The Kongsberg native silver contains 0·40 p. c. of *mercury* (D. Forbes), and the presence of this metal, Sæmann suggests, may account for its fine crystallization.

Fordyce (Phil. Trans., 1776, 523) found in silver from Kongsberg, Norway, silver 72, gold 28. Berthier (Ann. d. M., xi. 72) obtained 10 p. c. of copper from silver from Curcy, France.

Pyr., etc.—B.B. on charcoal fuses easily to a silver-white globule, which in O.F. gives a faint dark red coating of oxyd; crystallizes on cooling. Soluble in nitric acid, and deposited again by a plate of copper.

Obs.—Native silver occurs in masses, or in arborescences and filiform shapes, in veins traversing gneiss, schist, porphyry, and other rocks. Also occurs disseminated, but usually invisibly, in native copper, galena, chalcocite, etc.

The mines of Kongsberg in Norway, have afforded magnificent specimens of native silver. One among the splendid suite from this locality in the Royal collection at Copenhagen, weighs upwards of 5 cwt., and recently two masses have been obtained weighing severally 238 and 450 pounds. The principal Saxon localities are at Freiberg, Schneeberg, and Johanngeorgenstadt; the Bohemian, at Przibram, and Joachimsthal. A mass weighing 60 lbs. from the Himmelsfurst mine near Freiburg had G.=10·840. It also occurs in small quantities with other ores, at Andreasberg, in the Hartz; in Suabia; Hungary; at Allemont in Dauphiny; in the Ural near Beresof; in the Altai, at Zmeoff; and in some of the Cornish mines.

Mexico and Peru have been the most productive countries in silver. In Mexico, it has been obtained mostly from its ores, while in Peru it occurs principally native. A Mexican specimen from Batopilas weighed when obtained 400 pounds; and one from Southern Peru (mines of Huantaya) weighed over 8 cwt. During the first eighteen years of the present century, more than 8,180,000 marks of silver were afforded by the mines of Guanaxuato alone. In Durango, Sinaloa, and Sonora, in Northern Mexico, are noted mines affording native silver.

In the United States it is disseminated through much of the copper of Michigan, occasionally in spots of some size, and sometimes in cubes, skeleton octahedrons, etc., at various mines. It has been observed at a mine a mile south of Sing Sing prison, which was formerly worked for silver; at the Bridgewater copper mines, New Jersey; in interesting specimens at King's mine, Davidson Co., N. C.; at Prince's location, Lake Superior, Canada; rarely in filaments with barytes at Cheshire, Ct. In Idaho, at the "Poor Man's lode," large masses of native silver have been obtained. In Nevada, in the Comstock lode, it is rare, and mostly in filaments; at the Ophir mine rare, and disseminated or filamentous; in California, sparingly, in Silver Mountain district, Alpine Co.; in the Maris vein, in Los Angeles Co.; in the township of Ascot, Canada. The yield of the United States at the present time in silver is about $20,000,000.

Alt.—Pseudomorphs, consisting of horn silver, red silver ore, and argentite.

---

3. PLATINUM. Platina (fr. Choco) *Ulloa*, Relac. Hist. Viage Amer. Merid., lib. 6, c. 10, Madrid 1748. Platina (fr. Carthagena) *W. Brownrigg* (who received it in 1741 from C. Wood), Phil. Trans. 1750, 584. Platina del Pinto *Scheffer*, Ac. H. Stockh. 1752, 269. Polyxen *Hausm.*, Handb., 97, 1813, 20, 1847.

Isometric. Rarely in cubes or octahedrons (f. 1, 2). Usually in grains; occasionally in irregular lumps. Cleavage none.

H.=4—4·5. G.=16—19, 17·862, 17·759, two masses, G. Rose, 17·200, a smaller; 17·108, small grains, Breith.; 17·608, a mass, Breith.; 17·60, large mass from Nischne Tagilsk, Sokoloff. Lustre metallic. Color and streak whitish steel-gray; shining. Opaque. Ductile. Fracture hackly. Occasionally magneti-polar.

Comp.—Platinum combined with iron, iridium, osmium, and other metals. Analyses; 1—3, Berzelius (Ac. H. Stockholm 1828, 113); 4, 5, Osann (Pogg., viii. 505, xi. 411, xiii. 283, xiv. 329, xv. 158); 6, 7, Svanberg (Institut, ii. 294); 8 M. Böcking (Ann. Ch. Pharm., xcvi. 243); 9—20, H St. C. Deville & Debray (Ann. Ch. Phys. III., lvi. 449); 21, Kromayer (Arch. Pharm. II., cx. 14, Jahresb., 1862, 707):

	Pt	Au	Fe	Ir	Rh	Pd	Cu	I-O	Sand	Os	
1. Goroblago't	86·50	——	8·32	——	1·15	1·10	0·45	1·40	——	1·08	[a]=100 Berzelius.
2. N. Tagilsk	78·94	——	11·04.	4·97	0·86	0·28	0·70	1·96	——	1·25	[a]=100 Berzelius.
3. "	73·58	——	12.98	2·35	1·15	0·30	5·20	2·30	——	2·14	[a]=100 Berzelius.
4. "	83·07	——	10·79	1·91	0·59	0·26	1·30	1·80	——	——	=99·72 Osann.
5. Ural	80·87	——	10·92	0·06	4·44	1·30	2·30	0·11	——	——	=100 Osann.
6. Choco, S. A.	86·16	——	8·03	1·09	2·16	0·35	6·40	1·91	——	0·97	Mn 0·10=101·17 Sv.
7. Pinto?	84·34	——	7·52	2·52	3·13	1·66	*tr.*	1·56	——	0·19	" 0·31=101·23 Sv.
8. Borneo	82·60	0·20	10·67	0 66	——	——	0·13	3 80	——	——	=98·36 Böcking.
9. Choco	86·20	1·00	7·80	0·85	1·40	0·50	0·60	0·95	0·95	——	=100·25 D. & D.

	Pt	Au	Fe	Ir	Rh	Pd	Cu	I-O	Os	Sand
10. Choco	80·00	1·50	7·20	1 55	2·50	1·00	0·65	1·40	——	4·35=100·15 D & D.
11. "	76·82	1·22	7·43	1·18	1·22	1·14	0·88	7·98	——	2·41=100·28.
12. California	85·50	0·80	6·75	1·05	1·00	0·60	1·40	1·10	——	2·95=101·15.
13. "	79·85	0·55	4·45	4·20	0·65	1·95	0·75	4·95	0·05*	2·60=100·00.
14. "	76·50	1·20	6·10	0·85	1·95	1·30	1·25	7·55	1·25*	1·50 Pb ? 0·55=100.
15. Oregon	51·45	0·85	4·30	0·40	0·65	0·15	2·15	37·30	——	3·00=100·25.
16. Spain	45·70	3 15	6·80	0·95	2·65	0·85	1·05	2·85	0·05*	35·95=100·00.
17. Australia	59·80	2·40	4 30	2·20	1·50	1·50	1·10	25·00	0·80*	1·20=100·00.
18. "	61·40	1·20	4·53	1·10	1·85	1·80	1·10	26·00	——	1·20=100·20.
19. Russia	77·50	*und.*	9·60	1·45	2·80	0·85	2·15	2·35	2·30*	1·00=100·00.
20. "	76·40	0·40	11·70	4·30	0·30	1·40	4·10	0·50	——	1·40=100 50.
21. California	63·30	0·30	6·40	0·70	1·80	0·10	4·25	[22·55]	——	— Hg 0·60 =100 Krom

* the loss, with some osmium.

Var.—(1) Svanberg makes the Platinum of Nos. 2, 7, 8=Fe Pt^3; Fe Pt^4; (2) that of 3, 4, 5= Fe Pt^2. The last is called *Iron-Platinum* (*Eisenplatin, Breith.*); G.=14·6—15·8, H.=6.

Pyr., etc.—Infusible. Not affected by borax or salt of phosphorus, except in the state of fine dust, when reactions for iron and copper may be obtained. Soluble only in heated nitro-muriatic acid. Acts slightly on the magnet; this property has been supposed to depend on the amount of iron it contains; but Kokscharof states that platinum masses from Nischne Tagilsk are magneti-polar, and attract iron filings far more strongly than the ordinary magnet.

Obs.—Platinum was first found in pebbles and small grains, associated with iridium, osmium, palladium, gold, copper, and chromite, in the alluvial deposits of the river Pinto, in the district of Choco, near Popayan, in South America, where it received its name *platina*, from *plata*, *silver*. In the province of Antioquia, in Brazil, it has been found in auriferous regions in syenite (Boussingault).

In Russia, where it was first discovered in 1822, it occurs at Nischne Tagilsk, and Goroblagodat, in the Ural, in alluvial material; the gravel has been traced to a great extent up Mount La Martiane, which consists of crystalline rocks; in Nischne Tagilsk, it has been found with chromite in serpentine. Formerly used as coins by the Russians. Russia affords annually about 800 cwt. of platinum, which is nearly ten times the amount from Brazil, Columbia, St. Domingo, and Borneo. The amount coined from 1826 to 1844, equalled two and a half millions of dollars.

Platinum is also found on Borneo, which furnishes 600 to 800 lbs. annually; in the sands of the Rhine; at St. Aray, val du Drac; county of Wicklow, Ireland; on the river Jocky. St. Domingo: according to report, in Choloteca and Gracias, in Honduras; in California, in the Klamath region, at Cape Blanco, etc., but not abundant; in traces with gold in Rutherford Co., North Carolina; at St. François Beauce, etc., Canada East.

Although platinum generally occurs in quite small grains, masses are sometimes found of considerable magnitude. A mass weighing 1,088 grains was brought by Humboldt from South America, and deposited in the Berlin museum; specific gravity 18·94. In 1822, a mass from Condoto was deposited in the Madrid museum, measuring two inches and four lines in diameter, and weighing 11,641 grains. A specimen was found in the year 1827, in the Ural, not far from the Demidoff mines, which weighed 10$\frac{9}{16}$ Russian pounds, or 11·57 pounds troy, and similar masses are not uncommon; the largest yet seen weighed 21 pounds troy, and is in the Demidoff cabinet.

The metal platinum was brought from Choco, S. A., by Ulloa, a Spanish traveller in America, in the year 1735, and from Carthagena, by Charles Wood, who procured it in Jamaica. Ulloa speaks of specula made by the people of the country, of a peculiar metal, which Brownrigg says was "platina," and the latter mentions a "pummel of a sword," and other articles of platinum, received by him from Carthagena.

4. PLATINIRIDIUM. *Svanberg*, Jahresb., xv. 205, 1834.

Isometric. In small grains with Platinum; sometimes in cubes with truncated angles, (f. 6). H.=6—7; G.=22·6—23. Color white.

Comp.—Platinum and iridium in different proportions. Analyses by Svanberg:

	Plat.	Irid.	Pallad.	Rhod.	Fe	Cu	Os	
1. N. Tagilsk	19·64	76·80	0 89	——	——	1·78	——	=99·11
2. Brazil	55·44	27·79	0·49	6·86	4·14	3·30	*trace*	=98·02

Prinsep, in a specimen from Ava in India, found 60 of iridium and 20 of platinum. If platinum and iridium are isomorphous, it is probable that the proportions of these metals are indefinite.

Dr. Genth, after some trials, considers some grains occurring with the California gold to be Platiniridium. Am. J. Sci. II., xv. 246.

5. PALLADIUM. *Wollaston*, Phil. Trans. 1808.

Isometric. In minute octahedrons, Haid. Mostly in grains, sometimes composed of diverging fibres.

H.=4·5—5. G.=11·3—11·8, Wollaston; of hammered, 12·148, Lowry. Lustre metallic. Color whitish steel-gray. Opaque. Ductile and malleable.

Comp.—Palladium, alloyed with a little platinum and iridium, but not yet analyzed.

Pyr., etc.—The blowpipe reactions of *native* palladium are undescribed. As prepared by Deville, it is the most fusible of the platinum metals. Oxydizes at a lower temperature than silver, but is not blackened by sulphurous gases.

Obs.—Palladium occurs with platinum, in Brazil, where quite large masses of the metal are sometimes met with; also reported from St. Domingo, and the Ural.

Palladium has been employed for balances; also for the divided scales of delicate apparatus, for which it is adapted, because of its not blackening from sulphur gases, while at the same time it is nearly as white as silver.

6. ALLOPALLADIUM. Selenpalladium *Zinken*, Pogg., xvi. 496, 1829. Palladium pt.

Hexagonal, Zinken. In small six-sided tables. Cleavage: basal perfect. Lustre bright. Color nearly silver-white to pale steel-gray.

Comp.—Palladium, under the hexagonal system, the metal being dimorphous; the formula probably Pd^2, instead of Pd.

Obs.—From Tilkerode, in the Harz, in small hexagonal tables with gold.

7. IRIDOSMINE. Ore of Iridium, consisting of Iridium and Osmium, *Wollaston*, Phil. Trans., 1805, 316 (Metals Iridium and Osmium, first announced by *Tennant*, Phil. Trans., 1804, 411). Native Iridium *Jameson*. Osmiure d' Iridium *Berz.*, Nouv. Syst. Min., 195, 1819. Osmium-Iridium *Leonh.*, Handb., 1821. Iridosmium; Osmiridium. Newjanskit, Sisserskit, *Haid.* Handb., 558, 1845.

Hexagonal. Rarely in hexagonal prisms with replaced basal edges: pyramidal angle, 127° 36′, basal, 124°. Commonly in irregular flattened grains.

H.=6—7. G.=19·3—21·12. Lustre metallic. Color tin-white, and light steel-gray. Opaque. Malleable with difficulty.

Comp. Var.—Iridium and osmium in different proportions. Two varieties depending on these proportions have been named as species, but they are isomorphous, as are those of the metals (G. Rose). Some rhodium, platinum, ruthenium, and other metals are usually present.

Var. 1. *Newjanskite*, Haid.; H.=7; G.=18·8—19·5. In flat scales; color tin-white. Over 40 p. c. of Iridium. Named from a Siberian locality.

Analysis by Berzelius (Pogg., xxxii. 232, 1833):

Ir 46·77, Os 49·34, Rd 3·15, Fe 0·74, giving the formula Ir Os=Iridium 49·78, Osmium 50·22 G.=19·386—19·471.

Claus obtained (Beitr. Platinum, Dörpat, 1854) from six-sided tables from Nischne-Tagilsk:

Ir 55·24 Os 27·32 Pl 10 08 Rd 1·50 Pd Fe Cu *tr*,=100.

Deville and Debray (Ann. Ch. Phys., III. lvi. 481) found:

			Ir	Rd	Pt	Ru	Os	Cu	Fe
1.	N. Grenada		70·40	12·30	0·10	——	[17·20]	——	——=100
2.	"		57·80	0·63	——	6·37	35·10	0·06	0·10=100·06
3.	California		53·50	2·60	——	0·50	[43·40]	——	——=100
4.	Australia		58·13	3·04	——	5·22	[33·46]	0·15	——=100
5.	Borneo		58·27	2·64	0·15	——	[38·94]	——	——=100
6.	Russia		77·20	0·50	1·10	0·20	[21·00]	*tr.*	——=100
7.	"	G.=18·9	43·28	5·73	0·62	8·49	[40·11]	0·78	0 99=100

			Ir	Rd	Pt	Ru	Os	Cu	Fe
8.	Russia	G.=18·8	64·50	7·50	2·80	——	[22·90]	0·90	1·40=100
9.	"	G.=20·4	43·94	1·65	0·14	4·68	[48·85]	0·11	0·63=100
10.	"	G.=20·5	70·36	4·72	0·41		[23·01]	0·21	1·29=100

Thomson found in a steel-gray variety from Brazil 72·9 p. c. of iridium, with 24·1 osmium and 2·6 iron=100.

2. *Sisserskite* Haid. In flat scales, often six-sided, color grayish-white, steel-gray. G=20—21·2. Not over 30 p. c. of iridium. One kind from Nischne Tagilsk afforded Berzelius (l. c.) Ir Os^4=Iridium 19·9, osmium 80·1=100; G.=21·118. Another corresponded to the formula Ir Os^3=Iridium 24·8, osmium 75·2=100, it affording Ir 25, Os 75. Named from a Siberian locality.

Pyr., etc.—At a high temperature the Sisserskite gives out osmium, but undergoes no further change. The Newjanskite is not decomposed and does not give an osmium odor. With nitre, the characteristic odor of osmium is soon perceived, and a mass obtained soluble in water, from which a green precipitate is thrown down by nitric acid.

Obs.—It occurs with platinum in the province of Choco in South America; near Katharinenburg, Statoust, and Kyschtimsk, in the Ural mountains; in Australia. It is rather abundant in the auriferous beach-sands of northern California, occurring in small bright lead-colored scales, sometimes six-sided. Also traces in the gold-washings on the rivers du Loup and des Plantes, Canada.

8. **MERCURY.** Χυτὸς ἄργυρος *Theophr.* Ὑδράργυρος καθ' ἑαυτὴν [native] *Dioscor.*, E, cx. Argentum vivum, Hydrargyros, *Plin.* xxxiii. 32, 20, 41. Quicksilver. Mercurius *Alchem.* Gediegen Quecksilber *Germ.* Mercure natif *Fr.*

Isometric. Occurs in small fluid globules scattered through its gangue. G.=13·568. Lustre metallic. Color tin-white. Opaque.

Comp.—Pure mercury (Hg); with sometimes a little silver.

Pyr., etc.—B.B., entirely volatile, vaporizing at 662° F. Becomes solid at —39° F, and may be crystallized in octahedrons. Dissolves readily in nitric acid.

Obs.—Mercury in the metallic state is a rare mineral; the quicksilver of commerce is obtained mostly from cinnabar, one of its ores. The rocks affording the metal and its ores are mostly clay shales or schists of different geological ages.

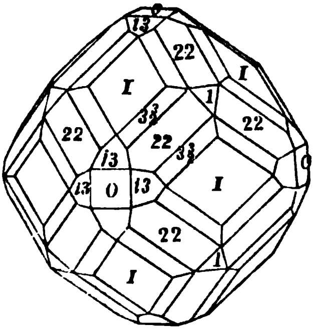
At Cividale, in Venetian Lombardy, it is found in a marl regarded as a part of the Eocene nummulitic beds. Mercury has been observed occasionally in *drift;* and near Eszbetek, in Transylvania, and also Newmarkt, in Galicia, springs, issuing from the Carpathian sandstone, sometimes bear along globules of mercury. Its most important mines are those of Idria, in Carniola, and Almaden in Spain. At Idria it occurs interspersed through a clay slate, from which it is obtained by washing. It is found in small quantities at Wölfstein and Mörsfeld, in the Palatinate, in Carinthia, Hungary, Peru, and other countries; also at Peyrat le Chateau, in the department of the Haute Vienne, in a disintegrated granite, unaccompanied by cinnabar; in California, especially at the Pioneer mine, in the Napa Valley, where some of the quartz geodes contain several pounds of mercury.

9. **AMALGAM.** Quicksilfwer amalgameradt med gediget Silfwer (fr. Sala) *Cronst.*, 189, 1758. Naturlich Amalgam, Silberamalgam, *Germ.* Amalgam natif *de Lisle*, i. 420, 1783. Mercure argental *H.* Pella natural *Del Rio.*

Isometric. Observed planes, as in f. 54, with also plane 2. Figure 3 common; also 4, 5, 8, 9, 13, 14. Cleavage: dodecahedral in traces. Also massive.

H.=3—3·5. G.=13·75—14; 13·755, Haid. Color and streak silver-white. Opaque. Fracture conchoidal, uneven. Brittle, and giving a grating noise when cut with a knife.

54



Comp.—Both $AgHg^2$ (=Silver 34·8, mercury, 65·2), and $AgHg^3$ (=Silver 26·25, and mercury, 73·75), are here included as afforded by the following analyses: 1, Klaproth (Beitr., i. 182); 2, Cordier (J. d. M., xii. 1, Phil. Mag., xix. 41); 3, Heyer (Crell's Ann., ii. 90):

	Silver.	Mercury.	
1. $Ag\ Hg^2$, Moschellandsberg	36	64 =100	Klaproth.
2. $Ag\ Hg^3$, Allemont ?	27·5	72·5=100	Cordier.
3. " Moschellandsberg	25·0	73·3= 98·3	Heyer.

Pyr., etc.—B.B., on charcoal the mercury volatilizes and a globule of silver is left. In the closed tube the mercury sublimes and condenses on the cold part of the tube in minute globules Dissolves in nitric acid. Rubbed on copper it gives a silvery lustre.

Obs.—From the Palatinate at Moschellandsberg, in fine crystals, and said to occur where the veins of mercury and silver intersect one another. Also reported from Rosenau in Hungary, Sala in Sweden, Allemont in Dauphiné, Almaden in Spain.

Domeyko reports (Min., 187, Ann. d. M., VI. ii. 123, v. 453) other compounds from the mines of La Rosilla, province of Atacama; one of white color, with Hg 56·4, Ag 43·6; 2, white with (mean of 3 anal.) Hg 53·2, Ag 46·8=$Ag^3\ Hg^4$; 3, granular and dull, (mean of 3 anal.) Hg 44·9, Ag 55·1=Ag Hg; 4, blackish and dull, (mean of 3 anal.) Hg 46·6, Ag 53·4; 5, blackish and dull metallic, sometimes in crystals, Hg 35·8, Ag 64·2=Ag^6H^2.

Of the last there is a mass in the museum at Santiago, Chili, weighing 21¾ lbs. These may be only mixtures of a true chemical amalgam with silver.

10. ARQUERITE. Arquerite *Berth.*, *de B.*, *& Duf.*, C. R., xiv. 567, 1842, in Rep. on Art. by *Domeyko*, pub. in Ann. d. M., III. xx. 268, 1841.

Isometric. In regular octahedrons; also in grains, small masses, and dendrites. G.=10·8. In color, lustre, ductility like native silver, but softer.

Comp.—According to Domeyko (l. c.) the crystallized contains $Ag^6\ Hg$=Silver 86·5, mercury 13·5=100.

Obs.—From the mines of Arqueros, in Coquimbo, Chili, where it is the principal ore In the first fifteen years of exploration these mines afforded 200,000 marcs of silver. Occurs with barite, cobalt bloom, and little sulphuret and chlorid of silver.

11. GOLD AMALGAM. *H. Schneider*, J. pr. Ch., xliii. 317, 1848.

In small white grains as large as a pea, easily crumbling (Columbia variety); also in yellowish-white, four-sided prisms (California variety).

Comp.—$(Au, Ag)^2\ Hg^5$, an analysis by Schneider of a specimen from Columbia (l. c.), affording, mercury 57·40, gold 38·39, silver 5·0.

The California amalgam gave Sonnenschein (ZS. G., vi. 243), gold 39·02, mercury 60·98; also another, gold 41·63, mercury 58·37, in which Au: Hg=2: 3.

Obs.—From the platinum region of Columbia, along with platinum; California, especially near Mariposa.

12. COPPER. Aes Cyprium *Plin.* Venus *Alchem.* Gediegen Kupfer *Germ.* Cuivre natif *Fr.*

Isometric. Observed forms O, 1, I, i-2, i-$\frac{5}{2}$, 3-3. Figs. 1, 2, 3, 4, 5, 6, 7, 8, 16, 17, and others. Cleavage none. Twins; composition-face octahedral, very common, and producing, in connection with distortion, complex forms; one a double six-sided pyramid, made of the six planes i-2 about one cubic angle of f. 17, and the six about the diagonally opposite, the rest wanting. Often filiform and arborescent; the latter with the branches passing off usually at 60°, the supplement of the dodecahedral angle; the branches sometimes twin-dodecahedrons modified by planes O, 1, and the composition-face longitudinal, but contained under only one dodecahedral plane along the upper side of the branch, and either side of this one octahedral and one cubic, with an oblique extremity made up of two cubic planes (Rose). Also massive.

H.=2·5—3. G.=8·838, native, Whitney; 8·948—8·958, electrotype copper, Dick. Lustre metallic. Color copper-red. Streak metallic shining. Ductile and malleable. Fracture hackly.

Comp.—Pure copper, but often containing some silver, bismuth, etc.

P. Collier obtained 0·015 p. c. silver in native copper from the Minnesota mine. (Private communication.)

Hautefeuille states that a Lake Superior specimen afforded him, Copper 69·280, silver 5·543, mercury 0·0119, gangue 25·248 (C. R., xliii. 166); while F. A. Abel found in a specimen of same, which had a thick vein of native silver running through it (J. Ch. Soc., II. i. 89), 0·002 p. c. of silver, with a trace of lead, and in another 0·56 of silver. Abel obtained for a Uralian, from the Kirghiz District, 0·034 silver, 0·11 bismuth, a trace of lead, and 1·28 of arsenic.

Pyr., etc.—B.B. fuses readily; on cooling, becomes covered with a coating of black oxyd. Dissolves readily in nitric acid, giving off red nitrous fumes, and produces a deep azure-blue solution with ammonia.

Obs.—Copper occurs in beds and veins accompanying its various ores, and is most abundant in the vicinity of dikes of igneous rocks. It is sometimes found in loose masses imbedded in the soil.

In Siberia, and the island of Nalsoe, in Faroe, it is associated with mesotype, in amygdaloid, and though mostly disseminated in minute particles, sometimes branches through the rock with extreme beauty. At Turinsk, in the Urals, in fine crystals. Common in Cornwall, at many of the mines near Redruth; and also in considerable quantities at the Consolidated mines, Wheal Buller, and others. Brazil, Chili, Bolivia, and Peru afford native copper; a mass now in the museum at Lisbon, supposed to be from a valley near Bahia, weighs 2,616 pounds; north of Tres Puntos, desert of Atacama, a large vein was discovered in 1859. In Bolivia, at Corocoro, in sandstone, and called in commerce "*Barilla de Cobre*" (copper barilla). Also found at some localities in China and Japan.

This metal has been found native throughout the red sandstone (Triassico-Jurassic) region of the eastern United States, in Massachusetts, Connecticut, and more abundantly in New Jersey, where it has been met with sometimes in fine crystalline masses, especially at New Brunswick, Somerville, Schuyler's mines, and Flemington. One mass from near Somerville, on the premises of J. C. Van Dyke, Esq., of N. Brunswick, weighed 78 pounds, and is said originally to have weighed 128. Near N. Brunswick a vein or sheet of copper, a line or so thick, has been traced for several rods. Near New Haven, Conn., a mass was formerly found weighing 90 pounds.

No known locality exceeds in the abundance of native copper the Lake Superior copper region, near Kewenaw Point, where it exists in veins that intersect the trap and sandstone. The annual yield of native copper at the present time is about 8,000 tons. Masses of great size were observed in this district near the Ontanagon river, by Mr. Schoolcraft, in 1821. The largest single mass yet found was discovered in February, 1857, in the Minnesota mine, in the belt of conglomerate, which forms the foot-wall of the vein. It was 45 feet in length, 22 feet at the greatest width, and the thickest part was more than 8 feet. It contained over 90 p. c. copper, and weighed about 420 tons. This copper contains silver, sometimes in visible grains, lumps, or strings, and occasionally a mass of copper, when polished, appears sprinkled with large silver spots, resembling, as Dr. Jackson observes, a porphyry with its feldspar crystals. The copper occurs in trap or sandstone, near the junction of these two rocks, and has probably been produced through the reduction of copper ores. It is associated with prehnite, datolite, analcite, laumontite, pectolite, epidote, chlorite, wollastonite, and sometimes coats amygdules of calcite, etc., in amygdaloid. Strings of copper often reticulate through crystals of analcite and prehnite. Pseudomorphs after scalenohedrons of calcite are sometimes met with. Besides this occurrence in the vicinity of trap, it is also in some parts of the Kewenaw region distributed widely in grains through the sandstone.

Native copper occurs sparingly in California; at the Union and Keystone, Napoleon and Lancha Plana mines in Calaveras Co.; in the Cosumnes mine, Amador Co.; in serpentine, in Sta. Barbara Co. Also on the Gila river in Arizona; in large drift masses in Russian America.

13. IRON. Mars *Alchem.* Gediegen Eisen *Germ.* Fer natif *Fr.*

Isometric. Cleavage octahedral.

H.=4·5. G.=7·3—7·8; 7·318 a partially oxydized fragment of a crystal of meteoric iron from Guilford Co., N. C. Lustre metallic. Color iron-gray. Streak shining. Fracture hackly. Ductile. Acts strongly on the magnet.

Obs.—The occurrence of masses of native iron apart from that of meteoric origin is not placed beyond doubt. An iron so regarded, with some reason, occurs in the hill country above Bexley in Bassa Co., Liberia, Africa. An analysis afforded A. A. Hayes (Am. J. Sci., II. xxi. 153) iron 98·40, quartz grains, magnetite and a zeolite 1·60 = 100. The mass of iron, from Canaan, Ct., published as native, was artificial. A fragment of iron found near Knoxville, Tenn., but of uncertain exact locality and possibly meteoric, afforded Genth (ib., xxviii. 246) Iron 99·79, nickel 0·14, magnesium 0·022, calcium 0·121, silicium 0·075. cobalt *trace* = 100·148. Cramer describes a mass weighing four pounds, obtained in the mine of Hackenburg. It is said to have been observed in thin laminæ in an ironstone conglomerate in Brazil, and in lava in Auvergne; also in the keuper in Thuringia, in an argillaceous sandstone, containing fossils; it afforded but a trace of nickel: G. = 5·24, (Pogg., lxxxviii. 1853. 145, where other localities are mentioned); also at Chotzen in Bohemia, in a limestone (the *Planerkalk*), affording on analysis Fe 98·83, graphite 0·74, As 0·32, Ni 0·61, and thought to be possibly an ancient meteorite (Jahrb. G. Reichs., viii. 354).

The presence of metallic iron in grains in basaltic rocks (from Giant's Causeway, etc.) has been announced by Dr. Andrews. After pulverizing the rock and separating by means of a magnet the grains that were attracted by it, he subjected the grains to the action of an acid solution of sulphate of copper in the field of a microscope, which salt, when there is a trace of *pure* iron present, gives a deposit of copper; and in his trials there were occasional deposits of copper in crystalline bunches. It has been noticed in other related rocks.

Meteoric iron usually contains 1 to 20 per cent. of nickel, besides a small percentage of other metals, as cobalt, manganese, tin, copper, chromium; also phosphorus common as a phosphuret, sulphur in sulphurets, carbon in some instances, chlorine.

For a review of papers on meteoric iron, see Rammelsberg's Handbuch der Mineralchemie (Liepzig, 1860). The following are a few analyses: 1, Berzelius (Ac. H. Stockh., 1834, Pogg., xxxiii. 123); 2, Bergemann (Pogg., lxxviii. 406); 3, W. S. Clarke (Ann. Ch. Pharm., lxxxii. 367); 4, Berzelius (Ac. H. Stockh., 1832, Pogg., xxvii. 118); 5, J. L. Smith (Am J. Sci., II. xix. 153):

	1 Siberia.	2 Zatatecas, Mexico.	3 Lenarto.	4 Bohumilitz.	5 Knoxville, Tenn.
Iron	88·042	85·09	90·153	93·77	83·02
Nickel	10·732	9·89	6·553	3·81	14·62
Cobalt	0·455	0·67	0·502	0·21	0·50
Manganese	0·132	——	0·145	——	——
Copper Tin	0·066	0·03	0·080	——	0·06
Magnesium	0·050	0.19	0·082	——	——
Carbon	0·043	C, Fe 0·33	——	——	$\dot{\text{M}}\text{g}$ 0·24
Sulphur	*tr.*	0·84	0·482	——	0·08
Fe, Ni, P		1·65	1·226	2·14	P 0·19
Chrome-iron		1·48	——	$\ddot{\text{S}}\text{i}$ 0·04	$\ddot{\text{S}}\text{i}$ 0·84
Gangue	0·480	——	——	$\ddot{\text{C}}$ 0·03	Cl 0·02
	100·000	100·33	99·223	100·00	99·57

Reichenbach has named the alloy of iron and nickel, containing up to 23 p. c. of the latter, *Chamasite*; that approaching probably the formula $Fe^4 Ni^3$, *Tænite*; and to that having the formula Fe Ni, Shepard has applied the name *Oktibbehite.* The phosphorus in the analyses is combined with iron as *Schreibersite*; the sulphur as *Troilite*; the magnesia, in anal. 5, with the silica probably as *Enstatite.*

Among large iron meteorites, the Gibbs meteorite, in the Yale College cabinet, weighs 1,635 lbs.; length three feet four inches; breadth two feet four inches; height one foot four inches. It was brought from Red River. The Tucson meteorite, now in the Smithsonian Institution, weighs 1,400 lbs.; it was originally from Sonora. It is ring-shaped, and is 49 inches in its greatest diameter. Still more remarkable masses exist in South America; one was discovered by Don Rubin de Celis in the district of Chaco-Gualamba, whose weight was estimated at 32,000 lbs.; and another was found at Bahia in Brazil, whose solid contents are at least twenty-eight cubic feet, and weight 14,000 lbs. The Siberian meteorite, discovered by Pallas, weighed originally 1,600 lbs. and contained imbedded crystals of chrysolite. Smaller masses are quite common. Meteoric iron is perfectly malleable, and may be readily worked in a forge, and put to the same uses as manufactured iron.

Bahr has observed grains of native iron in a fragment of petrified wood. The iron was mixed with limonite and organic matter, and is supposed to have been produced by the deoxydation of a salt of iron by the organic matter of the wood. He calls the iron *Sideroferrite.*

Von Dechen reports that an artificial iron has been observed by him, which has *cubic* cleavage (Verh. nat. Ver. Bonn, 1861.)

14. ZINC.

Hexagonal, Rose. Cleavage: basal perfect.

H.=2. G.=7. Lustre metallic. Color and streak white, slightly grayish.

Comp.—Zinc, with sometimes a trace of cadmium and other metals.

Obs.—Reported by G. Ulrich as having been found in a geode in basalt, near Melbourne, Victoria Land, Australia; the piece weighed 4½ ozs., and was incrusted with smithsonite and aragonite, and some cobalt bloom. Also said to occur in the gold sands of the Mittamitta river, north of Melbourne, along with topaz, corundum, etc.; a single piece, according to L. Becker, having been found which contained traces of cadmium and other metals. (L. Becker, in Trans. Phil. Inst., Victoria, 1856, and Jahrb. Min., 1857, 312, 698; G. Ulrich, in B. H. Ztg., xviii. 63.) It should be stated that the zinc said to come from the Melbourne basalt was found by a quarryman and not by a scientific observer, and that therefore there may be an error with regard to its actually having been taken from the basalt. The existence of native zinc seems still to need confirmation.

Stolba has recently obtained artificially hexagonal crystals of zinc, six-sided prisms with low pyramidal terminations (J. pr. Ch., xcvi. 182). Zinc is supposed to occur also in isometric forms (Am. J. Sci., II. xxxi. 191).

15. **LEAD.** Plumbum nigrum *Plin.*, xxxiv. 47. Saturnus *Alchem.* Gediegen Blei *Germ.* Plomb natif *Fr.*

Isometric. Found in thin plates and small globules.

H.=1·5. G.=11·445, when pure. Lustre metallic. Color lead-gray. Malleable and ductile.

Comp. Pure lead.

Pyr.—B.B. fuses easily, coating the charcoal with a yellow oxyd, which, treated in R. F., volatilizes, giving an azure-blue tinge to the flame.

Obs.—This species is reported as occurring in globules in galena at Alstonmoor; in lava in Madeira, Rathke; at the mines near Carthagena in Spain; in Carboniferous limestone near Bristol, and at Kenmare, Ireland; according to R. P. Greg, Jr., in thin sheets in red oxyd of lead near a basaltic dyke in Ireland; in an amygdaloid near Weissig; in basaltic tufa, at Rautenberg, in Moravia; with gold in an Altai gold region, seven miles from Mt. Alatau; the gold region of Velika, southern Slavonia; near Katherinenburg, in the Urals; in the district of Zomelahuacan, in the State of Vera Cruz, in a granular limestone, containing in some places species of ammonites, in laminæ, in a foliated argentiferous galena; in the iron and manganese ore bed of Paisberg, Wermland, with hematite, magnetite, and hausmannite (B. H. Ztg., xxv. 21); also in white quartz north-west of Lake Superior, near the Dog lake of the Kaministiquia, in the form of a small string (Chapman, Can. J., 1865).

---

16. **TIN.** Plumbum candidum *Plin.*, xxxiv. 47. Jupiter *Alchem.* Gediegen Zinn *Germ.* Etain natif *Fr.*

Tetragonal. $1 \wedge 1$, over basal edge, $=57° 13'$, over pyramidal $=140° 25'$, $1\text{-}i \wedge 1\text{-}i$, over basal edge, $=42° 11'$, over pyramidal $=150° 31'$; $a=0·38566$. In grayish-white metallic grains.

Comp.—Tin with some lead, *Hermann*, J. pr. Ch., xxxiii. 300.

Obs.—The above angles are from artificial crystals galvanically deposited, measured by Miller. Reported as occurring with the Siberian gold; also in the Rio Tipuani valley, in Bolivia, but probably only an artificial product (D. Forbes, Phil. Mag., IV. xxix. 133, xxx. 142.)

---

17. **ARSENIC.** Gediegen Arsenik *Germ.* Arsenic natif *Fr.*

Rhombohedral. $R \wedge R=85° 41'$, $O \wedge R=122° 9'$, $a=1·3779$. Observed forms R, $-\frac{1}{2}$, O; $-\frac{1}{2} \wedge -\frac{1}{2}=113° 21'$. Cleavage: basal, imperfect. Often granular massive; sometimes reticulated, reniform, and stalactitic. Structure rarely columnar.

H.=3·5. G.=5·93. Lustre nearly metallic. Color and streak tin-white, tarnishing soon to dark-gray. Fracture uneven and fine granular.

Comp.—Arsenic, often with some antimony, and traces of iron, silver, gold, or bismuth.

The *arsenical bismuth* of Werner (Arsenik Wismuth *Wern.*, Letztes Min.-Syst., 23, 56. 1817 *Breith.*, Char., 157, 1823, Arsenik-Glanz, Wismutischer Arsen-Glanz, *Breith.*, Char., 273, 1832), from Marienberg, is arsenic containing 3 p. c. of bismuth. H.=2; G.=5·36—5·39.

Pyr.—B.B., on charcoal volatilizes without fusing, coats the coal with white arsenous acid, and affords the odor of garlic; the coating treated in R. F. volatilizes, tinging the flame blue.

Obs.—Native arsenic commonly occurs in veins in crystalline rocks and the older schists, and is often accompanied by ores of antimony, red silver ore, realgar, blende, and other metallic minerals.

The silver mines of Freiberg, Annaberg, Marienberg, and Schneeberg, afford this metal in considerable quantities; also Joachimsthal in Bohemia, Andreasberg in the Harz, Kapnik in Transylvania, Oravicza in Hungary, Kongsberg in Norway, Zmeoff in Siberia, in large masses, and at St. Maria aux Mines in Alsace; abundantly, at the silver mines at Chanarçillo, and elsewhere in Chili. In the United States it has been observed by Jackson at Haverhill, N. H., on the estate of Mr. Francis Kimball, in thin layers in dark-blue mica slate, stained by plumbago, and containing also white and magnetic pyrites; also at Jackson, N. H.; on the E. flank of Furlong Mtn., Greenwood, Me.

The name arsenic is derived from the Greek ἀρσενικόν or ἀρρενικόν, *masculine*, a term applied to orpiment or sulphuret of arsenic, on account of its potent properties.

Alt.—Oxydizes on exposure, producing a black crust, which is a mixture of arsenic and arsenolite (Äs), and also pure arsenolite.

17A. Antimonial Arsenic.—An antimonial arsenic, containing, according to Schultz (Ramm. Min. Ch., 984), 7·97 p. c. of antimony, occurs at the Palmbaum mine, near Marienberg in Saxony. A similar compound, consisting, according to Genth (Am. J. Sci., II. xxxiii. 191), of arsenic 90·82 and antimony 9·18 (=17 As+1 Sb), occurs at the Comstock "lead" of the Ophir mine, Washoe Co., California, in finely crystalline, and somewhat radiated, reniform masses, between tin-white and iron-black on a fresh fracture, but grayish-black on tarnishing, associated with arsenolite, calcite, and quartz.

18. ANTIMONY. Gediget Spitsglas (fr. Sahlberg) *v. Swab.*, Ak. H. Stockh., x. 100, 1748, *Cronst.*, Min., 201, 1758. Spiesglas, Gediegen Antimon, *Germ.* Antimoine natif *Fr.*

Rhombohedral. $R \wedge R = 87° \ 35'$, Rose, $O \wedge R = 123° \ 32' \wedge a = 1·3068$. Observed planes, R, O, $\frac{1}{4}$, -2, i-2; $O \wedge \frac{1}{2}$ (cleavage plane)$=142° \ 58'$. $\frac{1}{2} \wedge \frac{1}{2} = 117° \ 7'$, $2 \wedge 2 = 89° \ 25'$, $\frac{1}{4} \wedge \frac{1}{4} = 144° \ 24'$, $O \wedge \frac{1}{4} = 159° \ 26'$, $O \wedge 2 = 108° \ 20'$. Cleavage: basal, highly perfect;—$\frac{1}{2}$ distinct. Generally massive, lamellar; sometimes botryoidal or reniform with a granular texture.

H.=3—3·5 G.=6·646—6·72,; 6·65—6·62, crystals, Kenngott. Lustre metallic. Color and streak tin-white. Very brittle.

Comp.—Antimony, containing sometimes silver, iron, or arsenic Analysis by Klaproth (Beitr., iii. 169): from Andreasberg, Antimony 98, silver 1, iron 0 25=99·25.

Pyr.—B.B., on charcoal fuses, gives a white coating in both O. and R. F.; if the blowing be intermitted, the globule continues to glow, giving off white fumes, until it is finally crusted over with prismatic crystals of oxyd of antimony. The white coating tinges the R. F. bluish-green. Crystallizes readily from fusion.

Occurs in lamellar concretions in limestone at Sahlberg, near Sahl, in Sweden; at Andreasberg in the Harz; in argentiferous veins in gneiss at Allemont in Dauphiny; at Przibram in Bohemia; in Mexico; Huasco, Chili; Sarawak in Borneo; in argillite at South Ham, Canada; at Warren, N. J.; at Prince William antimony mine, N. Brunswick, rare.

Alt.—Oxydizes on exposure and forms Valentinite (S̈b).

19. ALLEMONTITE. Antimoine natif arsenifère *H.*, Tr. iv. 281, 1822. Arsenikspiessglanz *Zippe*, Verh. Ges. Mus. Böhmen, 1824, 102. Arsenik-Antimon *Hausm.* Arseniure d' Antimoine *Fr.* Antimon-Arsen *Naum.* Arsenical Antimony, Allemontit, *Haid.*, Handb., 557, 1845.

Rhombohedral. In reniform masses and amorphous; structure curved lamellar; also fine granular.

H.=3·5. G.=6·13, Thomson; 6·203, Rammelsberg. Lustre metallic, occasionally splendent; sometimes dull. Color tin-white, or reddish-gray; often tarnished brownish-black.

Comp.—$SbAs^3$=Arsenic 65·22, antimony 34·78 Analysis by Rammelsberg of the Allemont ore (1st Supp. 18): Arsenic 62·15, antimony 37·85=100, giving 1 Sb to 2·6 As.

Pyr.—B.B. emits fumes of arsenic and antimony, and fuses to a metallic globule, which takes fire and burns away, leaving oxyd of antimony on the charcoal.

Obs.—Occurs sparingly at Allemont; Przibram in Bohemia, associated with blende, antimony, spathic iron, etc.; Schladmig in Styria; Andreasberg in the Harz.

20. **BISMUTH.** Bisemutum, Plumbum cinereum, *Agric.*, Foss., 439, Interpr. 467. Antimonium femininum, Tectum Argenti, *Alchem.* Gediegen Wismuth *Germ.*

Hexagonal. $R \wedge R=87^\circ\ 40'$, G. Rose; $O \wedge R=123^\circ\ 36'$; $a=1·3035$. Observed planes, R, $-R$, O, 2, and -2; $2 \wedge 2=69^\circ\ 28'$. Cleavage: basal, perfect, 2, -2, less so. Also in reticulated and arborescent shapes; foliated and granular.

H.=2—2·5. G.=9·727. Lustre metallic. Streak and color silver-white, with a reddish hue; subject to tarnish. Opaque. Fracture not observable. Sectile. Brittle when cold, but when heated somewhat malleable.

Comp. Var.—Pure bismuth, with occasional traces of arsenic, sulphur, tellurium. (1) A specimen from a gold mine of the Peak of Sorata gave Genth (Am. J. Sci., II. xxvii. 247), Bi 99·914, Te 0·042, Fe *tr*=99·956; and (2) Forbes (Phil. Mag., IV. xxix. 3), Bi 94·46, Te 5·09, As 0·38, S 0·07, Au *tr*=100. Forbes's mineral is much like tetradymite in foliation, and probably contains 12 to 15 p. c. of that species. (3) A fine scaly variety from Bispberg in Dalecarlia, analyzed by Clene and Feilitzen (Œfv. Ak. Stockh., 1861, 159), contains as mixture 3 to 7 p. c. of sulphid of iron.

Pyr., etc.—B.B. on charcoal fuses and entirely volatilizes, giving a coating orange-yellow while hot, and lemon-yellow on cooling. Fuses at 476° F. Dissolves in nitric acid; subsequent dilution causes a white precipitate. Crystallizes readily from fusion.

Obs.—Bismuth occurs in veins in gneiss and other crystalline rocks and clay slate, accompanying various ores of silver, cobalt, lead, and zinc. It is most abundant at the silver and cobalt mines of Saxony and Bohemia, Schneeberg, Altenberg, Joachimsthal, Johanngeorgenstadt, etc. It has also been found at Modum and Gjellebäk in Norway, and Fahlun in Sweden. At Schneeberg it forms arborescent delineations in brown jasper. At Wheal Sparnon, near Redruth, and elsewhere in Cornwall, and at Carrack Fell in Cumberland, it is associated with ores of cobalt; formerly from near Alva in Stirlingshire; in a large and rich vein at the Atlas mine, Devonshire; at San Antonio, near Copiapo, Chili; Mt. Illampa (Sorata), in Bolivia.

At Lane's mine in Monroe, Conn., it is associated in small quantities with wolfram, scheelite, galena, blende, etc., in quartz; occurs also at Brewer's mine, Chesterfield district, South Carolina.

---

21. **TELLURIUM.** Aurum paradoxum vel problematicum *Müller v. Reichenstein*, Phys. Arb. Wien, i. 1782. Sylvanite *Kirwan*, Min., ii. 324, 1796. Gediegen-Tellur *Klapr.*, Beitr., iii. 2, 1802. Gediegen Sylvan *Germ.* Tellure natif auro-ferrifère *H.*

Hexagonal. $R \wedge R=86^\circ\ 57'$, G. Rose; $O \wedge R=123^\circ\ 4'$, a 1·3302. Observed planes, R, $-R$, I, O; $R \wedge -R$, over base, $=113^\circ\ 52'$. In six-sided prisms, with basal edges replaced. Cleavage: lateral perfect, basal imperfect. Commonly massive and granular.

H.=2—2·5. G.=6·1—6·3. Lustre metallic. Color and streak tin-white. Brittle.

Comp.—According to Klaproth (l. c.), Tellurium 92·55, iron 7·20, and gold 0·25. A specimen from Nagyag afforded Petz (Pogg., lvii. 447), Tellurium 97·215, and gold 2·785, with a trace of iron and sulphur.

Pyr.—In the open tube fuses, giving a white sublimate of tellurous acid, which B. B. fuses to colorless transparent drops. On charcoal fuses, volatilizes almost entirely, tinges the flame green, and gives a white coating of tellurous acid.

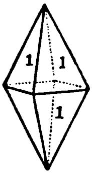
Obs.—Native tellurium occurs at the mine of Maria Loretto, near Zalathna, in Transylvania (whence the name *Sylvan* and *Sylvanite*), in sandstone, accompanying quartz, iron pyrites, and gold. About forty years since it was found in considerable abundance, and was melted to extract the small quantity of gold it contains.

22. NATIVE SULPHUR. Natürlicher Schwefel *Germ.* Soufre *Fr.*

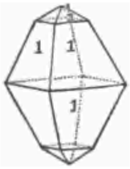
Orthorhombic. $I \wedge I = 101° \ 46'$, $O \wedge 1\text{-}\bar{i} = 113° \ 6'$; $a : b : c = 2{\cdot}344 : 1 : 1{\cdot}23$. Observed planes : O; vertical, I, $i\text{-}\bar{i}$, $i\text{-}\breve{i}$, $i\text{-}\breve{2}$, $i\text{-}\breve{3}$; domes, $1\text{-}\bar{i}$, $\frac{1}{3}\text{-}\bar{i}$, $\frac{1}{4}\text{-}\bar{i}$, $1\text{-}\breve{i}$, $\frac{2}{3}\text{-}\breve{i}$, $\frac{1}{3}\text{-}\breve{i}$; octahedral, 1, $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{5}$, $1\text{-}\breve{3}$, $\frac{3}{5}\text{-}\breve{3}$.

$O \wedge \frac{1}{3} = 134° \ 47'$	$O \wedge 1\text{-}\breve{3} = 115° \ 53'$	$1 \wedge 1$, mac., $= 106° \ 25'$
$O \wedge \frac{1}{2} = 123 \ \ 30$	$O \wedge 1\text{-}\breve{i} = 117 \ \ 41$	$1 \wedge 1$, brach., $= 85 \ \ 07$
$O \wedge 1 = 108 \ \ 19$	$O \wedge \frac{2}{3}\text{-}\breve{i} = 128 \ \ 12$	$1 \wedge 1$, bas., $= 143 \ \ 23$

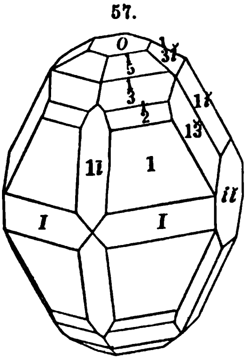
55.



56.



57.



Cleavage: I, and 1, imperfect. Twins, composition-face, I, sometimes producing cruciform crystals. Also massive, sometimes consisting of concentric coats.

H.=1·5–2·5. G.=2·072, of crystals from Spain. Lustre resinous. Streak sulphur-yellow, sometimes reddish or greenish. Transparent—subtranslucent. Fracture conchoidal, more or less perfect. Sectile.

Comp.—Pure sulphur; but often contaminated with clay or bitumen.

Pyr., etc.—Burns at a low temperature with a bluish flame, with the strong odor of sulphurous acid. Becomes resinously electrified by friction. Insoluble in water, and not acted on by the acids.

Obs.—Sulphur is dimorphous, the crystals being obtuse oblique rhombic prisms, of 90° 32′, and inclination of the vertical axis=95° 46′, when formed at a moderately high temperature (125° C., according to Frankenheim).

The great repositories of sulphur are either beds of gypsum and the associate rocks, or the regions of active and extinct volcanoes. In the valley of Noto and Mazzaro, in Sicily; at Conil, near Cadiz, in Spain; Bex, in Switzerland; Cracow, in Poland, it occurs in the former situation; near Bologna, Italy, in fine crystals, imbedded in bitumen. Sicily and the neighboring volcanic isles; the Solfatara, near Naples; the volcanoes of the Pacific ocean, etc., are localities of the latter kind. The crystals from Sicily are sometimes two or three inches in diameter. It is also deposited from hot springs in Iceland; and in Savoy, Switzerland, Hanover, and other countries. it is met with in certain metallic veins; near Cracow and in Upper Egypt there are large deposits. A fibrous variety is found near Siena, in Tuscany. Abundant in the Chilian Andes.

Sulphur is found near the sulphur springs of New York, Virginia, etc., sparingly; in many coal deposits and elsewhere, where sulphid of iron is undergoing decomposition; in microscopic crystals at some of the gold mines of Virginia and North Carolina; as a powder and in crystals in the Western lead regions, in cavities in the limestone; in minute crystals on cleavage surfaces of galena, Wheatley mine, Phenixville, Pa.; in small masses in limestone on the Potomac, twenty-five miles above Washington; in California, at the geysers of Napa valley, Sonoma Co.; in Santa Barbara in good crystals; near Clear lake, Lake Co., a large deposit, with a vein of cinnabar (now worked) cutting through it; in Nevada, in Humboldt Co., in large beds; Nye and Esmeralda Cos., 12 m. N. of Silver Peak; Washoe Co.

The sulphur mines of Sicily, the crater of Vulcano, the Solfatara near Naples, and the beds of California, afford large quantities of sulphur for commerce. It is also obtained in roasting the sulphids of iron and copper.

This species is homœomorphous with barytes and marcasite if $\frac{2}{3}$-ī be taken as the unit macrodome. The above figure, 57, is by Scacchi of Naples.

23. SELENSULPHUR. Selenschwefel *Stromeyer*, Schw. J., xliii. 453.

Resembling sulphur, but of an orange or brownish color.

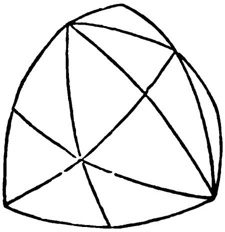
B.B. on charcoal burns readily, yields fumes of selenium and sulphurous acid. From Vulcano, one of the Lipari islands, mixed with sulphur. Also observed by the author at Kilauea, Hawaii

---

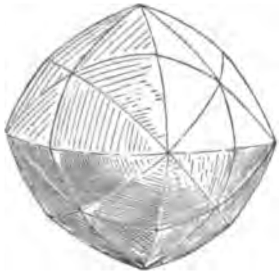
24. DIAMOND. Adamas, punctum lapidis, pretiosior auro, *Manilius*, Astron., iv. l. 926 (the earliest distinct mention of true Diamond). Adamas, in part, *Plin.*, xxxvii. 15. Domant *Germ.* Diamant *Fr.*

Isometric. Observed planes, 1, 2, *I*, *O*, 3-$\frac{3}{2}$, *i*-$\frac{3}{2}$, *i*-$\frac{4}{3}$; often tetrahedral in planes 1, 2, and 3-$\frac{3}{2}$. Figs 1, 2, 3, 5, 6, 8, 24, 25, 27; also *i*-$\frac{4}{3}$, similar to f. 16 and 17; also f. 40, all usually with curved faces, as in f. 58 (=27), 59 (=39), 60, the planes of which are 3-$\frac{3}{2}$; 60 is a distorted form of 58. Cleavage: octahedral, highly perfect. Twins; composition-face, octahedral, as in fig. 50, but with curved faces; f. 61, which is an elliptic twin of 58, the middle portion between two opposite sets of six planes being wanting; f. 63, in which composition is parallel to the octahedral faces, but the form corresponds to two interpenetrating tetrahedrons, as illustrated in f. 62. Rarely massive.

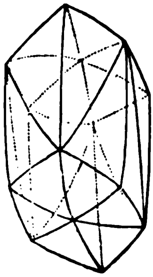
59.



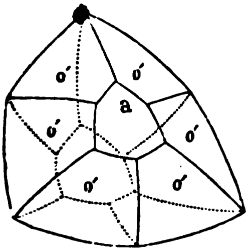
58.



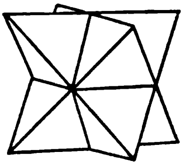
60.



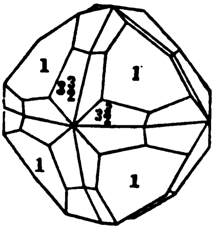
61.



62.



63.



H.=10. G.=3·5295, Thomson; 3·55, Pelouze. Lustre brilliant a mantine. Color white or colorless: occasionally tinged yellow, red, orang green, blue, brown, sometimes black. Transparent; translucent wh dark colored. Fracture conchoidal. Index of refraction 2·439. Exhib vitreous electricity when rubbed.

Comp.—Pure carbon, isometric in crystallization.

Var.—1. *Ordinary*, or crystallized. The crystals often contain numerous microscopic caviti as detected by Brewster, and some are rendered nearly black by their number; and around th cavities the diamond shows evidence, by polarized light, of compression, as if from pressure the included gas when the diamond was crystallized. Sometimes crystals bear impressions other crystals. The back planes of diamonds reflect all the light that strikes them at an an exceeding 24° 13′, and hence comes the peculiar brilliancy of the gem. The refraction of li by the diamond is often irregular, probably arising from the cause which has produced the con forms. In some plates from crystals, Descloizeaux has observed a fixed star of six symmetri rays, and in others, allied in character, the rays were replaced by three large elliptical arc Descloizeaux shows that the rays are symmetrical with reference to the faces of the octahedr

2. *Massive.* In black pebbles or masses, called *carbonado*, occasionally 1,000 carats in weig H.=10; G.=3·012—3·416. Consist of pure carbon, excepting 0·27 to 2·07 p. c.

3. *Anthracitic; Carbon diamantaire*, Count de Douhet, Les Mondes, Ap. 11, 1867. Like anth cite, but hard enough to scratch even the diamond. In globules or mammillary masses, consisti partly of concentric layers; fragile; G.=1·66; composition, Carbon 97, hydrogen 0·5, oxygen 1 Cut in facets and polished, it refracts and disperses light, with the white lustre peculiar to t diamond. Locality unknown, but supposed to come from Brazil. C. Mène has observed that anthracite from Creuzot, consisting of C 98·2, O 0·04, ash 0·12, long heated in pieces in a crucib takes a metallic lustre, and will then cut glass like a diamond. As anthracite is derived fr bituminous coal, by subjection to more or less heat under pressure, it is possible that the deg or condition of heating may produce an anthracite with its particles partly or wholly of the natu of the diamond, and still have the low specific gravity of anthracite.

Pyr., etc.—Burns, and is wholly consumed at a temperature of 14° Wedgewood, produci carbonic acid gas. It is not acted on by acids or alkalies.

Obs.—The diamond appears generally to occur in regions that afford a laminated granul quartz rock, called *itacolumite*, which pertains to the talcose series, and which in thin slabs more or less flexible. This rock is found at the mines of Brazil and the Urals; and also in Georg and North Carolina, where a few diamonds have been found. It has also been detected in species of conglomerate, composed of rounded siliceous pebbles, quartz, chalcedony, etc., cement by a kind of ferruginous clay. Diamonds are usually, however, washed out from the so According to M. Denis (Ann. des M., III. xix. 602) the diamond in Minas Geraes, Brazil, is fou in two different deposits; one called *gurgulho*, consisting of broken quartz, and covered by a th bed of sand or earth; the other, *cascalho*, of *rolled* quartz pebbles, united by a ferruginous cla resting usually on talcose clays, the whole the debris from talcose rocks. The first depo affords the finest diamonds, and both contain also gold, platinum, magnetic iron, rutile, etc. Th most celebrated mines are on the rivers Jequitinhonha and Pardo, north of Rio Janeiro, whe the sands (the waters being turned off) are washed by slaves. It has lately been found in Bahi on the river Cachoeira, at the mines of Surua and Sincora; and Damour has recognized in th sand of the locality, quartz, feldspar, rutile, brookite, anatase, zircon, diaspore, magnetic iron, go in grains, anhydrous phosphate of alumina and lime, a silicate of yttria, and a hydro-phosphate o yttria. At Bogagem, Minas Geraes, an enormous diamond of 254½ carats has been found; it wa a dodecahedron, with beveled edges, in which there were impressions of other diamond crysta showing that it was originally one of a cluster; it weighs, since cutting, 122 to 125 carats, and called the "Star of the South." The Brazilian mines were first opened in 1727, and it is estimate that since then they have yielded two tons of diamonds.

The Ural diamonds occur in the detritus along the Adolfskoi rivulet, where worked for gol and also at other places.

In India the diamond is met with at Purteal, between Hyderabad and Masulipatam, where th famous Kohinoor was found; but there are now only two places of exploration, and these are l to some of the natives for less than 25 francs a year; and if the hands find a stone worth four o five rupees ($2 to $2½) a month, they consider themselves fortunate. To such a state are th famous mines of Golconda now reduced. They are obtained also near Parma in Bundelcun where some of the most magnificent specimens have been found; also on the Mahanuddy nea Ellore. The locality on Borneo is at Pontiana, on the west side of the Ratoos mountain. Th river Gunil, in the province of Constantine in Africa, is reported to have afforded some diamond

In the United States a few crystals have been met with in Rutherford Co., N. C., and Hal Co

Ga (Am. J. Sci. II. ii. 253, and xv. 373); they occur also at Portis mine, Franklin Co., N. C. (Genth); one handsome one, over ½ in. in diameter, in the village of Manchester, opposite Richmond, Va.

In California, at Cherokee ravine, in Butte Co.; also in N. San Juan, Nevada Co.; in French Corral, one of 1⅓ carats; at Forest Hill, El Dorado Co., of 1½ carats; Fiddletown, Amador Co.; near Placerville. Reported from Idaho.

In Australia, in the valley of the Turon; in the bed of the Macquarie; mouth of Pyramul Creek; on Calcula Creek; and also in Victoria; also in West Australia, at Freemantle.

In Brazil the diamond has been found massive, in small black pebbles, called *carbonado*, having the specific gravity 3·012—3·416. They proved on trial to be pure carbon excepting 2·07 to 0·27 per cent. This compact diamond is sold in the region at 75 cents the carat of three and one-sixth grains troy, and the masses are sometimes 1,000 carats in weight.

Brewster finds that diamonds contain generally numerous microscopic cavities, and some are rendered nearly black by their number; and around these cavities the diamond shows evidence of compression, as if from pressure in the included gas when the diamond was crystallizing. Diamonds have been observed having impressions of other crystals.

The largest diamond of which we have any knowledge is mentioned by Tavernier as in possession of the Great Mogul. It weighed originally 900 carats, or 2769·3 grains, but was reduced by cutting to 861 grains. It has the form and size of half a hen's egg. It was found in 1550 in the mine of Colone. The Pitt or Regent diamond weighs but 136·25 carats, or 419½ grains; but is of unblemished transparency and color. It is cut in the form of a brilliant, and is estimated at £125,000. The Kohinoor measured, on its arrival in England, about 1⅜ inches in its greatest diameter, over ⅝ of an inch in thickness, and weighed 186 1/16 carats, and was cut with many facets. It has since been recut, and reduced to a diameter of 1 7/16 by 1⅜ nearly, and thus diminished over one-third in weight. It is supposed by Mr. Tennant to have been originally a dodecahedron, and he suggests that the great Russian diamond and another large slab weighing 130 carats were actually cut from the original dodecahedron. Tavernier gives the original weight at 787½ carats. The Rajah of Mattan has in his possession a diamond from Borneo, weighing 367 carats. The mines of Brazil were not known to afford diamonds till the commencement of the 18th century.

Colorless diamonds are in general most highly esteemed. When cut and polished, a diamond of the purest water in England, weighing one carat, is valued at £12; and the value of others is calculated by multiplying the square of the weight in carats by 12, except for those exceeding 20 carats, the value of which increases at a much more rapid rate. This rule is scarcely regarded in market, as the standard of purity and taste for different countries differs, and the slightest tinge of color affects greatly the commercial value. Blue is an exceedingly rare color; and one of this shade, the Hope diamond, weighing only 4½ carats, but of peculiar beauty and brilliancy, is valued at £25,000. A yellowish diamond of large size (value £12,000) has been found by Fremy to take a rose-red color when heated, which color it retains for two or three days, and then resumes the original yellow. An emerald-green diamond in the Dresden Treasury weighs 31½ carats.

The ancient Romans had rings set with the diamond, and used the chippings for arming gravers' tools. Pliny speaks of the six-angled form of the crystals of the *adamas*, and their resemblance to two pyramids or tops placed base to base, a description that would apply, perhaps, as well to a double hexagonal pyramid as to an octahedron; yet it is probable, from the other characters mentioned, the hardness, rarity, small size, use, and occurrence in gold regions, that the octahedral diamond was referred to. The adamas of the ancients included some corundum and other hard stones and even hard metal. Theophrastus makes no mention of the true diamond. (See, on the adamas of the ancients, King on Precious Stones and Gems, p. 19.)

The method of polishing diamonds was discovered in 1456, by Louis Berquen, a citizen of Bruges, previous to which time the diamond was known in Europe only in its uncut state. It appears to have been practised long before in India, the faceting of the Kohinoor dating far back into uncertain time. (See King, pp 30, 31.)

The diamond has probably proceeded, like mineral coal and oil, from the slow decomposition of vegetable material, or even from animal matters, either source affording the requisite carbon; but it has been formed under those conditions as to heat that has produced the metamorphism of argillaceous and arenaceous schists and their auriferous quartz veins; since it is found exclusively in gold regions, or in the sands derived from gold-bearing rocks. The schists that were altered at the time may have previously been shales impregnated with petroleum, or other carbonaceous substances (hydrocarburets) of organic origin. Chancourtois observes that the formation from a hydrocarburetted vapor or gas is analogous to that of sulphur from hydrosulphuretted emanations. In the oxydation of the latter by the humid process, the hydrogen becomes oxydized, and only a part of the sulphur changes to sulphurous acid, the rest remaining as sulphur. So in the humid oxydation of a carburetted hydrogen, the hydrogen is oxydized, part of the carbon becomes carbonic acid, and the rest remains as carbon and may form crystallized diamond.

25. GRAPHITE. Plumbago, Molybdæna, Bly-Ertz, *Bromell*, Min., 58, 1739 [not Plumb *Agric.*, *Gesner*]. Blyertz pt, Mica pictoria nigra, Molybdæna pt., *Wall.*, 131, 1747. Mica Peintres, Crayon, *Fr. Trl.* Wall., 1753. Black Lead. Reissbley (=Drawing-lead) *Germ.* Mol dænum *Linn.*, 1768. Plumbago *Scheele* (proving its carbon nature), Ak. H. Stockholm, 17 Plombagine *de Lisle*, Crist., 1783. Graphit *Wern.*, Bergm. J., 380, 1789, *Karst.*, Mus. Lesk. 339, 1789. Carburet of Iron. Fer carburé *Fr.*

Hexagonal. In flat six-sided tables. $R \wedge R = 85° \ 29'$, Kenngott, by c culation from Ticonderoga crystals, which have the planes $2R$, $\frac{2}{3}$-2 and 2 with, approximately, $O \wedge \frac{2}{3}\text{-}2 = 137°$, $O \wedge 2 = 110°$, and $O \wedge 2 = 122°$. A plan observed by Haidinger, is probably $\frac{1}{4}R$, or $\frac{1}{4}$-2; the angle measured, 40° 5 was the basal angle of the pyramid. The basal planes (O) are often striat parallel to the alternate edges. Cleavage: basal, perfect. Commonly imbedded, foliated, or granular masses. Rarely in globular concretio radiated in structure.

H.=1—2. G.=2·0891; of Ticonderoga, 2·229 Kenngott; 2·14 Wu siedel, Fuchs. Lustre metallic. Streak black and shining. Color iro black—dark steel-gray. Opaque. Sectile; soils paper, Thin lamin flexible. Feel greasy.

Var.—(*a*) Foliated; (*b*) columnar, and sometimes radiated; (*c*) scaly, massive, and slat (*d*) granular massive; (*e*) earthy, amorphous, without metallic lustre except in the streak; (*f*) radiated concretious.

Comp.—Pure carbon, with often a little oxyd of iron mechanically mixed. Scheele (1779, l. and some later chemists made the iron essential, and the species a carburet of iron. Vanuxem 1825 (J. Ac. Philad., v. 21) showed that the iron was an oxyd, and unessential. He obtain from the graphite of Bustletown, Pa., Carbon 94·4, ox. iron and manganese 1·4, silica 2·6, $\dot{\mathrm{H}}$ 0·6 99. Fuchs found (J. pr. Ch., vii. 253) only 0·33 p. c of ash (or impurities) in that of Wunsied a pure black, amorphous, unmetallic kind, metallic in streak, having G.=2·14; Fritzsche (B. Ztg., 323, 1854) 0·9 in that of Ceylon.

The following are analyses of different graphites by C. Mène (C. R., lxiv. 1091, 1867):

	G.	Carbon	Vol.	Ash	Comp. of 100 parts of ash.				
					$\ddot{\mathrm{Si}}$	$\dddot{\bar{\mathrm{Al}}}$	$\dddot{\bar{\mathrm{Fe}}}$	$\dot{\mathrm{Mg}}$, $\dot{\mathrm{Ca}}$	Alk. los
1. Ural, Mt. Alibert	2·1759	94·03	0·72	5·25	64·2	24·7	10·0	0·8	0·3
2. Cumberland, England	2·3455	91·55	1·10	7·35	52·5	28·3	12·0	6·0	1·2
3. Mugrau, Bohemia	2·1197	91·05	4·10	4·85	61·8	28·5	8·0	0·7	1·0
4. Zaptau, Lower Austria	2·2179	90·63	2·20	7·17	55·0	30·0	14·3	—	0·7
5. Swarbock, Bohemia	2·3438	88·05	1·05	10·90	62·0	28·5	6·3	1·5	1·7
6. Fagerita, Sweden	2·1092	87·65	1 55	10·80	58·6	31·5	7·2	0·5	2·2
7. Cumberland	2·5857	84·38	2·62	13·00	62·0	25·0	10·0	2·6	0·4
8. Passau, Bavaria	2·3032	81·08	7·30	11·62	53·7	35·6	6·8	1·7	2·2
9. Buckingham, Canada	2·2863	78·48	1·82	19·70	65·0	25·1	6·2	0·5	1·2
10. Cumberland	2·4092	78·10	6·10	15·80	58·5	30·5	7·5	3·5	—
11. Ceara, Brazil	2·3865	77·15	2·55	20·30	79·0	11·7	7·8	1·5	—
12. Passau, Bavaria	2·3108	73·65	4·20	22·15	69·5	21·1	5·5	2·0	1·9
13. Madagascar	2·4085	70·69	5·18	24·13	59·6	31·8	6·8	1·2	0·6
14. Ceylon	2·2659	68·30	5·20	26·50	50·3	41·5	8·2	—	—
15. Pissie, Hautes-Alpes	2·4572	59·67	3·20	37·13	68·7	20·8	8·1	1·5	0·9

Other analyses: 16–19, V. Regnault (Ann. Ch. Phys., II. i. 202); 20, 21, C. G. Wheeler (pri contrib.):

	C	H	Ash
16. Canada (I.)	86·8	0·5	12·6=99·9 Regnault.
17. " (II)	76·35	0·70	23·40=100·45 Regnault.
18. " (III.)	98·56	1·34	0·20=100·10 Regnault.
19. Siberia	89·51	0·60	10·40=100·51 Regnault.
20. Albert mine, Siberia	94·7	——	5 3=100 Wheeler.
21. " "	97·17	——	2·83=100 Wheeler.

In the G. of Mariinskoi, v. Jevreinof found (Russ. B. J. 1849) C 94·77, ash 5·22 (=$\ddot{\mathrm{S}}\mathrm{i}$ 2·04, $\overline{\mathrm{F}}\mathrm{e}$ 1·83, $\overline{\mathrm{A}}\mathrm{l}$ 0·88, $\dot{\mathrm{M}}\mathrm{g}$, $\dot{\mathrm{C}}\mathrm{a}$ 0·17); v. Laskovsky found (Bull. Soc. Nat. Mosc. 1856) in a plumose var. C 83·755, ash 15·111, water 0·888; v. Pusirevski found (Verh. Min. Ges. St. Pet. 1857, 1858) C 84·08, $\ddot{\mathrm{S}}\mathrm{i}$ 10·98, $\dot{\mathrm{H}}$ 3·77, with some $\overline{\mathrm{F}}\mathrm{e}$, $\dot{\mathrm{C}}\mathrm{a}$, $\overline{\ddot{\mathrm{M}}}\mathrm{n}$, and G.=2·26—2·31. In G. of the Kirghis Steppe, Hermann found C 40·55, earthy matters 56·56, $\dot{\mathrm{H}}$ 2·89=100. These results show that the variations arising from impurities are great. The material analyzed by Wheeler is that used by the firm of A. W. Faber.

Tremenheerite, Piddington, appears to be impure graphite, or is between coal and graphite; it is scaly in structure, and highly metallic in lustre. It afforded Piddington Carbon 85·70, water and sulphur 4·00, sesquioxyd of iron 2·50, earthy impurities, chiefly silica, 7·50, water and loss 0·30=100; the iron occurs as sulphuret. *Tenasserim*, Rev. F. Mason, Maulmain, 1852, p. 52.

Pyr., etc.—At a high temperature it burns without flame or smoke, leaving usually some red oxyd of iron. B.B. infusible; fused with nitre in a platinum spoon, deflagrates, converting the reagent into carbonate of potash, which effervesces with acids. Unaltered by acids.

Obs.—Graphite occurs in beds and imbedded masses, laminæ, or scales, in granite, gneiss, mica schist, crystalline limestone. It is in some places a result of the alteration by heat of the coal of the coal formation. Sometimes met with in greenstone. It is a common furnace product.

A fine variety of graphite occurs at Borrowdale in Cumberland, in nests in trap, which occurs in clay slate; in Glenstrathfarrar in Invernesshire, forms nests in gneiss; at Arendal in Norway, in quartz; at Pargas in Finland; in the Urals, Siberia, Finland; in various parts of Austria; Prussia; France; at Craigman in Ayrshire, it occurs in coal beds, which have been altered by contact with trap. In Irkutsk, in the Tunkinsk mts., at the very valuable Mariinskoi graphite mine, a large mass has been obtained, having the structure of the wood from which it was formed. Large quantities are brought from the East Indies.

Forms beds in gneiss, at Sturbridge, Mass., where it presents a structure between scaly and fine granular, and an occasional approximation to distinct crystallizations; also at North Brookfield, Brimfield, and Hinsdale, Mass.; extensively in Cornwall, near the Housatonic, and in Ashford, Conn.; also in Brandon, Vt.; at Grenville, C. E., associated with sphene and tabular spar in granular limestone. Foliated graphite occurs in large quantities at Ticonderoga, on Lake George; also upon Roger's Rock, associated with pyroxene and sphene. Near Amity, Orange Co., N. Y., it is met with in white limestone, accompanying spinel, chondrodite, hornblende, etc.; at Rossie, St. Lawrence Co., N. Y., with iron ore, and in gneiss; in Franklin, N. J., in rounded concretions radiated within; in Wake, N. C.; on Tyger River, and at Spartenburgh near the Cowpens Furnace, S. C.; also in Bucks Co., Penn., three miles from Attleboro', associated with tabular spar, pyroxene, and scapolite; and one and a half miles from this locality, it occurs in abundance in syenite, at Mansell's black lead mine. There is a large deposit at St. John, New Brunswick.

In the United States, the mines of Sturbridge, Mass., of Ticonderoga and Fishkill, N. Y., of Brandon, Vt., and of Wake, N. C., are worked; and that of Ashford, Conn., formerly afforded a large amount of graphite.

The name *black lead*, applied to this species, is inappropriate, as it contains no lead. The name graphite, of Werner, is derived from *γράφω*, *I write*.

Nordenskiöld makes the graphite of Ersby and Storgard *monoclinic*, with the inclination of the vertical axis 88° 14′, *i-i* (cleavage face) on faces of oblique prism=106° 21′, and angle of prism 122° 24′ (Pogg., xcvi. 110).

II. SULPHIDS, TELLURIDS, SELENIDS, ARSENIDS, ANTIMONIDS, BISMUTHIDS.

THERE are three natural divisions of the species of this section:

1. SIMPLE SULPHIDS AND TELLURIDS OF METALS OF THE SULPHUR OR ARSENIC GROUP.

2. SIMPLE SULPHIDS, TELLURIDS, SELENIDS, ARSENIDS, ANTIMONIDS, BISMUTHIDS, OF METALS OF THE GOLD, IRON, AND TIN GROUPS. Some of the species contain, along with sulphur, also arsenic, antimony, or bismuth; but the arsenic, antimony, or bismuth, in such cases, replaces sulphur as its isomorph.

3. DOUBLE SULPHIDS: OR SULPHARSENITES, SULPHANTIMONITES, SULPHOBISMUTHITES.

In this section of Sulphids, etc., the atomic weights of *arsenic*, *antimony* and *bismuth* are taken at half the value given in the table on page xvi, as it is in this state that they approximate to sulphur in the forms and relations of their compounds. The atomic weights thus halved are, for arsenic 37·5, antimony 61, bismuth 105; that of sulphur being 16.

1. SIMPLE SULPHIDS AND TELLURIDS OF METALS OF THE SULPHUR AND ARSENIC GROUPS.

1. REALGAR GROUP. Composition RS. Crystallization Monoclinic.
    26. REALGAR, AsS.
2. ORPIMENT GROUP. Composition R^2S^3. Crystallization Orthorhombic.
    27. ORPIMENT, As^2S^3
    28. DIMORPHITE, ? As^4S^3
    29. STIBNITE, Sb^2S^3
    30. BISMUTHINITE, Bi^2S^3
3. TETRADYMITE GROUP. Containing Bi, Te.
    31. TETRADYMITE,
    32. JOSEITE.
    33. WEHRLITE.
4. MOLYBDENITE GROUP. Containing Molybdenum.
    34. MOLYBDENITE, MoS^2.

26. REALGAR. Σανδαράκη *Theophr.*, 325 B.C. Σανδαράχη *Dioscor.*, 50 A.D. Sandaracha *Plin.*, xxxv. 6, 77 A.D. Sandaraca *Germ.* Reuschgeel, Rosgeel, *Agric.*, 444, etc., 1529, Interpr., 468, 1546. Rauschgelb pt., Arsenicum sulphure mixtum, Risigallum pt., Realgar, Arsenicum rubrum, *Wall.*, 224, 1747. Arsenic rouge *Fr. Trl.* Wall., 406, 1753. Realgar natif, Rubine d'Arsenic, *de Lisle*, iii. 333, 1783. Red Sulphuret of Arsenic. Rothes Rauschgelb, Operment, *Germ.* Arsenic sulfuré rouge *Fr.*

Monoclinic. $C=66°\ 5'$, $I \wedge I=74°\ 26'$, Marignac, Scacchi $O \wedge 1\text{-}\grave{i}=138°\ 21'$; $a:b:c=0{\cdot}6755:1:0{\cdot}6943$.

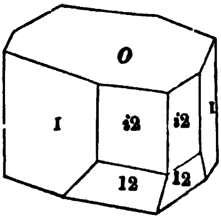
$O \wedge I=104°\ 12'$ $O \wedge i\text{-}i=113°\ 55'$ $i\text{-}\grave{i} \wedge 1=133°\ 1'$
$O \wedge 1\text{-}i=139\ \ 38$ $i\text{-}2 \wedge i\text{-}2=113\ \ 6$ $i\text{-}\grave{i} \wedge 1\text{-}2=115\ \ 1$

Cleavage: *i-ì*, *O* rather perfect; I, *i-i* in traces. Also granular, coarse or fine; compact.

O									
					−½-2				
					−1-2				−1-*i*
i-ì	*i-2̀*	*i*-$\grave{\frac{3}{2}}$	*I*	*i*-$\frac{4}{3}$	*i*-2	*i*-$\frac{5}{2}$	*i*-4	*i*-6	*i-i*
					42				
								8-6	
			2		2-2		2-4		2-*i*
$\frac{3}{2}$-*ì*		$\frac{3}{2}$-$\grave{\frac{3}{2}}$							
1-*ì*			1		1-2		1-4		1-*i*
½-*ì*					½-2				

Observed planes.

64



H.=1·5—2. G.=3·4—3·6. Lustre resinous. Color aurora-red or orange-yellow. Streak varying from orange-red to aurora-red. Transparent—translucent. Fracture conchoidal, uneven.

Comp.—As S=Sulphur 29·9, arsenic 70·1=100. A specimen from Pola de Lena in Asturia, Spain, gave Hugo Miller (J. Ch. Soc., xi. 242) S 30·00, As 70·25.

Pyr., etc.—In the closed tube melts, volatilizes, and gives a transparent red sublimate; in the open tube, sulphurous fumes, and a white crystalline sublimate of arsenous acid. B.B. on charcoal burns with a blue flame, emitting arsenical and sulphurous odors. Soluble in caustic alkalies.

Obs.—Occurs with ores of silver and lead, at Felsobanya in Upper Hungary, at Kapnik and Nagyag in Transylvania, at Joachimsthal in Bohemia, at Schneeberg in Saxony, at Andreasberg in the Harz; at Tajowa in Hungary, in beds of clay; at Binnenthal, Switzerland, in dolomite; at Wiesloch in Baden, in the Muschelkalk; near Julamerk in Koordistan; in Vesuvian lavas, in minute crystals. Strabo speaks of a mine of *sandaraca* (the ancient name of this species) at Pompeiopolis in Paphlagonia.

For recent crystallographic observations see Hessenberg's Min. Notizen, Nos. 1 and 3.

The name *realgar* is of Arabic origin.

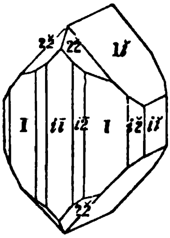
Alt.—Changes, on exposure, to orpiment (As^2S^3) and arsenolite (As^2O^3), 6 of As S becoming 2 As^2S^3, and 2 As being set free which changes to As^2O^3 or arsenolite (Volger). A black crust sometimes forms on realgar, which is supposed by Volger to be a sulphid containing less sulphur than realgar.

27. ORPIMENT. 'Αῤῥενικὸν *Theophr.* 'Αρσενικὸν *Dioscor.* Auripigmentum, Arrhenicum, *Plin.*, xxxiii. 22, xxxiv. 56. Auripigmentum, *Germ.* Operment, *Agric.*, Interpr., 463, 1546. Orpiment. Rauschgelb pt., Risigallum pt., Arsenicum flavum, *Wall.*, 224, 1747. Arsenic jaune *Fr. trl.* Wall., i. 406, 1753. Gelbes Rauschgelb *Germ.* Arsenic sulfuré jaune *Fr.* Yellow sulphuret of Arsenic

Orthorhombic. $I \wedge I=100°\ 40'$, $O \wedge 1\text{-}\bar{i}=126°\ 30'$; $a:b:c=1{\cdot}3511:1:1{\cdot}2059$. Observed planes as in the annexed figure.

O ∧ 1-ĭ=131° 45′ *i*-2̆ ∧ *i*-2̆ ov. *i*-ĭ=117° 49′ 1-ĭ ∧ 1-ĭ=83° 30′
O ∧ 2-2̆=127 27 2-2̆ ∧ 2-2̆ adj. = 94 20 2-2̆ ∧ 2-2̆ ov. 1-ĭ=131 36

65



Cleavage: *i*-ī highly perfect, *i*-ĭ in traces. *i*-ĭ longitudinally striated. Also, massive, foliated, or columnar, sometimes reniform.

H. = 1·5 – 2. G. = 3·48, Haidinger; 3·4, Breithaupt. Lustre pearly upon the faces of perfect cleavage; elsewhere resinous. Color several shades of lemon-yellow. Streak yellow, commonly a little paler than the color. Subtransparent—subtranslucent. Sub-sectile. Thin laminæ obtained by cleavage flexible but not elastic.

Comp.—$As^2 S^3$=Sulphur 39, arsenic 61=100.

Pyr., etc.—In the closed tube, fuses, volatilizes, and gives a dark yellow sublimate; other reactions the same as under realgar. Dissolves in nitromuriatic acid and caustic alkalies.

Obs.—Orpiment in small crystals is imbedded in clay at Tajowa, near Neusohl in Upper Hungary. It is usually in foliated and fibrous masses, and in this form is found at Kapnik in Transylvania, at Moldawa in the Bannat, and at Felsobanya in Upper Hungary, where it exists in metalliferous veins, associated with realgar and native arsenic; at Hall in the Tyrol it is found in gypsum; at St. Gothard in dolomite; at the Solfatara near Naples, it is the result of volcanic sublimation; in Fohnsdorf, Styria, found in brown coal. Near Julamerk in Koordistan, there is a large Turkish mine. Occurs also at Acobambillo, Peru. Small traces are met with in Edenville, Orange Co., N. Y., on arsenical iron.

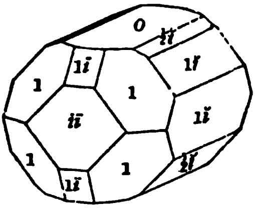
The name orpiment is a corruption of its Latin name auripigmentum, "*golden paint*," which was given in allusion to the color, and also because the substance was supposed to contain gold.

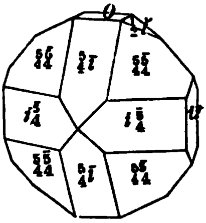
The crystalline form is made *monoclinic* by Breithaupt (B. H. Ztg., xxv. 194). He makes *i*-ī the clinodiagonal plane, and *i*-ĭ the front or orthodiagonal, with the planes *i*-ĭ, above and below *i*-ĭ, hemidomes, inclined at unequal angles on *i*-ĭ, that below at an angle 2° to 3° the smaller. Also, he makes *i*-2̆ the plane *I*. No definite measurements are given.

28. DIMORPHITE. Dimorfina *Scacchi*, Mem. Geol. sulla Campania, Napoli, 116, 1849.

Orthorhombic. Two types: (A), *I* ∧ *I* = 98° 6′, *O* ∧ 1-ī = 127° 50′; *a* : *b* : *c*=1·2876 : 1 : 1·1526; (B) common form, *I* ∧ *I*=100° 32′, *O* ∧ 1-ī=127° 1′; *a* : *b* : *c* = 1·3262 : 1 : 1·203. Observed planes as in the annexed figures.

66 67





In A, *O* ∧ 1= 120° 23′, *O* ∧ 1-ĭ =131° 50′, *O* ∧ $\frac{1}{2}$-ĭ = 150° 49′, 1-ĭ ∧ 1-ĭ over *O* = 83° 40′, 1 ∧ 1 ov. 1-ĭ=111° 10′.

In B, *O* ∧ $\frac{5}{4}$-ī=121° 6′, *O* ∧ $\frac{1}{2}$-ĭ =151° 7′, *O* ∧ $\frac{5}{4}$-$\bar{\frac{5}{4}}$=116° 40′, *i*-$\breve{\frac{5}{4}}$ ∧ *i*-$\bar{\frac{5}{4}}$=112° 45′. Cleavage none. Crystals minute.

H.=1·5. G.=3·58. Lustre splendent adamantine. Color orange-yellow: powder saffron-yellow. Translucent and transparent. Fragile.

Comp.—From imperfect trials by Scacchi, perhaps $As^4 S^3$=Sulphur 24·55, arsenic 75·45=100.

Pyr., etc.—Heated in a porcelain crucible with a spirit lamp, affords odorous fumes and becomes red; with more heat becomes brown, gives off yellow fumes, and evaporates, leaving no residue; with soda a garlic odor. Completely soluble in nitric acid.

Obs.—From a fumarole of the Solfatara, Phlegræan fields. Crystals not over half a millimeter in their longest direction.

29. STIBNITE. Στίμμι, Στίβι, Πλατυόφθαλμον, *Dioscor.* Stimmi, Stibi, Stibium, *Plin.*, xxxiii. 33, 34. Stibi, Spiessglas, *Basil Valentine* (who proved it to contain sulphur), 1430. Lupus metallorum *Alchem.* Spiess-Glass-Erz *Brückmann*, Berkwerke, 1727. Spitsglasmalm, Minera Antimonii, Antimonium Sulphure mineralisatum, *Wall.*, 237, 1747. Grauspiessglaserz, Grauspiessglanzerz, Antimonglanz, *Germ.* Antimoine sulfuré *Fr.* Sulphuret of Antimony; Gray Antimony; Antimony Glance. Stibine *Beud.*, Tr., ii. 421, 1832. Antimonit *Haid.*, Handb., 568, 1845. Stibnite *Dana*, Min., 1854.

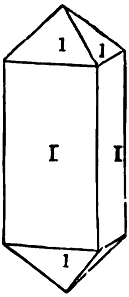
Orthorhombic. $I \wedge I = 90°\ 54'$, $O \wedge 1\text{-}\bar{i} = 134°\ 16'$; $a : b : c = 1{\cdot}0259 : 1 : 1{\cdot}0158$. Observed planes: O; vertical I, $i\text{-}\breve{i}$, $i\text{-}\bar{i}$, $i\text{-}\breve{\tfrac{4}{3}}$, $i\text{-}\breve{\tfrac{3}{2}}$, $i\text{-}\breve{\tfrac{5}{3}}$, $i\text{-}\breve{2}$, $i\text{-}\breve{3}$, $i\text{-}\breve{4}$, $i\text{-}\breve{5}$, $i\text{-}\bar{\tfrac{4}{3}}$, $i\text{-}\bar{2}$, $i\text{-}\bar{3}$; domes, $\tfrac{1}{6}\text{-}\bar{i}$, $\tfrac{1}{3}\text{-}\bar{i}$, $\tfrac{1}{2}\text{-}\bar{i}$, $1\text{-}\bar{i}$, $\tfrac{1}{3}\text{-}\breve{i}$, $\tfrac{1}{2}\text{-}\breve{i}$, $\tfrac{2}{3}\text{-}\breve{i}$, $1\text{-}\breve{i}$, $\tfrac{4}{3}\text{-}\breve{i}$, $\tfrac{5}{3}\text{-}\breve{i}$, $3\text{-}\breve{i}$; octahedrons, $\tfrac{1}{3}$, $\tfrac{1}{2}$, 1, 3; $1\text{-}\bar{\tfrac{5}{4}}$, $1\text{-}\breve{\tfrac{8}{5}}$, $1\text{-}\bar{\tfrac{8}{7}}$, $1\text{-}\bar{\tfrac{4}{3}}$, $1\text{-}\bar{\tfrac{9}{7}}$, $\tfrac{1}{2}\text{-}\breve{2}$, $\tfrac{2}{3}\text{-}\breve{2}$, $\tfrac{4}{3}\text{-}\breve{4}$, $\tfrac{2}{3}\text{-}\bar{2}$, $2\text{-}\breve{2}$, $6\text{-}\breve{2}$, $3\text{-}\breve{3}$, $\tfrac{2}{3}\text{-}\breve{4}$, $\tfrac{4}{3}\text{-}4$. Krenner.

$O \wedge \tfrac{1}{3} = 154°\ 20'$.	$O \wedge 1\text{-}\breve{i} = 134°\ 42'\tfrac{1}{2}$.	$O \wedge 1 = 124°\ 45'$.
$O \wedge 1 = 124\ \ 45$	$i\text{-}\bar{2} \wedge i\text{-}\bar{2}$, mac., $= 127\ \ 36$	$1 \wedge 1$, brach., $= 108\ \ 40$
$O \wedge 2\text{-}\breve{2} = 113\ \ 49$	$1\text{-}\breve{i} \wedge 1\text{-}\breve{i}$, top, $= 89\ \ 24$	$1 \wedge 1$, bas., $= 110\ \ 30$

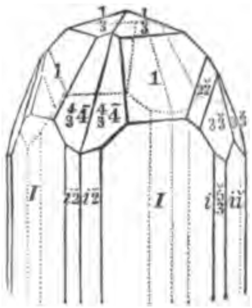
Lateral planes deeply striated longitudinally. Cleavage: $i\text{-}\breve{i}$ highly perfect. Often columnar, coarse or fine; also granular to impalpable.

H.=2. G.=4·516, Haüy; 4·62, Mohs. Lustre metallic. Color and streak lead-gray, inclining to steel-gray: subject to blackish tarnish, sometimes iridescent. Fracture small sub-conchoidal. Sectile. Thin laminæ a little flexible.

68



69



Comp.—Sb^2S^3=Sulphur 28·2, antimony 71·8=100. Bergmann, who made the first determination of the sulphur in the mineral (Opusc., ii. 167, 1782), obtained S 26, Sb 74=100. Eight analyses of stibnite from Arnsberg, Westphalia, gave Schneider a mean of Sb 71·48, S 28·52, excluding 0·33 p. c. of quartz; the results of the analyses varied from 71·441 to 71·519 (Pogg., xcviii. 293). Schnabel obtained for the same Sb 72·02, S 27·85, Fe 0·13 (Ramm. Min. Ch., 39).

Pyr., etc.—In the open tube sulphurous and antimonous fumes, the latter condensing as a white sublimate which B.B. is non-volatile. On charcoal fuses, spreads out, gives sulphurous and antimonous fumes, coats the coal white with oxyd of antimony; this coating treated in R.F. tinges the flame greenish-blue. Fus.=1. When pure perfectly soluble in muriatic acid.

Obs.—Occurs with spathic iron in beds, but generally in veins. Often associated with blende, heavy spar, and quartz.

Met with in veins at Wolfsberg, in the Harz: at Bräunsdorf, near Freiberg; at Przibram; Felsobanya, Schemnitz, and Kremnitz, in Hungary, where it often occurs in diverging prisms, several inches long, accompanied by crystals of heavy spar and other mineral species; at Pereta, in Tuscany, in crystals: in Katharinenberg, in the Urals; in Dumfriesshire, fibrous and laminated; in Cornwall, abundant near Padstow and Tintagel; also crystallized at Wheal Boys; at Hare Hill, in Scotland; in Perthshire. Also found at different Mexican mines. Also abundant in Borneo.

In the United States, it occurs sparingly at Carmel, Penobscot Co., Me.; at Cornish and Lyme, N. H.; at "Soldier's Delight," Md.; abundant in the granitic range, south side of Tulare valley, near pass of San Amedio; in the Humboldt mining region in Nevada, and usually argentiferous; also in the mines of Aurora, Esmeralda Co., Nevada. Also found in New Brunswick, 20 m. from Fredericton, S.W. side of St. John R.

This ore affords nearly all the antimony of commerce. The crude antimony of the shops is obtained by simple fusion, which separates the accompanying rock. From this product most of the pharmaceutical preparations of antimony are made, and the pure metal extracted.

This ore was employed by the ancients for coloring the hair, eyebrows, etc., to increase the apparent size of the eye; whence they called the ore πλατυόφθαλμον, from πλατύς, *broad*, and ὀφθαλμός, *eye.* According to Dioscorides, it was prepared for this purpose by enclosing it in a lump o dough, and then burning it in the coals till reduced to a cinder. It was then extinguished wit milk and wine, and again placed upon coals and blown till ignition: after which the heat wa discontinued, lest, as Pliny says, "plumbum fiat," *it become lead.* It hence appears that the met antimony was occasionally seen by the ancients, though not distinguished from lead.

On cryst. see Krenner, Ber. Ak. Wien, li. 1864, 436.

Alt.—Changes on exposure by partial oxydation to *antimony blende* ($2\,Sb^2S^3+Sb^2O^3$), and b further oxydation to *valentinite* (S^3O^3). *Antimony ochre* ($Sb^2O^3+Sb^2O^5$), and also Sb^2O^5+5H are other results of alteration.

30. BISMUTHINITE. Visimutum Sulphure mineralisatum (fr. Riddarhyttan) *Cronst.*, 193 1758. Wismuthglanz *Germ.*; Bismuth sulfuré *Fr.* Sulphuret of Bismuth. Bismuth Glance Bismuthine *Beud.*, Tr., ii. 418, 1832. Bismutholamprite *Glock.*, Syn., 27, 1847.

Orthorhombic. $I\wedge I=91°\ 30'$. Observed planes I, $i\text{-}\bar{\imath}$, $i\text{-}\breve{\imath}$, $i\text{-}3$, Brooke. Cleavage: brachydiagonal perfect; macrodiagonal less so; basal perfect. In acicular crystals. Also massive, with a foliated or fibrous structure.

H.=2. G.=6·4–6·459; 7·2; 7·16, Bolivia, Forbes. Lustre metallic. Streak and color lead-gray, inclining to tin-white, with a yellowish or iridescent tarnish. Opaque.

Comp.—Bi^2S^3=Sulphur 18·75, bismuth 81·25=100; isomorphous with stibnite. Analyses: 1, H. Rose (Gilb. Ann., lxxii. 192); 2, Wehrle (Baumg. Ztg., x. 385); 3, Scheerer (Pogg., lxv. 299); 4, Hubert (Haid. Ber., iii. 401); 5, Rammelsberg (5th Suppl., 261); 6, F. A. Genth (Am. J. Sci., II. xxiii. 415); 7, D. Forbes (Phil. Mag., IV. xxix. 4):

	S	Bi
1. Riddarhyttan	18·72	80·98=99·70 Rose.
2. Retzbanya	18·28	80·96=99·24 Wehrle.
3. Gjellebäk	19·12	79·77, Fe 0·15, Cu 0·14=99·18, Scheerer; G. 6·403.
4. Oravicza	19·46	74·55, Fe 0·40, Cu 3·13, Au 0·53, Pb 2·26=100·33 Hubert.
5. Cornwall	18·42	78·00, Fe 1·04, Cu 2·42=99·88 Rammelsberg.
6. Riddarhyttan	18·19	77·33, Fe 0·31, Cu 0·39, Te 0·30, Se *tr.*, Actinolite 2·93=99·45 Genth.
7. Bolivia	19·61	80·93=100·54 Forbes.

Pyr., etc.—In the open tube sulphurous fumes, and a white sublimate which B.B. fuses into drops, brown while hot and opaque yellow on cooling. On charcoal at first gives sulphurous fumes, then fuses with spirting, and coats the coal with yellow oxyd of bismuth. Fus.=1. Dissolves readily in hot nitric acid, and a white precipitate falls on diluting with water.

Obs.—Accompanies molybdenite and apatite in quartz, at Brandy Gill, Carrock Fells, in Cumberland, having a foliated structure; occurs near Redruth; at Botallack near Land's End; at Herland Mine, Gwennap; with childrenite, near Callington; at Lanescott mine, near St. Austell; at Johanngeorgenstadt, Altenberg, Schneeberg, in limestone; with cerium ore at Riddarhyttan, Sweden; at the San Baldomero mine, near Sorata, Bolivia, foliated, massive, and acicular.

Occurs with gold, pyrite, and chalcopyrite in Rowan Co., N. C., at the Barnhardt vein. Reported by Shepard to have been found with chrysoberyl at Haddam, Ct.

G. Rose obtained from artificial crystals, $I\wedge I=90°\ 40'$, $i\text{-}\breve{2}\wedge i\text{-}\breve{2}=53°\ 40'$ and $126°\ 20'$, $I\wedge i\text{-}\bar{\imath}=135°\ 20'$, $i\text{-}4\wedge i\text{-}4=28°\ 23'$, $i\text{-}4\wedge i\text{-}4=152°\ 14'$. G.=7·10–6·89, the variation depending on some bismuth present. Pogg., xci. 402.

31. TETRADYMITE. Ore of Tellurium (fr. Tellemark) *Esmark*, Trans. G. Soc., iii. 413, June 1, 1815. Tellurwismuth (fr. Riddarhyttan) *Berz.*, Ac. H. Stockh., 1823. Telluric Bismuth. Tetradymite (fr. Schubkau) *Haid.*, Baumg. ZS., ix. 129, 1831. Bismuth telluré, Tellure selenié bismuthifère *Fr.* Bornine *Beud.*, Tr., ii. 538, 1832. Bismuthotellurites pt. *Glocker*, Syn. 19, 1847. Tellurbismuth *Balch*, Am. J. Sci., II. xxxv. 99, 1863.

Hexagonal. $O\wedge R=118°\ 38'$, $R\wedge R=81°\ 2'$; $a=1·5865$. $-2\wedge-2=66°\ 40'$, $O\wedge-2=105°\ 16'$, Haid, from Schubkau crystals. Crystals often tabular. Cleavage: basal, very perfect. Also massive, foliated, or granular.

H.=1·5–2. G.=7·2–7·9, Lustre metallic, splendent. Color pale steel-gray. Not very sectile. Laminæ flexible. Soils paper.

Comp., Var.—Consists of bismuth and tellurium, with sometimes sulphur and selenium. If sulphur, when present, replaces part of the tellurium, the analyses for the most part afford the general formula $Bi^2\,(Te, S)^3$.

Var. 1.—*Free from sulphur.* $Bi^2\,Te^3$=Tellurium 48·1, bismuth 51·9; analyses 1—7. G=7·868, from Dahlonega, Jackson; 7·642, id., Balch.

2. *Sulphurous.* $Bi^2\,(\frac{2}{3}\,Te+\frac{1}{3}S)^3$; analyses 8—11. G.=7·500, crystals from Schubkau, Wehrle; 7·514, id., Baumgartner; 7·237, fr. Davidson Co., Genth. The name *Bornine*, after von Born, was given by Beudant in 1832, and Wehrle's analysis of the Schubkau ore was the only one cited.

3. *Seleniferous.* The Tellemark ore, according to Berzelius, gives B.B. a strong odor of selenium.

Analyses: 1—3, Genth (Am. J. Sci., II xix. 16); 4, 5, Genth (ib., xxxi. 368); 6, 7, D. M. Balch (ib., xxxv. 99); 8, Wehrle (Schw. J., lix. 482, 1830); 9, Berzelius (Jahresb., xii. 178, 1831); 10, Hruschauer (J. pr. Ch., xlv. 456); 11, C. T. Jackson (This Min., 712, 1850); 12, Genth (Am. J. Sci., II. xvi. 81):

	Te	S	Se	Bi	Fe	
1. Fluvanna Co., Va	48·19	——	*tr.*	53·07	——	=101·26 Genth.
2. " "	47·07	——	*tr.*	53·78	——	=100·85 Genth.
3. " "	49·79	——	*tr.*	51·56	——	=101·35 Genth.
4. Dahlonega	48·22	*tr.*	*tr.*	[50·83]	0·17	Cu 0·06, Au, quartz, etc., 0·72=100 Genth.
5. "	47·25	*tr.*	*tr.*	50·97	0·25	" 0·06, " " " 0·80=99·33 Genth.
6. "	48·26	——	—	51·46	——	= 99·72 Balch.
7. "	48·73	——	—	51·57	——	=100·30 Balch.
8. Schubkau	34·6	4·8	*tr.*	60·0	——	= 99·4 Wehrle.
9. "	36·05	4·32	—	58·30	——	gangue 0·75=99·42 Berz.
10. "	35·8	4·6	—	59·2	——	=99·6 Hruschauer.
11. Whitehall, Va.	35·05	3·65	—	58·80	——	Au, $\bar{\mathrm{F}}\mathrm{i}$, $\ddot{\mathrm{S}}\mathrm{i}$ 2·70=100·20 Jackson.
12. Davidson Co., N.C.	33·84	5·27	*tr.*	61·35	——	=100·46 Genth.

Fisher obtained in an analysis of the Fluvanna mineral, 6·81 p. c. of selenium. But Dr. Genth finds in it no selenium or sulphur. C. T. Jackson obtained (Am. J. Sci., II. xxvii. 366) the composition of joseïte for the Dahlonega mineral; but the later results of Genth and Balch have shown this to be incorrect.

Pyr.—In the open tube a white sublimate of tellurous acid, which B.B. fuses to colorless drops. On charcoal fuses, gives white fumes, and entirely volatilizes; tinges the R.F. bluish-green; coats the coal at first white (tellurous acid), and finally orange-yellow (oxyd of bismuth); some varieties give sulphurous and selenous odors; that from Fluvanna Co., Va., gave Fisher a red sublimate of selenium in the open tube.

Obs.—Occurs at Schubkau near Schemnitz; at Retzbanya; at Tellemark in Norway; at Bastnaes mine, near Riddarhyttan, Sweden.

In the United States, in Virginia, at the Whitehall gold mines, Spotsylvania Co., at Monroe mine, Stafford Co., and Tellurium mine, Fluvanna Co., with native gold; in North Carolina, Davidson Co., about 5 m. W. of Washington mine, in foliated scales and lamellar masses along with gold, chalcopyrite, magnetite, epidote, limonite, etc.; it was partly altered to a combination of tellurous acid and oxyd of bismuth, with but little of carbonate of bismuth (Genth, l. c.); in Georgia, Lumpkin Co., 4 m. E. of Dahlonega, and also in Cherokee and Polk counties.

32. JOSËITE. Tellurure de Bismuth *Damour*, Ann. Ch. Phys., III. xiii. 372, 1845. Bornine, Tellure bismuthifère du Brésil, *Duf.* [not Bornine *Beud.*] Joseït *Kenng.*, Min., 121, 1853.

Hexagonal, with perfect basal cleavage, like tetradymite. Soft. G.=7·924—7·936. Lustre submetallic. Color grayish-black, steel-gray. Fragile.

Comp.—From Damour's analyses, $Bi^3\,Te^2\,(S, Se)^2=Bi^3\,(\frac{1}{2}\,Te+\frac{1}{2}(S, Se))^4$, or a tellurid of bismuth, in which half of the tellurium is replaced by sulphur and selenium. Analyses by Damour (l. c.):

	Te	S	Se	Bi	
1. San José, Brazil	15·93	3·15	1·48	79·15	=99·71
2. " "	15·68	4·58		78·40	=98·66

Rammelsberg obtained from an allied mineral, from Cumberland, England (Min. Ch., 5): Tellurium 6·73, sulphur 6·43, bismuth 84·33=97·49: corresponding to Bi^4, Te, S^4, making the Te : S =1 : 4.

An ore from Sorata, passing for native bismuth, and mentioned under that species, gave Forbes as there cited, 5·09 p. c. of tellurium, with As 0·38, and S 0·07; while Genth found in another specimen only 0·042 Te. Forbes's specimen may have the formula Bi^6 Te. It is foliated nearly like tetradymite.

Pyr.—B.B. the Brazil ore acts nearly like tetradymite. In an open tube it gives off some sulphur, then white fumes of oxyd of tellurium, and then affords a decided odor of selenium; and in the upper part of the tube a white coating with some brick-red over it, due to the selenium; and a yellowish residue below due to the oxyd of bismuth.

Obs.—Found in granular limestone at San José, near Mariana, province of Minas Geraes, Brazil, and first brought to France by Mr. Claussen.

33. WEHRLITE. Argent molybdique *de Born*, Cat. de Raab., ii. 419, 1790. Wasserblei silber, Molybdän-silber, *Wern.*, Letztes Min. Syst., 18, 48, 1817. Molybdic silver. Wismuth glanz *Klapr.*, Beitr., i. 254, 1795. Tellurwismuth *Berz.*, Ak. H. Stockh., 1823. Wismuthspiegel *Weiss.* Spiegelglanz [=Mirror-glance] *Breith.* Tetradymite pt. *many authors.* Wehrlite *Huot*, Min., i. 188, 1841. Pilsenit *Kenng.*, Min., 121, 1853.

Hexagonal. Like tetradymite in perfect basal cleavage.

H.=1—2. G.=8·44, Wehrle. Lustre very bright. Color light steel-gray. Thin folia a little elastic.

Comp.—$Bi(Te, S)^2$, with Te : S=3 : 1, from an imperfect analysis by Wehrle (Baumg. Ztg., ix. 144):

Deutsch-Pilsen	Te 29·74	S 2·33	Bi 61·15	Ag 2·07	=95·29

Pyr., etc.—Like tetradymite.

Obs.—From Deutsch Pilsen, in Hungary. First reported as an ore of silver and molybdenum. Distinguished from tetradymite by its high specific gravity. Breithaupt obtained G.=8·00 with a specimen not wholly free from the gangue.

34. MOLYBDENITE. Not Molybdæna [=product fr. partial reduct. and oxyd. of Galena] *Dioscor.*, *Plin.*, *Agric.* Blyertz, Molybdena pt. [rest graphite] *Wall.*, 131, 1747, *Linn.*, 1748, 1768. Sulphur ferro et stanno saturatum (fr. Bastnaes, etc.), Wasserbley pt., Molybdena pt., *Cronst.*, 139, 1758. Molybdæna (with discov. of metal) *Hielm*, Ak. H. Stockh., 1782, 1788-1793. Wasserblei *Wern.* Molybdänglanz *Germ.* Molybdena *Kirw.*, Min., 1796 (calls the metal Molybdenite). Sulphuret of Molybdena. Molybdénite *Brongn.*, ii. 92, 1807, citing Kirwan as authority.

Monoclinic? Hexagonal? In short or tabular hexagonal prisms. Twins: consisting of three combined crystals, sometimes indicated by striæ on the base of the hexagonal prisms, at right angles to its sides, having occasionally replaced terminal edges. Cleavage: eminent, parallel to base of hexagonal prisms. Commonly foliated, massive, or in scales; also fine granular.

H.=1—1·5, being easily impressed by the nail. G.=4·44—4·8. Lustre metallic. Color pure lead-gray. Streak similar to color, slightly inclined to green. Opaque. Laminæ very flexible, not elastic. Sectile, and almost malleable. Gray trace on paper.

Comp.—MoS^2=Sulphur 41·0, molybdenum 59·0=100. Analyses: 1, Brandes (Schw. J., xxix. 325); 2, Seybert (Am. J. Sci., iv. 1822, 320); 3, 4, Svanberg & Struve (J. pr. Ch., xliv. 257); 5, Wetherill (Am. J. Sci., II. xv. 443):

		Mo	S
1. Altenberg		59·6	40·4=100 Brandes.
2. Chester, Pa.	G.=4·444	59·42	39·68=99·10 Seybert.
3. Smoaland		58·627	40·573, gangue 0·800 S & S.
4. Bohüslan		57·154	39·710, " 3·136 S & S.
5. Reading, Pa.		55·727	38·198, $\ddot{F}e$ 3·495, $\ddot{S}i$ 2·283, H. 0·297 Wetherill

Pyr., etc.—In the open tube sulphurous fumes. B.B. in the forceps infusible, imparts a yellowish-green color to the flame; on charcoal the pulverized mineral gives in O.F. a strong odor of sulphur, and coats the coal with crystals of molybdic acid, which appear yellow while hot, and white on cooling; near the assay the coating is copper-red, and if the white coating be touched with an intermittent R.F., it assumes a beautiful azure-blue color. Decomposed by nitric acid, leaving a white or grayish residue (molybdic acid).

Obs.—Molybdenite generally occurs imbedded in, or disseminated through, granite, gneiss, zircon-syenite, granular limestone, and other crystalline rocks. At Numedal in Sweden, Arendal, Selba, and Tellemarken in Norway, Nertschinsk in Russia, and Auerbach in Saxony, it has been observed in hexagonal prisms. Found also at Altenberg and Ehrenfriedersdorf in Saxony; Schlackenwald and Zinnwald in Bohemia; Rathausberg in Austria; near Miask, Urals; Bastnaes, etc, Sweden; in Finland; Laurvig in Norway; Chessy in France; Peru; Brazil; Calbeck Fell, Carrock Fells, and near the source of the Caldew in Cumberland, associated with tungstate of lime and apatite; several of the Cornish mines; in Scotland at East Tulloch, south of Loch Tay; at Mount Corybv on Loch Creran, etc.

In *Maine*, at Blue Hill Bay and Camdage farm, in large crystallizations; also at Brunswick, Bowdoinham, and Sanford, but less interesting. In *Conn.*, at Haddam and the adjoining towns on the Connecticut river, in gneiss in crystals and large plates; also at Saybrook. In *Vermont*, at Newport, with crystals of white apatite. In *N. Hampshire*, at Westmoreland, four miles south of the north village meeting-house, in a vein of mica slate, abundant: at Llandaff in regular tabular crystals; at Franconia. In *Mass.*, at Shutesbury, east of Locke's pond; at Brimfield, with iolite. In *N. York*, two miles southeast of Warwick, in irregular plates associated with rutile, zircon, and pyrite. In *Penn.*, in Chester, on Chester Creek, near Reading; near Concord, Cabarrus Co., N. C., with pyrite in quartz. In *California*, at Excelsior gold mine, in Excelsior district. In *Canada*, at Balsam Lake, Terrace Cove, Lake Superior; north of Balsam Lake, on a small island in Big Turtle Lake, with scapolite, pyroxene, etc., in a vein of quartz intersecting crystalline limestone; at St. Jerome, C. E.; at Seabeach Bay, near Black River, N. W. of L. Superior (48° 46′ N., 87° 17′ W.).

Distinguished from plumbago by its lustre and streak, and also by its behavior before the blowpipe and with acids.

---

2. SIMPLE SULPHIDS, TELLURIDS, SELENIDS, ARSENIDS, ANTIMONIDS, BISMUTHIDS, PHOSPHIDS, OF METALS OF THE GOLD, IRON, AND TIN GROUPS.

Three divisions of these *Sulphids*, *Arsenids*, etc., are here recognized: (1) a *basic* division, in which the atomic ratio between the sulphur or arsenic metal and the others is 1 to more than one; (2) a *proto* division, with the ratio 1 : 1; (3) a *deuto* division, with the ratio 1 : 2. In these ratios, and in stating the formulas beyond, the halved atomic weights of arsenic, antimony, and bismuth are in view, as stated on p. 26. In the *third* division, some species are included which appear to be combinations of deuto and proto compounds.

The mineral *chalcopyrite* is sometimes referred to the double-binary sulphids, on the ground of its containing, along with a protosulphid, the sulphid $Fe^2\,S^3$; but as the existence of a sesquisulphid $Fe^2\,S^3$ is not established, while $Fe\,S^2$ is the one of common occurrence, the more probable view of the sulphid is that it consists of two sulphids $Fe\,S$ and $Fe\,S^2$ in combination. This view is sustained by the near isomorphism of pyrite and chalcopyrite. The above remark applies also to *bornite* and *pyrrhotite*, in which $Fe^2\,S^3$ has been supposed to be present. $Fe^2\,S^3$, it should be noted, equals $Fe\,S + Fe\,S^2$. *Linnæite* and *carrolite* come into the same category.

In an article in the American Journal of Science, vol. xliv. 1867, the author gives reasons for believing that the compounds crystallizing in *hexagonal* forms have the number of atoms of the negative element 3, or a multiple of 3, and in *tetragonal* forms, a multiple of 4; whence it follows, that while ordinary *isometric* blende, or sulphid of zinc, for example, may be Zn S, the *hexagonal*, or wurtzite, is probably $Zn^3 S^3$. The principle, if real, has a very wide application among chemi and mineral species.

I. BASIC OR DYSCRASITE DIVISION.

35.	Dyscrasite	$Ag^2 Sb$
(B)	"	$Ag^3 Sb$
36.	Chilenite	$Ag^6 Bi$
37.	Domeykite	$\text{Ꞓu}^3 As^2$
38.	Algodonite	$\text{Ꞓu}^6 As^2$
39.	Whitneyite	$\text{Ꞓu}^9 As^2$

II. PROTO OR GALENA DIVISION.

1. GALENA GROUP.—Isometric, holohedral.

40.	Argentite	$Ag\ S$
41.	Naumannite	$(Ag, Pb)\ Se$
42.	Eucairite	$(\text{Ꞓu}, Ag)\ Se$
43.	Crookesite	$(\text{Ꞓu}, Tl)\ Se$
44.	Galenite	$Pb\ S$
44 A.	Huascolite	$(Pb, Zn)\ S$
45.	Clausthalite	$Pb\ Se$
46.	Zorgite	$?(Pb, \text{Ꞓu})\ Se$
47.	Lehrbachite	$(Pb, Hg)\ Se$
48.	Altaite	$Pb\ Te$
49.	Bornite	$(\text{Ꞓu}, Fe)\ S$
	"	$(\text{Ꞓu}, Fe)\ S + \frac{2}{n}\ Fe\ S^2$
50.	Berzelianite	$\text{Ꞓu}\ Se$
51.	Castillite	$(\text{Ꞓu}, Zn, R)\ S + \frac{1}{n}\ Fe\ S$
52.	Alabandite	$Mn\ S$
53.	Syepoorite	$Co\ S$
54.	Pentlandite	$(Ni, Fe)\ S$
55.	Grünauite	

2. BLENDE GROUP.—Isometric, tetrahedral.

56.	Sphalerite	$Zn\ S$
	[Marmatite	$(Zn, Fe)\ S$
	[Przibramite]	$(Zn, Cd)\ S$
57.	Voltzite	$Zn\ S + \frac{1}{4}\ Zn\ O$

3. CHALCOCITE GROUP.—Orthorhombic.

58.	Hessite	$Ag\ Te$
59.	Daleminzite	$Ag\ S$
60.	Acanthite	$Ag\ S$
61.	Chalcocite	$\text{Ꞓu}\ S$
62.	Stromeyerite	$(\text{Ꞓu}, Ag)\ S$
63.	Sternbergite	$(Fe, Ag)\ S + \frac{1}{2}\ Fe\ S^2$

4. PYRRHOTITE GROUP.—Hexagonal.

64.	Cinnabar	$Hg\ S$
65.	Tiemannite	$Hg\ Se\ ?$
66.	Millerite	$Ni\ S$
67.	Troilite	$Fe\ S$
68.	Pyrrhotite	$Fe\ S + \frac{1}{n}\ Fe\ S^2$
69.	Greenockite	$Cd\ S$
70.	Wurtzite	$Zn\ S$
71.	Niccolite	$Ni\ As$
72.	Breithauptite	$Ni\ Sb$
73.	Kaneite	$Mn\ As$
74.	Schreibersite	Fe, Ni, P

III. DEUTO OR PYRITE DIVISION.

1. PYRITE GROUP.—Isometric.

75.	Pyrite	$Fe\ S^2$
76.	Hauerite	$Mn\ S^2$
77.	Cubanite	$[2(Fe, \text{Ꞓu})S + FeS^2] + [2FeS^2]$
78.	Chalcopyrite	$2\ (\text{Ꞓu}, Fe)\ S + Fe\ S^2$
79	Barnhardtite	$[2(\text{Ꞓu}, Fe)S + Fe\ S^2] + [\text{Ꞓu}\ S]$
80.	Stannite	$2\ (\text{Ꞓu}, Fe, Zn)\ S + Sn\ S^2$
81.	Linnæite	$2\ Co\ S + Co\ S^2$
82.	Carrollite	$2(\text{Ꞓu}, Co)S + Co\ S^2 + [2Co\ S^2]$
83.	Smaltite,	$(Co, Fe, Ni)\ As^2$
	"	$R\ As + R\ As^2$
84.	Skutterudite	$Co\ As^3$
85.	Cobaltite	$Co\ (S, As)^2$
86.	Gersdorffite	$Ni\ (S, As)^2$
87.	Ullmannite	$Ni\ (S, Sb, As)^2$
88.	Corynite	$Ni\ (S, As, Sb)^2$
89.	Laurite	$Ru\ S^2\ [+ \frac{1}{20}\ Ru^4\ Os]$

2. MARCASITE GROUP.—Orthorhombic.

90.	Marcasite	$Fe\ S^2$
91.	Leucopyrite	$Fe\ As^2$
92.	Rammelsbergite	$Ni\ As^2$
93.	Moesite	$Fe\ As^2 + Fe\ As$
94.	Arsenopyrite	$Fe\ (S, As)^2$
95.	Glaucodot	$(Co, Fe)\ (S, As)^2$
96.	Pacite	$Fe\ (\frac{1}{6}\ S + \frac{5}{6}\ As)^2$
97.	Alloclasite	$Co\ (S, As)^2 + n\ Bi\ As$
[98.	Sylvanite	$(Ag, Au)\ Te^2$

3. NAGYAGITE GROUP.—Tetragonal.

39. Nagyagite

4. COVELLITE GROUP.—Hexagonal.

100. Covellite Cu S, or $\text{€u} S^2$

I. BASIC OR DYSCRASITE DIVISION.

35. **DYSCRASITE.** Argentum nativum antimonio adunatum *Bergm.*, Sciagr., 159, 1782. Spiesglanz-Silber *Selb*, Lempe Mag., iii. 5, 1786. Silberspiessglanz, Spiesglas-Silber, Antimon-Silber, *Germ.* Antimonial Silver. Argent Antimonial *Fr.* Discrase *Beud.*, ii. 613, 1832. Discrasit *Fröbel*, ? Prodr. Stöchiolith, 1837.

Orthorhombic. $I \wedge I = 119° \ 59'$; $O \wedge 1\text{-}\bar{i}$ 130° 41′; $a : b : c = 1{\cdot}1683 : 1 : 1{\cdot}7315$.

$O \wedge \frac{1}{2} = 146° \ 7'$	$O \wedge 1\text{-}\breve{i} = 146° \ 6'$	$1 \wedge 1$, brach., $= 92°$
$O \wedge 1 = 126 \ 40$	$O \wedge 2\text{-}\breve{i} = 126 \ 39\frac{1}{2}$	$i\text{-}\breve{2} \wedge i\text{-}\breve{2} = 98 \ 13\frac{1}{2}$
$O \wedge 1\text{-}\breve{3} = 142 \ 12$	$1 \wedge 1$, mac., 132 42	$i\text{-}\breve{3} \wedge i\text{-}\breve{3} = 120 \ 1$

Cleavage: basal distinct: $1\text{-}\breve{i}$ also distinct; I imperfect. Twins: stellate forms and hexagonal prisms. Also massive, granular; particles of various sizes, weakly coherent.

H.=3·5—4. G.=9·44—9·82; 9·4406, Haüy. Lustre metallic. Color and streak silver-white, inclining to tin-white; sometimes tarnished yellow or blackish. Opaque. Fracture uneven.

O					
	$\frac{1}{2}$				
$1\text{-}\bar{i}$	1		$1\text{-}\breve{3}$		$1\text{-}\breve{i}$
					$2\text{-}\breve{i}$
$i\text{-}\bar{i}$	I	$i\text{-}\breve{2}$	$i\text{-}\breve{3}$	$i\text{-}\breve{5}$	$i\text{-}\breve{i}$

Observed planes.

Comp.—(A) $Ag^2 Sb$=Antimony 22, silver 78=100. Also (B) $Ag^3 Sb$=Antimony 15·66, silver 84·34. Also $Ag^3 Sb^2$=Silver 72·92, antimony 27·08. Analyses: 1, 2, 7, Klaproth (Beitr., ii. 298, iii. 173); 3, Vauquelin (Haüy's Min., iii. 392); 4, Abich (Crell's Ann., 1798, ii. 3); 5, Plattner (Ramm. Min. Ch., 30); 6, 8, 9, Rammelsberg (ZS. G., xvi. 620):

		Antimony	Silver	
1.	Wolfach, *coarse granular*	[24]	78	Klaproth.
2.	Andreasberg, *foliated granular*, G.=9·82	[23]	77	Klaproth.
3.	"	[22]	78	Vauquelin.
4.	"	[24·75]	75·25	Abich.
5.	"	15·0	84·7=99·7	Plattner.
6.	"	[27·08]	72·72	Ramm.
7.	Wolfach, *fine granular*	[16]	84	Klaproth.
8.	" G. = 10·027.	15·81	83·85, As *tr*=99·66	Ramm.
9.	"	[17·81]	82·19	Ramm.

Pyr., etc.—B.B. on charcoal fuses to a globule, coating the coal with white oxyd of antimony, and finally giving a globule of almost pure silver. Soluble in nitric acid, leaving oxyd of antimony.

Obs.—Occurs in veins near Wolfach in Baden, Wittichen in Suabia, and at Andreasberg in the Harz, associated with several ores of silver, native arsenic, and galena, and other species; also at Allemont in Dauphiné, Casalla in Spain, and in Bolivia, S. A.

If less rare, this would be a valuable ore of silver. Named from δυσκρασις, *a bad alloy.*

Arsenic Silver (Arseniksilber), from Andreasberg, analyzed by Klaproth (Beitr., i. 183), and

Dumenil (Schweig. J., xxxiv. 357), has been shown by Rammelsberg to be probably a mixture of arsenopyrite, arsenical iron, and dyscrasite (Pogg., lxxvii. 262, and Min. Ch., 28).

35C. Domeyko found a mass of ore from Chañarcillo, Chili, which was mainly impure chlorobromid of silver externally, to contain within (Tr. de Ensayes, 238, 1858) 55·9 p. c. of chlorid of silver, 15·1 of an antimonid of silver, with 14·5 of carbonates and 14·2 ochreous clay; and this antimonid, he says, consists of Sb 36, Ag 64, and "appears to constitute a distinct species." The formula would be Ag Sb. This species is not mentioned in his Mineralogy of 1860.

Domeyko states (Min. 190, 1860) that at Chañarcillo a finely granular grayish-white silver ore, disseminated in grains, taking the lustre of silver when rubbed, afforded him 4 to 6 p. c. of antimony; that of the Descubridora mine 4·1 Ag; that of the Rosario mine 5·8 p. c. He also states that the filamentous silver of Bolivia contains Sb 3·7, As 2·3 p. c.

35D. CHANARCILLITE *Dana.*—He describes further (ib.) a silver-white, shining *arsenio-antimonial* ore from Chañarcillo, disseminated through calcite, which afforded him Sb 19·6 – 21·4, As 23·8—22·3, Ag 53·6—53·3, Fe 3·0—3·0. Regarding the iron as arsenical iron, he deduces the formula $\mathrm{Ag^2\,(As,\,Sb)^3}$.

Rammelsberg points out the isomorphism of dyscrasite and the antimonid of zinc, $\mathrm{Zn^3\,Sb}$, described by Cooke (Am. J. Sci., II. xviii. 229, xx. 222).

36. CHILENITE. Aleacion de plata con bismuto *Domeyko*, Min., 187, 1845. Plata Bismutal *id.*, ib. 185, 1860. Chilenite *Dana.*

Amorphous; granular.

Soft. Silver-white, but tarnishing easily to yellowish.

Comp.—$\mathrm{Ag^6\,Bi}$=Bismuth 13·8, silver 86·2. Domeyko obtained (Min., 185, 1860) Bi 10·1, Ag 60·1, Cu 6·8, As 2·8, gangue 19·0, corresponding to Bi 14·4, silver 85·6. Also (Ann. d. M., IV. v. 456) Bi 15·3, Ag 84·7. For the last the material was separated from a mass containing 8 to 10 p. c. of it disseminated in small points.

Obs.—From the mine of San Antonio in Copiapo.

36A. BISMUTH SILVER OF SCHAPBACH, SCHAPBACHITE. (Bismuthisches Silber *Selb*, Crell's Ann., 1793, i. 10, Schapbachite *Kenng.*, Min., 118, 1853). According to F. Sandberger, this bismuth-silver, analyzed by Klaproth, is a mixture of bismuthine in needles, argentite, and galena (Jahresb., 1863, 797, 1864). Klaproth obtained (Beitr., ii. 291) Bi 27, Ag 15, Pb 33, Fe 4·3, Cu 0·9, S 16·3. Sandberger gives an analysis by von Muth, who obtained Bi 8·22, Ag 4·05, Pb 45·30, Fe 0·07, S 9·72, quartz 32·33=99·69; which, after separating the iron as $\mathrm{Fe\,S^2}$, affords for the rest 1 $\mathrm{Bi\,S^3}$, 12 R S. D. Forbes remarks with regard to Klaproth's analysis (Phil. Mag., IV. xxv. 105) that the sulphur is sufficient to make sulphids of the metals, and suggests the same conclusion.

37. DOMEYKITE. Arsenikkupfer (fr. Copiapo) *Zinken*, Pogg., xli. 659, 1837. Arseniure de cuivre *Domeyko*, Ann. d. M., IV. iii. 3, 1843; Cobre Blanco *id.*, Min. 138, 1845. Weisskupfer *Hausm.* Cuivre arsenical *Fr.* Arsenical Copper. Domeykite *Haid.*, Handb., 562, 1845. Condurrite *W. Phillips*, Phil. Mag., ii. 286, 1827.

Reniform and botryoidal; also massive and disseminated.

H.=3—3·5. G.=7—7·50, Portage Lake, Genth. Lustre metallic, but dull on exposure. Color tin-white to steel-gray, with a yellowish to pinchbeck-brown, and, afterward, an iridescent tarnish. Fracture uneven.

Comp.—$\mathrm{\bar{C}u^3\,As^2}$=Arsenic 28·3, copper 71·7=100. Analyses: 1, 2, Domeyko (Ann. d. M., IV. iii. 5); 3, 4, F. Field (J. Ch. Soc., x. 289); 5, D. Forbes (2 J. G. Soc., xvii. 44); 6, 7, F. A. Genth (Am. J. Sci., II. xxxiii. 193); 8, 9, Rammelsberg (Pogg., lxxi. 305); 10, Blythe (J. Ch. Soc., i. 213):

1.	Calabozo, Chili	As 28·36	Cu 71·64=100 Domeyko.
2.	Copiapo "	23·29	70·70, Fe 0·52, S 3·87=98·38 Domeyko.
3.	" "	28·44	71·56=100 Field.
4.	Coquimbo, "	28·26	71·48=99·74 Field.
5.	Coracoro, Bolivia	28·41	71·13, Ag 0·46=100 Forbes.
6.	Portage Lake	29·25	70·68=99·93 Genth.
7.	" "	29·48	70·01=99·59 Genth.
8.	Cornwall, *Condurrite*	18·70	70·51, Fe 0·66 Rammelsberg.
9.	" "	17·84	70·02, gangue 1·07 Rammelsberg.
10.	" "	19·51	60·21, Fe 0·25, S 2·33, $\dot{\mathrm{H}}$ 2·41, C 1·62, H 0·44, N 0·06, O 13·17=100 Blythe.

(A) *Condurrite* is a result of the alteration of other ores. It is black and soft, soiling the fingers. It appears, sometimes, at least, to be a mixture of arsenite of copper with domeykite, and some sulphid of copper. Rammelsberg treated one specimen with muriatic acid, and analyzed the soluble and insoluble portions separately, obtaining

1. Insoluble	As 13·89	Cu 12·81	S 2·20	gangue 0·70	=29·60
2. Soluble	$\ddot{A}s$ 3·70	$\dot{C}u$ 62·29	$\dot{H}$ 5·83		=71·82.

The insoluble portion contains, therefore, As 4·16, Cu 13·89, with 10·85 of sulphid of copper; corresponding, the last excluded, to arsenic 23·04, copper 76·96=100.

Von Kobell (J. pr. Ch., xxxix. 204), with the same treatment of another specimen, found the composition of the soluble part, $\ddot{A}s$ 8·03, $\dot{C}u$ 79·00, $\bar{F}e$ 3·47, $\dot{H}$ 9·50=100, and the insoluble consisted of arsenic and some sulphid of copper in grains.

Blythe concludes, as a mean of many analyses, that the arsenid of copper contained in condurrite consists of arsenic 28·85, copper 71·15, which corresponds with the domeykite; and Faraday's analysis (Phil Mag., 1827, 286) leads to the same result, or arsenic 29·88, copper 70·11; but Rammelsberg's analysis gives a larger proportion of copper.

Pyr., etc.—In the open tube fuses and gives a white crystalline sublimate of arsenous acid. B.B. on charcoal arsenical fumes and a malleable metallic globule, which, on treatment with soda, gives a globule of pure copper. Not dissolved in muriatic acid, but soluble in nitric acid.

Obs.—From the Chilian mines of Algodones in Coquimbo, in Illapel, San Antonio in Copiapo, etc.

In N. America, found on the Sheldon location, Portage Lake; and mixed with copper-nickel at Michipicoten Island, in L. Superior.

Condurrite is from the Condurrow mine, near Helstone, and Wheal Druid mine at Carnbrae, near Redruth, Cornwall.

38. ALGODONITE. *F. Field*, J. Ch. Soc., x. 289, 1857.

In incrustations minutely crystalline. Commonly massive and distinctly granular.

H.=4. G.=7·62, from Chili, Genth. Lustre metallic and bright, but becoming dull on exposure. Color steel-gray to silver-white, the latter on a polished surface. Opaque. Fracture sub-conchoidal, affording a granular surface.

Comp.—$\text{Ꞓu}^6\text{As}^2=\text{Ꞓu}^3\text{As}$=As 16·50, Cu 83·50=100. Analyses: 1, F. Field (l. c.); 2—4, Genth (Am. J. Sci. II. xxxiii. 192):

	As	Cu	Ag		
1. Chili	([illegible]) 16·23	83·30	0·31	=99·84	Field.
2. "	([illegible]) 16·95	82·42	*tr.*	=99·37	Genth.
3. L. Superior	15·30	84·22	0·32	=99·84	Genth.
4. "	16·72	82·35	0·30		Genth.

In analysis 3, a little whitneyite was mixed with the ore, and hence the higher percentage of copper (Genth).

Pyr.—The same as with domeykite, but less fusible.

Obs.—In Chili, at the silver mine of Algodones, near Coquimbo, in the Cerro de los Seguas, Department of Rancagua; in the United States, in the Lake Superior region. A transported mass of mixed whitneyite and algodonite, weighing 95—100 lbs., was found on St. Louis R. The color is grayer, and the texture more granular and less malleable, than in whitneyite.

39. WHITNEYITE, *Genth*, Am. J. Sci., II. xxvii. 400, 1859, xxxiii. 191, 1862. Darwinite *D. Forbes*, Phil. Mag., IV. xx. 423, 1860.

Massive. Crystalline; very fine granular.

H.=3·5. G.=8·246—8·471, from Lake Superior, varying probably on account of porosity, Genth; 8·64 from Chili, Forbes. Lustre dull and submetallic on surface of fresh fracture, but strong metallic where scratched or rubbed, but soon tarnishing. Color pale reddish to grayish-white, pale reddish-white on a rubbed surface; becoming yellowish-bronze, brown, and brownish-black on exposure. Sometimes iridescent. Opaque. Malleable.

Comp.—$\mathrm{Cu}^9\,\mathrm{As}^2$=Arsenic 11·64, copper 88·36=100. Analyses: 1—4, F. A. Genth (l. c.); 5 id. (priv. contrib.); 6, D. Forbes (l. c.):

		As	Cu	Ag & insol.		
1. Michigan	(⅔)	11·61	88·13	0·40	=100·14	Genth.
2. "		12·28	87·48	0·04	= 99·80	Genth.
3. "		12·28	87·37	0·03	= 99·68	Genth.
4. "		10·92 (?)	87·64	0·19	= 98·75	Genth.
5. Sonora		11·46	88·54	*tr.*	=100	Genth.
6. Chili	(¼)	11·58	88·14	0·28	=100	Forbes.

Pyr.—Less fusible than algodonite; otherwise as in domeykite.

Obs.—In Houghton Co., Michigan, coated with red copper. A loose mass, weighing about 15 lbs., and consisting partly of algodonite, was found on the Pewabic location, 1 m. from Hancock village, Portage Lake; recently found in place on the Sheldon location, near Houghton, Mich.; stated to occur at the Albion location, about a mile from the Cliff mine, in a vein 4 inches wide; also at the Minnesota mine; also in Sonora (Genth), near La Lagoona, a ranch on the road to Libertad, Gulf of California, 35 m. fr. Saric.

Named after J. D. Whitney.

II. GALENA DIVISION.

[For list of species see page 34.]

40. ARGENTITE. Argentum rude plumbei coloris et Galenæ simile, cultro diffinditur, dentibus compressum dilatatur, *Agric.*, 438, 1529; *Germ.* Glaserz, *Agric.*, Interpr., 463, 1546; *Henckel*, Min., 1734 (proving it a sulphur compound). Silfverglas, Minera argenti vitrea, Argentum sulphure mineralisatum, *Wall.*, 308, 1746; *Sage*, Ann. Ch., ii. 250, 1776 (with earliest anal.) Glanzerz, Silberglas, Silberglanz, Schwefel-Silber, Weichgewachs, *Germ.* Vitreous Silver, Sulphuret of Silver, Silver Glance. Argent sulfuré *Fr.* Argyrose *Beud.*, Tr., ii. 392, 1832. Argentit *Haid.*, Handb., 565, 1845. Argyrit *Glock.*, Syn., 23, 1847.

Isometric. Observed planes *O*, *I*, 1, 2, 2-2. Figs. 1 to 11, 23. Cleavage: dodecahedral in traces. Also reticulated, arborescent, and filiform; also amorphous.

H.=2—2·5. G.=7·196—7·365. Lustre metallic. Streak and color blackish lead-gray; streak shining. Opaque. Fracture small sub-conchoidal, uneven. Perfectly sectile.

Comp.—Ag S=Sulphur 12·9, silver 87·1=100, Analyses: 1, 2, Klaproth (Beitr., i. 158); 3 Lindaker (Vogl's Min. Joach., 78):

	S	Ag	
1. Joachimsthal	[15]	85	=100 Klaproth.
2. Himmelsfürst	[14·7]	85·3	=100 Klaproth.
3. Joachimsthal	14·46	77·58	Pb 3·68, Cu 1·53, Fe 2·02=99·27 Lind.

Pyr., etc.—In the open tube gives off sulphurous acid. B.B. on charcoal fuses with intumescence in O.F., emitting sulphurous fumes, and yielding a globule of silver.

Obs.—This important ore of silver is found at Freiberg, Annaberg, Joachimsthal of the Erzgebirge; at Schemnitz and Kremnitz in Hungary; in Norway near Kongsberg; in the Altai at the Smeinogorsk mine; in the Urals at the Blagodat mine; in Cornwall; in Bolivia; Peru; Chili; Mexico at Guanajuato, Zacatecas, Catorce, San Pedro del Potosi, etc.

Occurs in Nevada, at the Comstock lode, at different mines, along with stephanite, native gold, etc.; in the vein at Gold Hill; common in the ores of Reese River; probably the chief ore of silver in the Cortez district; in the Kearsarge district, Silver-Sprout vein.

A mass of sulphid of silver is stated by Troost to have been found in Sparta, Tennessee; occurs with native silver and copper in northern Michigan. [A silver ore not yet analyzed, occurs, according to Jackson, with gray antimony, at Cornish, N. H.]

Alt.—Native silver, at Joachimsthal. Also a mixture called silver-black (Silberschwärze *Germ.*).

40A. ARGENTOPYRITE (Silberkies). This mineral from Joachimsthal, made a species by v. Waltershausen (Ges Wiss. Göttingen, 1866, No. 2), is shown by Tschermak (Ber. Ak. Wien, liv. 342) to be a pseudomorph consisting of the minerals argentite, marcasite, pyrrhotite, pyrargyrite. It occurs in small hexagonal crystals, which were probably pyrrhotite originally. Von Waltershausen obtained in his analysis, Sulphur 34·2, iron 39·3, silver 26·5.

40B. JALPAITE Breithaupt (B. H. Ztg., xv. 85, 1858).—Jalpaite is a cupriferous silver-glance from Jalpa, Mexico. It is isometric in cleavage, and malleable like ordinary argentite; color blackish lead-gray; G.=6·877—6·890. Composition according to R. Richter (l. c.) S 14·36, Ag 71·51, Cu 13·12, Fe 0·79, affording the formula 3 Ag S + Ɵu S or (¾ Ag + ¼ Ɵu) S.

41. NAUMANNITE. Selensilber *G. Rose*, Pogg., xiv. 471, 1828. Selensilberglanz. Séléniure d'argent *Fr.* Seleniuret of Silver. Naumannit *Haid.*, Handb., 565, 1845.

Isometric. In cubes. Cleavage: cubic, perfect. Also massive, granular, and in thin plates.

H.=2·5. G.=8·0. Lustre metallic, splendent. Color and streak iron-black.

Comp.—(Ag, Pb) Se. Pure, Ag Se=Selenium 26·8, silver 73·2. Analyses: 1, Rose (l. c.); 2, Rammelsberg (2d. Suppl., 127, and Min. Ch., 34):

1. Tilkerode	Selenium [29·53]	Silver 65·56	Lead 4·91=100	Rose.
2. "	" 26·52	" 11·67	" 60·15=98·34	Ramm.

In No. 1, Ag : Pb=13 : 1, in 2, 1 : 5.

Pyr., etc.—B.B. on charcoal it melts easily in the outer flame; in the inner, with some intumescence. With soda and borax it yields a bead of silver.

Obs.—Occurs at Tilkerode in the Harz. Named after the crystallographer Naumann.

According to Del Rio, another selenid of silver occurs at Tasco in Mexico, crystallized in hexagonal tables. (Beud. Tr., ii. 535.)

42. EUCAIRITE. Eukairit *Berz.*, Afh. vi. 42, 1818. Cuivre sélenié argental *H.* Seleniuret of silver and copper. Selenkupfersilber *Germ.*

Massive and granular; also in black metallic films, staining the calcite in which it is contained.

Soft; easily cut by the knife. Lustre metallic. Color between silver-white and lead-gray. Streak shining.

Comp.—Ɵu Se + Ag Se=(Ɵu, Ag) Se=Selenium 31·6, copper 25·3, silver 43·1=100. Analyses: 1–3, Berzelius (l. c.); 4–6, Nordenskiöld (Bull. Soc. Ch., II. vii. 411):

1. Skrikerum	Selenium 28·54	Copper 25·30	Silver 42·73=96·57.	
2. "	" 26·00	" 23·05	" 42·73, gangue 8·90=96·88.	
3. "	" 28·63	" 25·39	" 42·86=96·88.	
4 "	" 32·01	" 23·83	" 44·21, thallium *tr.*=100·41	Nord.
5. "	" [31·97]	" 25·30	" 42·73, " " =100	Nord.
6. "	" [32·22]	" 24·86	" 42·57=100	Nord.

Pyr., etc.—B B. gives copious fumes of selenium, and on charcoal fuses readily to a gray metallic globule, leaving a bead of selenid of silver. With borax a copper reaction. Dissolves in boiling nitric acid.

Obs.—Occurs in small quantities in the Skrikerum copper mine in Smoaland, Sweden, in a kind of serpentine rock, imbedded in calcite; in Chili at Aguas Blancas, near Copiapo (this variety affording Domeyko (Min., 206) Se 32·2, Cu 28·0, Ag. 39·8), and at the mines of Flamenco, a few leagues north of Trespuntas, in the desert of Atacama. Also a similar ore (Ann. d. M., VI. v. 458, and C. R, lviii. 556) on the east side of the Andes of Chili, in the province of San Juan, where it occurs in a narrow vein (10–12 mm. broad), and has a lead-gray color, tarnishes easily, and is partly granular, and partly very imperfectly lamellar; at the Cacheuta mine, in the province of Mendoza, with other selenids.

Named by Berzelius from εὖ, καιρός, *opportunely*, because found by him soon after the discovery of the metal selenium.

43. CROOKESITE. *A. E. Nordenskiöld*, Œfv. Ak. Stockh., 1866, Bull. Soc. Ch., II. vii. 413

Massive, compact; no trace of crystallization.

H.=2·5—3. G.=6·90. Lustre metallic. Color lead-gray. Brittle.

Comp.—(Cu, Tl, Ag) Se=Selenium 33·28. copper 45·76, thallium 17·25, silver 3·71=100
Analyses: Nordenskiöld (l. c.):

	Se	Cu	Ag	Fe	Tl
1.	[33·27]	46·11	1·44	0·63	18·55=100.
2.	30·86	46·55	5·04	0·36	16·27=99·08.
3.	32·10	44·21	5·09	1·28	16·89=99·57.

Pyr., etc.—B.B. fuses very easily to a greenish-black shining enamel, coloring the flame strongly green. Insoluble in muriatic acid; completely soluble in nitric.

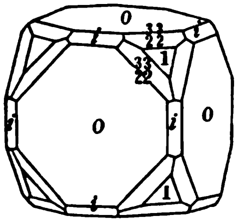
Obs.—From the mine of Skrikerum in Norway. Formerly regarded as selenid of copper or berzelianite. Named after Wm. Crookes, the discoverer of the metal thallium.

44. GALENITE. Galena *Plin.*, xxxiii. 31 [not Galena or Molybdæna (=litharge-like product from the ore), *Plin.*, xxxiv. 47, 53]. Molybdæna pt., Plumbago pt., Galena, Pleiertz, Plei-Glanz, *Agric.*, 1546. Plumbago pt., Blyglants, Galena, Plumbum sulphure et argento mineralisatum, *Wall.*, 292, 1747, *Cronst.*, 167, 168, 1758. Sulphuret of Lead. Plomb sulfuré *Fr.* Galenit *von Kob.*, Min., 201, 1858.

Plumbago, Pleischweis? *Agric.*, Interpr., 467, 1546. Bleischveif, Plumbago, Plumbum sulphure et arsenico mineralisatum, *Wall.*, 294, 1746. Steinmannite *Zippe*, Verh. Ges. Mus. Böhmen., 1833, 39. Targionite *Bechi*, Am. J. Sci., II. xiv. 60, 1852. Supersulphuretted Lead *Johnston*, Rep. Brit. Assoc., 572, 1833; *Thomson*, Min., i. 552, 1836; Johnstonite *Greg & Lettsom*, Min., 448, 1858.

Isometric. Observed planes: *O*, 1, *I*; 2, 3; 3-3, 2-2, $\frac{3}{2}$-$\frac{3}{2}$. Figs. 1 to 8, 23 with planes 1, 70, 71, the last a distorted form. Cleavage, cubic, perfect; octahedral in traces. Twins, like f. 50; the same kind of composition repeated, f. 72, and flattened parallel to 1. Also reticulated, tabular; coarse or fine granular; sometimes impalpable; occasionally fibrous.

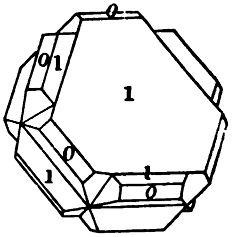
70



71

Rossie, N. Y.

72



H.=2·5—2·75. G.=7·25—7·7. Lustre metallic. Color and streak pure lead-gray. Surface of crystals occasionally tarnished. Fracture flat subconchoidal, or even. Frangible.

Comp., Var.—Pb S=Sulphur 13·4, lead 86·6=100. Contains silver, and occasionally selenium (ore fr. Fahlun, Berz.), zinc, cadmium, antimony, copper, as sulphids; besides, also, sometimes native silver and gold; and even platinum has been reported as occurring in a galenite from the Dept. of Charente, France.

Var. 1. *Ordinary.* (*a*) Well crystallized; (*b*) somewhat fibrous and plumose; (*c*) granular coarse or fine; (*d*) crypto-crystalline.

2. *Argentiferous.* All galenite is more or less argentiferous, and no external characters serve to distinguish the kinds that are much so from those that are not.

3. Containing arsenic, or antimony, or an ore of these metals, as impurity. Here belong the *bleischweif*, *targionite*, and *steinmannite*, which appear to be merely impure galenite.

4. Containing an excess of sulphur, through mixture. *Supersulphuretted lead* of Johnston and others (or Johnstonite) is here included. The excess of sulphur is owing to a decomposition of a portion of the mass, setting part of the sulphur free.

Analyses: 1, Thomson (Ed. Phil. J., 1829, 256); 2, 3, Lerch (Ann. Ch. Pharm., xlv. 325):

1. Durham		S 13·02	Pb 85·13	Fe 0·50=98·65	Thomson.	
2. Przibram	G.=7·252	14·41	81·80	Zn 3·59=99·80	L.	Pb S to Zn S as 6 : 1
3. "	G.=7·324	14·18	83·61	2·18=99·97	L.	Pb S to Zn S as 12 : 1

Schwartz found 6·02 p. c. of cadmium in a galena from Altenberg.

The silver present is detected easily by cupellation. The galenite of the Harz affords ·03 to ·05 p. c. of silver; the English ·02 to ·03; that of Leadhills, Scotland, ·03 to ·06; of Monroe, Ct., 3 p. c.; of Roxbury, Ct., assayed by P. Collier, 1·85 p. c. silver; Eaton, N. H., 0·1, C. T. Jackson; Shelburne, N. H., 0·15; of Missouri, ·0012 to ·0027, Litton; Arkansas, 0·03 to ·05, Silliman, Jr.; Middletown, Ct., 0·15 to 0·20 p. c.; Pike's Peak, Colorado, 0·05 to 0·06 p. c.

The following, from Tuscany, contain antimony and silver (E. Bechi, Am. J. Sci., II. xiv. 60):

	S	Pb	Sb	Fe	Cu	Zn	Ag
1. Bottino	12·840	80·700	3·307	1·377	0·440	0·024	0·825= 99·013
2. "	15·245	78·238	4·431	1·828	*tr.*	——	0·485=100·227
3. "	15·503	78·284	2·452	2·811	——	——	0·560= 99·610
4. Argentiera	16·780	72·440	4·308	1·855	4·251	——	0·650=100·284
5. "	15·62	72·90	5·77	1·77	1·11	1·33	0·72 = 99·220

No 5 is the *targionite* of Bechi, occurring in octahedrons with G.=6·932.

The *bleischweif* from Clausthal in the Harz, G.=7·53—7·55, analyzed by Rammelsberg (Min. Chem., 49) afforded, Pb S 95·85, Zn S 3·34, Fe S^2 0·54, Sb S^3 0·30=100·03. Schwarz (Ber. Ak. Wien, xxv. 561) found in one specimen of *steinmannite*, Pb S 76·48, with $As^2 S^3$ 9·25, $Sb^2 S^3$ 0·77, Zn S 11·38, Fe S 2·10=99·88; and in another, less lead, only a trace of zinc, very little arsenic, and much antimony; and he concluded that the sulphid of lead was the only constant constituent.

The *supersulphuretted lead* gave Johnston, Pb S 90·38, S 8·71. R. Hofmann found 8·7 p. c. of sulphur in a galenite from New-Sinka, Transylvania, along with 51·30 of sulphate of lead.

Pyr.—In the open tube gives sulphurous fumes. B.B. on charcoal fuses, emits sulphurous fumes, coats the coal yellow, and yields a globule of metallic lead. Soluble in nitric acid.

Obs.—Occurs in beds and veins, both in crystalline and uncrystalline rocks. It is often associated with pyrite, marcasite, blende, chalcopyrite, arsenopyrite, etc., in a gangue of quartz, calcite, barite or fluor, etc.; also with cerussite, anglesite, and other salts of lead, which are frequent results of its alteration. It is also common with gold, and in veins of silver ores E. J. Chapman remarks that galenite is seldom much argentiferous except when it is associated with mispickel or some other arsenical ore.

At Freiberg in Saxony it occupies veins in gneiss; in Spain, in granite at Linares, and also in Catalonia, Grenada, and elsewhere: at Clausthal and Neudorf in the Harz, and at Przibram in Bohemia, it forms veins in clay slate; in Styria it occurs in the same kind of rock in beds; at Sala in Sweden it forms veins in granular limestone; through the graywacke of Leadhills and the killas of Cornwall, in veins; in mountain limestone in Derbyshire, Cumberland, and the northern districts of England, and also in Bleiberg, and the neighboring localities of Carinthia. In the English mines it is associated with calcite, pearl spar, fluor, barite, witherite, calamine, and blende. Other localities are Joachimsthal, where it is worked principally for the silver; Przibram in Bohemia; in Nertschinsk, East Siberia; in Algeria; near Cape of Good Hope; in Australia; Chili; Bolivia, etc.

Extensive deposits of this ore in the United States exist in Missouri, Illinois, Iowa, and Wisconsin. The ore occurs in stratified limestone, of different periods of the Lower Silurian era, especially the Trenton, associated with blende, smithsonite ("dry-bone" of the miners), calcite, pyrite, and often an ore of copper and cobalt. The mines of Missouri were discovered in 1720, by Francis Renault and Mr. la Motte; they are situated in the counties of Washington, Jefferson, and Madison. Of the Upper Mississippi lead region, five-sixths, says Whitney (Rep. Up. Miss. region, 1862), belong to Wisconsin, and the richest portion is in that part of the State adjoining Illinois and Iowa. The productive lead district is bounded on the west, north, and east by the Mississippi, Wisconsin, and Rock rivers. The occurrence of calc spar in the soil, or sink holes in lines, are considered indications of lead. From a single spot, not exceeding fifty yards square, 1,500 tons of ore have been raised.

Occurs also in *Illinois*, at Cave-in-Rock, associated with fluorite. In *New York*, at Rossie, St

Lawrence Co., in veins from one to three or four feet in width, the crystals often very large (like f. 70, without *i*), with calcite, iron and copper pyrites, and some blende and celestine; near Wurtzboro, Sullivan Co., in a large vein in millstone grit, with blende, iron and copper pyrites, at Ancram, Columbia Co.; in Ulster Co., where often in crystals with the planes *O*, 1, 3-3, *i*-3, or like 70, except that the edges are bevelled. In *Maine*, veins of considerable extent exist at Lubec, where the ore is associated with chalcopyrite and blende; also less extensively at Blue Hill Bay, Bingham, and Parsonsville. In *New Hampshire*, at Eaton, with blende and chalcopyrite; and also at Haverhill, Bath, and Tamworth. In *Vermont*, at Thetford. In *Connecticut*, at Middletown, in a vein in argillite, massive and crystalline. In *Massachusetts*, at Southampton, Leverett, and Sterling. In *Pennsylvania*, at Phenixville and elsewhere. In *Virginia*, at Austin's mines in Wythe Co., Walton's gold mine in Louisa Co, and other places. In *Tennessee*, at Brown's Creek, and at Haysboro, near Nashville, with blende and heavy spar. In *Michigan*, in the region of Chocolate river and elsewhere, and Lake Superior copper districts; on the N. shore of L. Superior, in Neebing on Thunder Bay, and around Black Bay.

In *California*, at many of the gold mines. In *Nevada*, abundant on Walker's river, and at Steamboat Springs, Galena district. In *Arizona*, in the Castle Dome, Eureka, and other districts. In *Colorado*, at Pike's Peak, etc.

Alt.—Minium, anglesite, cerussite, pyromorphite, wulfenite, tetrahedrite, chalcocite, diallogite, quartz, limonite, pyrite, pistomesite (pistopyrite Breith.), calamine, occur as pseudomorphs after galenite, partly from alteration, and partly through removal and substitution. A change to the carbonate (cerussite), with the setting free of sulphur, is the most common.

The specimens regarded as pseudomorphs after pyromorphite, from Bernkastel on the Mosel, Breithaupt makes into a new species (B. H. Ztg., xxi. 99, 1862, xxii. 36, 1863), which he calls *plumbeine*, or one species of his *Sexangulites*, regarding this sulphid of lead as crystallized in hexagonal prisms, and not a pseudomorph. It has G.=6·729—6·87, and *hexagonal* cleavage. He places with it the stalactitic galena of Cornwall, Freiberg, and Przibram.

A galenite occurs in Lebanon Co., Pa., which has an easy *octahedral cleavage*, as first observed by Dr. John Torrey. It is regarded by some as proof of dimorphism of the sulphid of lead, and by others as a result of pseudomorphism after a mineral with octahedral cleavage. See Am. J. Sci., II. xxxv. 126. Dr. Torrey observes that on moderate heating *the cleavage becomes cubic*. In specific gravity it does not differ from ordinary galenite.

Fournetite of Ch. Mène (C. R., li. 463), supposed to be near tetrahedrite, is pronounced by Fournet (C. R., liv. 1096) a mixture of galenite with copper ore.

Artif.—Galenite is sometimes a furnace product. It has been made in crystals by heating oxyd or silicate of lead with vapor of sulphur (Wurtz); also by suspending sulphate of lead in a bag in water saturated with carbonic acid, and in which putrid fermentation is kept up (as by an oyster in the water), there resulting an incrustation of galenite upon the shells (Gages, Brit. Assoc., 206. 1863).

44A. HUASCOLITE *Dana*. (Galena blendosa *Domeyko*, Min., 168, 1860. Sulphid of lead and zinc *D. Forbes*, Phil. Mag., IV. xxv. 110.) The characters are mostly those of galenite. It has a granular or saccharoidal texture, a lead-gray color rather paler than ordinary galenite, but little lustre, and is apparently homogeneous and without any mixture of blende. Domeyko obtained (l. c.) S 19·2, Pb 48·6, Zn 25·6, gangue 3·1; which corresponds nearly to Pb S + $1\frac{1}{2}$ Zn S. It comes from Ingahuas, in the province of Huasco, where it forms large aggregated masses or nodules in the lower part of the vein.

44B. CUPROPLUMBITE Breith. (*Kupferbleispath* of the Germans, *Galena cobriza* Domeyko), from Chili, where it is not rare, appears to be, as Domeyko's name for it and his description implies (Min., 1860, 168), a mere mixture of galenite and chalcocite. The structure, color, and lustre vary from those of galenite to those nearly of chalcocite and covellite: the color a little darker, and passing to iron-gray and indigo-blue; the lustre generally feeble and sometimes almost wanting, and looking, says Domeyko, "as if sulphuret of copper were distributed through it." The specimens contain disseminated ores of copper, and come from a mine in Catemo (Aconcagua). Analyses: 1, Plattner (Pogg., lxi. 671); 2, Field (Am. J. Sci., II. xxvii. 387):

1.	S [15·1]	Pb 64·9	Cu 19·5	Ag 0·5	=100	Plattner.	G.=6·4—6·43
2. Algodones	17·00	28·25	53·63		=98·88	Field.	G.=6·10.

Field has named the variety analyzed by him *Alisonite*; it was from Mina Grande, near Coquimbo. According to G. Ulrich, a similar mineral occurs at M'Ivor in Victoria, Australia. Genth suggests that this mineral may have resulted from the alteration of galenite, which is probably true in some cases.

45. CLAUSTHALITE. Selenblei *Zinken*, 1823, Pogg., ii. 415, 1824, iii. 271; H. Rose, ib., ii. 415, iii. 281. Seleniuret of Lead. Plomb séléniuré *Fr.* Clausthalie *Beud.*, Tr., ii. 531. Clausthalite.

Kobalt-Bleiglanz [=Cobaltic Galena] *Hausm.*, Nordd. Beitr. B. H., iii. 120. Kobaltbleierz *Hausm.*, Handb., 183, 1813; id. *Strom. & Hausm.*, Gött. gel. Anz., 1825, 329. Selenkobaltblei *H. Rose*, Pogg., iii. 288, 290. Tilkerodite *Haid.*, Handb., 566, 1845.

Isometric. Occurs commonly in fine granular masses; some specimens foliated. Cleavage cubic.

H.=2·5—3. G.=7·6—8·8. Lustre metallic. Color lead-gray, somewhat bluish. Streak darker. Opaque. · Fracture granular and shining.

Comp., Var.—Pb Se=Selenium 27·6, lead 72·4=100. Besides (1) the pure selenid of lead, there are others, often arranged as distinct species, which contain cobalt, copper, or mercury, in place of part of the lead, and sometimes a little silver or iron. The proportions of these ingredients vary so much and so irregularly, that the true chemical constitution of the ores, as Rammelsberg states, is yet doubtful. (2) The cobaltic ore (anal. 3), *Tilkerodite* Haid., is here retained as a variety of clausthalite. It affords the formula 6 Pb Se + Co S^3, according to Rose, who makes the loss mainly selenium; but taking the results as they stand, 6 Pb Se + Co Se.

Analyses: 1, H. Rose (l. c.); 2, Stromeyer (Pogg., ii. 403); 3, H. Rose (Pogg., iii. 288):

	Se	Pb	Co	Fe		
1. *Clausthalite*	27·59	71·81	——	——	=99·40 Rose.	
2. "	28·11	70·98	0·83	——	=99·92 Strom.	G.=7·697.
3. *Tilkerodite*	31·42	63·92	3·14	0·45	=98·93 Rose.	

Pyr.—Decrepitates in the closed tube. In the open tube gives selenous fumes and a red sublimate. B.B. on charcoal a strong selenous odor; partially fuses. Coats the coal near the assay at first gray, with a reddish border (selenium), and later yellow (oxyd of lead); when pure entirely volatile; with soda gives a globule of metallic lead. The *tilkerodite* yields a black residue, and gives a cobalt-blue bead with borax.

Obs.—Much resembles a granular galenite; but the faint tinge of blue and the B.B. selenium fumes serve to distinguish it.

Found with the following selenic ores: first by Zinken, near Harzgerode in the Harz with hematite, at Clausthal, Tilkerode, Zorge, and Lehrbach; at Reinsberg, near Freiberg, in Saxony; at the Rio Tinto mines near Seville, Spain; Cacheuta mine, Mondoza, S. A.

46. ZORGITE. Selenblei mit Selenkupfer *H. Rose*, Pogg., ii. 415, 1824. Selenkupferblei, Selenbleikupfer, *Rose*, ib., iii. 293, 294, 296. Seleniuret of Lead and Copper. Zorgite *B. & M.*, 153, 1852. Raphanosmit *v. Kob.*, Taf., 6, 1853.

Massive, granular, like Clausthalite.

H.=2·5. G.=7—7·5. Lustre metallic. Color dark or light lead-gray, sometimes inclining to reddish, and often with a brass-yellow or blue tarnish. Streak darker. Brittle.

Comp.—Pb Se + Cu and Se in varying amounts; and perhaps only a mixture of clausthalite with the other ingredients. Analyses: 1, 2, H. Rose (Pogg., iii. 288); 3, 4, Kersten (ib., xlvi. 265):

	Se	Pb	Cu	Ag	
1. Tilkerode	34·26	47·43	15·15	1·29	Fe Pb 2·08=100·51 Rose.
2. "	29·96	59.67	7·86	——	Fe Pb 0·44 *undec.* 1·00=99·26 Rose.
3. Glasbach	30·00	53.74	8·02	0·05	Fe 2·00 S *tr.*, quartz 4·5=98·31 Kerst.
4. "	29·35	63·82	4·00	0·07	Fe S *tr.*, quartz 2·06=99·30 Kerst.

(1) No. 1 is Rose's *Selenbleikupfer*=4 Pb + 4 Cu + 7 Se. or wanting ¼ Se of Pb Se + Cu Se; and (2) No. 2 his *Selenkupferblei*=9 Pb + 4 Cu + 12 Se, which is near 2 Pb Se + Cu Se, the formula of No. 3; (3) No. 4=5 Pb Se + Cu Se. The deficiency of Se in Nos. 1 and 2 may be a result of partial alteration.

Pyr.—Like clausthalite, but yielding a black residue and a globule of copper, with usually, when cupelled, a trace of silver.

Obs.—Occurs under similar circumstances with clausthalite at Tilkerode and Zorge in the Harz; at Glasbach near Gabel in Thuringia, in argillaceous schist with galenite, chalcopyrite, malachite, in a gangue of calcite, siderite, fluorite, and quartz.

47. LEHRBACHITE. Selenblei mit Selenquecksilber *H. Rose*, ii. 418, 1824, iii. 297. Sele Quecksilberblei *Leonh.*, Handb., 592, 1826. Seleniuret of Lead and Mercury. Lehrbachite *B. M.*, Min., 153, 1852.

Massive, granular.

G.=7·804—7·876. Color lead-gray, steel-gray, iron-black. Brittle.

Comp.—Pb Se with Hg Se. Analyses: 1, Rose (l. c.); 2, 3, Schultz (Ramm. Min. Ch., 1011

1.	Tilkerode	Se 24·97	Pb 55·84	Hg 16·94=97·75.	
2.	"	27·68	61·70	8·33,	S 0·8, Fe 0·64=99·15 S., G.=7·089.
3.	"	24·41	16·93	55·52,	S 1·1=97·96 S., G.=8·104.

Pyr.—In the closed tube gives a lustrous metallic gray sublimate of selenid of mercury; wit soda, a sublimate consisting of globules of mercury. In the open tube gives reactions for selei ium, and a sublimate of selenate of mercury condensing in drops. On charcoal like clausthalit

Obs.—From Tilkerode and Lehrbach, in the Harz, like clausthalite.

48. ALTAITE. Tellurblei *G. Rose*, Pogg., xviii.68, 1830. Tellurid of Lead. Elasmose *Huot* Min., i. 1841; *O. d'Halloy*, Introd. à la Geol., 1833 (not of Beud. Tr., 1832), etc. Altait *Haid* Handb., 556, 1845.

Isometric. Usually massive; rarely in cubes. Cleavage: cubic.

H.=3—3·5. G.=8·159, G. Rose. Lustre metallic. Color tin-white resembling that of native antimony, with a yellow tarnish. Sectile.

Comp.—Pb Te=Tellurium 38·3, lead 61·7. Analysis by G. Rose (Pogg., xviii. 68) gave silve 1·28 p. c.; and from an imperfect approximative determination of the lead and tellurium Ros assumed them to have the same relation as in hessite, or Tellurium 38·37, lead 60·35.

Pyr.—In the open tube fuses, gives fumes of tellurous acid, forming a white sublimate, whic B.B. fuses into colorless drops. On charcoal in R.F. colors the flame bluish, fuses to a globule coats the coal near the assay with a lustrous metallic ring of tellurid of lead, outside of which i is brownish-yellow, and in O.F. still more yellow. Entirely volatile, except a trace of silver.

Obs.—From Savodinski near Siranovski, in the Altai, with hessite.

Huot says that Beudant in his lectures changed his first use of the name *Elasmose;* and th later use Huot adopts in his Mineralogy, and Omalius d'Halloy in his Introduction to Geology The confusion thus occasioned, and the unallowable form of the name, are reasons enough for setting it aside altogether, and adopting *Altaite.*

49. BORNITE. Kupferkies pt., Kupfer-Lazul *Henckel*, Pyrit., 1725. Lefverslag, Bru Kopparmalm, Minera Cupri Hepatica, Cuprum sulfure et ferro mineralisatum, *Wall.*, 283, 1747 Cuivre vitreuse violette *Fr. Trl.* Wall., 1753. Koppar-Lazur, Minera Cupri Lazurea, *Cronst.* 175, 1758. Buntkupfererz *Wern.* Purple Copper Ore *Kirw.* Variegated Copper Ore. Cuivre pyriteux hepatique, *H.* Phillipsite *Beud.*, ii., Tr., ii. 411, 1832. Pyrites erubescens *Dana* Min., 408, 1837; Poikilopyrites *Glock.*, Grundr., 328, 1839. Bornit *Haid.*, Handb., 562, 1845 Poikilit *Breith.* Erubescite *Dana*, Min., 510, 1850. Cobre abigarrado, Cobre panacoo, *Domeyko.*

Isometric. Observed planes *O*, *I*, 1, 2-2. Figs. 1, 2, 3, 11, 14. Cleavage: octahedral in traces. Twins: f. 50. Massive, structure granular o compact.

H.=3. G.=4·4—5·5. Lustre metallic. Color between copper-red and pinchbeck-brown; speedily tarnishes. Streak pale grayish-black, slightly shining. Fracture small conchoidal, uneven. Brittle.

Comp., Var.—(Ꞓu, Fe) S, the proportion of Ꞓu to Fe varying; and sometimes (there being an excess of sulphur above the ratio of unity) united to Fe S^2 (pyrite), either as an impurity or a chemical compound; at times also mixed with chalcopyrite. As it is a result of the alteration of other ores, occurring only sparingly at great depths in veins, such compounds, or mixtures, are not improbable.

(1). In anal. 1, 5, 6, Ȼu : Fe=4 : 1 nearly, whence the special formula ($\frac{4}{5}$ Ȼu + $\frac{1}{5}$ Fe) S=Sulphur 22·11, copper 70·13, Fe 7·76=100.

(2). In anal. 3, 4, 17, 18, Ȼu : Fe=2 : 1 nearly, and hence ($\frac{2}{3}$ Ȼu + $\frac{1}{3}$ Fe) S=Sulphur 23·7, copper 62·5, Fe 13·8=100.

(3). In the other analyses Fe S^2 is apparently present. (*a*). Anal. 2, 16, 19, 20, 21, 22 approximate more or less, in the ratio of sulphur to the metals, to 15 : 13, whence the formula 11 (Ȼu, Fe) S + 2 Fe S^2 (=4$\frac{1}{2}$ Ȼu S + Fe^2 S^3 Ramm.)=S 26·00, Cu 61·87, Fe 12·13. (*b*). Anal. 7 and 13 correspond to 6 (Ȼu, Fe) S + Fe S^2 (=5 Ȼu S + Fe^2 S^3 Ramm.). (*c*). Anal. 8, 9, 10. 12, 15, correspond to 4 (Ȼu, Fe) S + Fe S^2 (=3 Ȼu S + Fe^2 S^3)=S 28·04, Cu 55·60, Fe 16·36=100. (*d*). Anal. 24=10 (Ȼu, Fe) S + Fe S^2 (=9 Ȼu S + Fe^2 S^3 Ramm.). Rammelsberg writes for No. 5, 10 Ȼu S + Fe^2 S^3=11 (Ȼu, Fe) S + Fe S^2; and for No. 6, 8 Ȼu S + Fe^2 S^3=9 Ȼu S + Fe S^2.

In anal. 25, the proportion of copper is unusually small; Ȼu : Fe=3 : 2; formula 3 Ȼu S + Fe S + Fe S^2 (=$\frac{3}{4}$ Ȼu + $\frac{1}{4}$ Fe) S + $\frac{1}{4}$ Fe S^2. But Mène observes that the ore is not pure, and that after separating the impurity, or what is so regarded, it corresponds to Ȼu S + Fe S^2.

The presence of the ordinary sulphid of iron Fe S^2 appears to be far more probable than that of the uncertain Fe^2 S^3, as stated on page 33.

Analyses: 1, 2, Berthier (Ann. d. M., III. iii. 48, vii. 540, 556); 3, Phillips (Ann. Phil., 1822, 297); 4, Brandes (Schw. J., xxii. 354); 5–9, Plattner (Pogg., xlvii. 351); 10, Varrentrapp (ib.); 11, Hisinger (Afh., iv. 362); 12, Chodnef (Pogg., lxi. 395); 13, Bodemann (Pogg., lv. 115); 14, Staaf (Œfv. Ak. Stockh., 1848, 66); 15–18, E. Bechi (Am. J. Sci., II. xiv. 61); D. Forbes (Ed. N. Phil. J., l. 278); 20, Böcking (Ann. Ch. Ph., xcvi. 244); 21, C. Bergemann (Jahrb. Min., 1857, 394); 22, Rammelsberg (ZS. G., xviii. 19); 23, Collier (private contrib.); 24, Rammelsberg (ib., 29); 25, Mène (C. R., lxiii. 53):

	S	Cu	Fe
1. Montecastelli, Tuscany	21·4	67·2	6·8, gangue 4·0=99·4 Berthier.
2. St. Pancrace	22·8	59·2	13·0, gangue 5·0=100 Berthier.
3. Ross I., L. Killarney	23·75	61·07	14·0, quartz 0·5=99·32 Phillips.
4. Siberia	21·65	61·63	12·75, " 3·5=99·53 Brandes.
5. Sangerhausen, *massive*	22·58	71·00	6·41=99·99 Plattner.
6. Eisleben, *massive*	22·65	69·72	7·54=99·91 Plattner.
7. Woitzki, White Sea, *mass.*	25·06	63·03	11·56=99·65 Plattner.
8. Condurra M., Cornw., *cryst.*	28·24	56·76	14·84=99·84 Plattner.
9. Dalarne, *massive*	25·80	56·10	17·36, S̈i 0·13=99·39 Plattner.
10. "	26·98	58·20	14·85=100·03 Varrentrapp.
11. Vestanforss, Westmannl'd	24·70	63·33	11·80=99·83 Hisinger.
12. Redruth *cryst.*	26·84	57·89	14·94, gangue 0·04=99·71 Chodnef.
13. Bristol, Ct., *massive*	25·70	62·75	11·64, quartz 0·04=100·13 Bodemn.
14. Westmannland	——	60·56	10·24, gangue 4·09=99·11 Staaf.
15. Mt. Catini	24·93	55·88	18·03=98·84 Bechi.
16. "	23·36	59·47	13·87, gangue 0·75, Fe 1·50=98·95 B.
17. Miemo	23·98	60·16	15·09=99·23 Bechi.
18. Fericcio	24·70	60·01	15·89=100·60 Bechi.
19. Jemteland, Sweden	24·49	59·71	11·12, Mn *tr.*, S̈i 3·83 = 99·15 Forbes—G. 4·432.
20. Coquimbo	25·46	60·80	13·67=99·93 Böcking.
21. Ramos, Mexico	23·46	62·17	11·79, Ag 2·58=100 Berg. G.=5—5·476.
22. " G.=5·030	25·27	61 66	11·80, Pb 1·90, Ag *tr.*=100·63 Ramm.
23. Bristol, Ct.	25·83	61·79	11·77, Ag *tr.*=99·39 Collier.
24. Lauterberg	23·75	68·73	7·63=100·11 Ramm.
25. Corsica	26·3	50·0	15·4, *insol.* 8·1=99·80 Mène.

Pyr., etc.—In the closed tube gives a faint sublimate of sulphur. In the open tube yields sulphurous acid, but gives no sublimate. B.B. on charcoal fuses in R.F. to a brittle magnetic globule. The roasted mineral gives with the fluxes the reactions of iron and copper, and with soda a metallic globule. Soluble in nitric acid with separation of sulphur.

Obs.—Occurs with other copper ores, and is a valuable ore of copper. Crystalline varieties are found in Cornwall, and mostly in the mines of Tincroft and Dolcoath near Redruth, where it is called by the miners "horse-flesh ore." Other foreign localities of massive varieties are at Ross Island in Killarney, in Ireland; at Mount Catini, Tuscany; in cupriferous shale in the Mansfeld district, Germany; and in Norway, Siberia, Silesia, and Hungary.

It is the principal copper ore at some Chilian mines, especially those of Tamaya and Sapos; also common in Peru, Bolivia, and Mexico. At the copper mine in Bristol, Conn., it is abundant, and often in fine crystallizations (f. 1, 3, 4, and 14 with planes *O*). At Cheshire, it is met with in cubes, along with barite, malachite, and chalcocite. Found massive at Mahoopeny, ne Wilkesbarre, Penn., and in other parts of the same State, in cupriferous shale, associated in sm quantities with vitreous copper; also in granite at Chesterfield, Mass.; also in New Jersey. common ore in Canada, at the Acton and other mines, along a belt of 15–20 m., between L. Me phromagog and Quebec.

Named after von Born, a distinguished mineralogist of the last century. The name Philli site has a prior use for another species.

50. **BERZELIANITE.** Selenkupfer *Berz.*, Afh., vi. 42, 1818. Selenid of copper; Seleniur of Copper. Cuivre sélénié *Fr.* Berzoline *Beud.*, Tr., ii. 534, 1832. Berzelianite *Dana*, Mi 509, 1850.

In thin dendritic crusts. Soft. Lustre metallic. Color silver-whit Streak shining.

Comp—Ɵu Se=Selenium 38·4, copper 61·6=100. Analysis by Berzelius (l. c.):

Selenium 40	Copper 64.

Pyr.—In the open tube gives a red sublimate of selenium, with white crystals of selenou acid. B.B. on charcoal selenous fumes, and with soda yields a globule of copper.

Obs.—Occurs at Skrikerum in Sweden, and also near Lehrbach in the Harz.

Beudant gave the name *Berzeline* to this species, which, as it has another earlier application i the science, is given to another form above.

51. **CASTILLITE.** Castillit *Ramm.*, ZS. G., xviii. 213.

Massive. Distinctly foliated.

H.=3. G.=5·186–5·241. Lustre metallic. Color and tarnish as ir bornite.

Comp.—4½ (Ɵu, Zn, Pb, Ag) S+Fe S^2 with Ɵu : Zn : Pb : Ag=30 : 7 : 2½ : 1). Analysis: Rammelsberg (l. c.):

S	Cu	Zn	Pb	Ag	Fe
25·65	41·11	12·09	10·04	4·64	6·49=100·02

Rammelsberg writes the formula $(Cu\ Ag)^2\ S+2\ (Cu, Pb, Zn, Fe)\ S$.

Pyr., etc.—B.B. fuses rather difficultly, and changes to a slag colored red by copper. In nitric acid dissolves with the separation of sulphur and sulphate of lead, and gives a blue solution.

Obs.—From Guanasevi in Mexico, where it was considered an argentiferous bornite. It is nea bornite in constitution, as observed by Rammelsberg.

52. **ALABANDITE.** Schwarze Blende (fr. Transylvania) *Müller v. Reichenstein*, Phys. Arb. Fr. in Wien, i. 2nd Quart., 86, 1784; *Bindheim*, Schrift. Ges. Fr., Berl. v. 452, 1784 (making it comp. of Mn, S, Fe, Ag). Schwarzerz *Klapr.*, Beitr., iii. 35, 1802. Braunsteinkies *Leonh.*, Tab., 70, 1806. Brunsteinblende [=Manganblende] *Blumenbach*, Handb., i. 707, 1807. Manganglanz *Karst.*, Tab., 72, 1808. Manganèse sulfuré, *H.*, Tab., iii. 1809. Sulphuret of Manganese. Schwefel-Mangan *Germ.* Alabandine *Beud.*, Tr., ii. 399, 1832. Blumenbachit *Breith.*, B. H. Ztg., xxii. 193, 1866.

Isometric. In cubes and octahedrons. Cleavage: cubic perfect. Twins: simple, with composition-face octahedral; also cruciform, made of five combined octahedrons. Usually granularly massive.

H.=3·5–4. G.=3·95–4·04. 4·036, Mexico. Lustre submetallic. Color iron-black, tarnished brown on exposure. Streak green. Fracture uneven.

Comp.—MnS=Sulphur 36·7, manganese 63·3=100. Analyses: 1, Arfvedson (Ak. H. Stockh. 1822); 2, Bergemann (Jahrb. Min., 1857, 394):

1. Transylvania	Sulphur	37·9	Manganese	62·1=100	Arfvedson.
2. Mexico	"	36·81	"	62·98=99·79	Bergemann.

Earlier analyses by Klaproth, Vauquelin, and Del Rio give erroneous results, the first two finding it mainly Mn, with 11 to 15 S.

Pyr.—Unchanged in the closed tube. In the open tube sulphurous fumes. Roasted on charcoal, the assay is converted into oxyd, which, with the fluxes, gives the reactions of manganese. Soluble in dilute nitric acid, with evolution of sulphuretted hydrogen.

Obs.—Manganblende occurs in veins in the gold mines of Nagyag, Kapnik, and Offenbanya, in Transylvania, associated with tellurium, carbonate of manganese, and quartz; at Gersdorf, near Freiberg, a variety containing a trace of arsenic; in Mexico, at the mine Preciosa in Puebla, with tetrahedrite.

With regard to the cruciform twins of five octahedrons, Schrauf, who describes them, observes that 5 times the tetrahedral angle 70½ is nearly 360°.

53. SYEPOORITE. Sulphuret of Cobalt *Middleton*, Phil. Mag., III. xviii. 352, 1846. Syepoorite *J. Nicol*, Min., 458, 1849. Kobaltsulfuret pt., Schwefel Kobalt pt., Kobaltkies pt., Graukobalterz, *Germ.*

Massive, disseminated in grains or veins.

G.=5·45. Color steel-gray, inclining to yellow.

Comp.—Co S=Sulphur 35·2, cobalt 64·8=100. Analysis by Middleton (l. c.):

Sulphur 35·36 Cobalt 64·64=100.

Obs.—From Syepoor, near Rajpootanah in North-west India, where it occurs in ancient schists with pyrrhotite. It is employed by the Indian jewelers to give a rose color to gold.

54. PENTLANDITE. Eisen-Nickelkies *Scheerer*, Pogg., lviii. 316, 1843. Sulphuret of Iron and Nickel. Pentlandite *Dufr.*, Min., ii. 549, 1856. Nicopyrite *Shep.*, Min., 307, 1857.

Isometric. Cleavage octahedral. Massive, granular.

H.=3·5—4. G.=4·6. Color light bronze-yellow. Streak light bronze-brown. Not magnetic.

Comp.—(½ Ni + ½ Fe) S = Sulphur 36·0, iron 41·9, nickel 22·1=100. **Analysis**: Scheerer (Pogg., lviii. 315):

	S	Fe	Ni	Cu
1.	36·45	42·70	18·35	1·16=98·66
2.	36·64	40·21	21·07	1·78=99·70

Excluding the copper as chalcopyrite, No. 1 gives S 37·02, Fe 43·73, Ni 19·25; No. 2, S 36·86, Fe 40·86, Ni 22·28. Rivot found (Dufr. Min., l. c.), for the ore from Craigmuir in Argyleshire, S 35·8, Fe 54·8, Ni 7·6, quartz 1·4=99·6.

Pyr.—In the open tube sulphurous fumes. The powdered mineral roasted B.B. on charcoal gives with the fluxes reactions for nickel and iron.

Obs.—Occurs with chalcopyrite in a hornblende rock near Lillehammer in Southern Norway, slightly mixed with magnetite at Craigmuir, 9 m. from Inverary, in Argyleshire, Scotland, in gneiss; also 2 m. from Inverary, both extensively mined; at Wheal Jane in Kenwyn, Cornwall. The ore is valuable for the extraction of nickel.

Named after Mr. Pentland.

55. GRÜNAUITE. Nickelwismuthglanz *v. Kob.*, J. pr. Ch., vi. 332, 1835. Bismuth Nickel. Grünauite *Nicol*, Min. 458, 1849. Saynit *v. Kob.*, Taf., 13, 1853.

Isometric. Figs. 2, 6, 7. Cleavage octahedral.

H.=4·5. G.=5·13. Lustre metallic. Color light steel-gray to silver-white, often yellowish or grayish through tarnish. Streak dark gray. Brittle.

Comp.—Analyses: 1, Kobell (l. c.). 2, 3, Schnabel (Ramm., 4th Suppl., 164):

	S	Bi	Ni	Fe	Co	Cu	Pb
1.	38·46	14·11	40·65	3·48	0·28	1·68	1·58=100·24 Kobell.
2.	31·99	10·49	22·03	5·55	11·24	11·59	7·11=100 Schnabel.
3.	33·10	10·41	22·78	6·06	11·73	11·56	4·36=100 Schnabel.

The sulphur is to the metals present as 4½ : 3. No probable formula has been deduced.

Pyr., etc.—Fuses to a gray, brittle, magnetic globule, coloring the charcoal greenish-yellow Dissolves in nitric acid, excepting the sulphur.

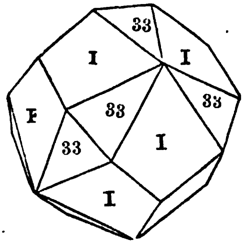
Obs.—Found at Grünau, in Sayn Altenkirchen, with quartz and chalcopyrite.

56. SPHALERITE or BLENDE. Galena inanis, *Germ.* Blende, *Agric.*, Interpr., 465, 1546 Bläude, Pseudo-galena, Zincum S, As, et Fe mineralisatum, *Wall.*, Min., 248, 1747. Zincum cum Fe, S mineralisatum *Bergm.*, Sciagr., 1782. Sulphuret of zinc. Zinc sulfuré *Fr.* Zinc Blende. Sphalerit *Glock.*, Syn., 17, 1847. Black-Jack *Engl. Miners.*

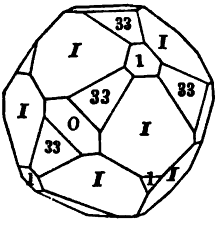
Cleiophane *Nuttal.* Marmatite (fr. Marmato) *Boussingault*, Pogg., xvii. 399, 1829. Przibramit *Huot*, Min., 298, 1841. Marasmolite *Shep.*, Am. J. Sci., II. xii. 210, 1851. Christophit *Breith* B. H. Ztg., xxii. 27. Rahtite *Shep.*, Am. J. Sci., II. xli. 209, 1866.

Isometric: tetrahedral, Observed planes, O; I; 1; 2; i-$\frac{3}{2}$, i-2; 2-2 3-3, 4-4, 5-5. Figs. 3, 29 to 33; also 73, 74. Cleavage: dodecahedral highly perfect. Twins: composition-face 1, as in f. 75; also 76, of which 73 is the simple form. Also botryoidal, and other imitative shapes; sometimes fibrous and radiated; also massive, compact.

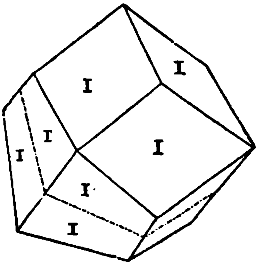
73



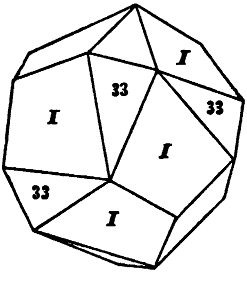
74



75



76



H.=3·5—4. G.=3·9—4·2. 4·063, white, New Jersey. Lustre resinous to adamantine. Color brown, yellow, black, red, green; white or yellow when pure. Streak white—reddish-brown. Transparent—translucent. Fracture conchoidal. Brittle.

Comp., Var.—Zn S=Sulphur 33, zinc 67=100. But often having part of the zinc replaced by iron, and sometimes by cadmium.

Var. 1. *Ordinary.* Containing little or no iron; colors white to yellowish-brown, sometimes black; G.=3·9—4·1. The pure white blende of Franklin, N. J., is the *cleiophane* (anal. 5).

2. *Ferriferous; Marmatite.* Containing 10 p. c. or more of iron; dark-brown to black; G.=3·9—4·2. The proportion of sulphid of iron to sulphid of zinc varies from 1 : 5 to 1 : 2, and the last ratio is that of the *christophite* of Breithaupt (l. c.), a brilliant-black blende from St. Christophe mine, at Breitenbrunn, near Johanngeorgenstadt, having G.=3·91—3·923 (l. c.).

3. *Cadmiferous; Przibramite.* The amount of cadmium present in any blende thus far analyzed is less than 5 per cent.

Each of the above varieties may occur (*a*) in crystals; (*b*) firm, fibrous, or columnar, at times radiated or plumose; (*c*) cleavable, massive, or foliated; (*d*) granular, or compact massive.

The *brass-ore* (*Messingerz* Germ.) of early mineralogists is a mixture of blende and chalcopyrite. Shepard's *marasmolite* (l. c.) is a partially decomposed blende containing some free sulphur.

Analyses: 1, Arfvedson (Ac. H. Stockh., 1822, 438, Pogg., i. 62); 2, Löwe (Pogg., xxxviii. 161); 3, Kersten (Pogg., lxiii. 132); 4, C. Kuhlemann (ZS. nat. Ver. Halle. viii. 499); 5, T. H. Henry (Phil. Mag., IV. i. 23); 6, J. L. Smith (Am. J. Sci., II. xx. 250); 7, 8, 9, Jackson (G. Rep. N. Hampshire. 208); 10, Scheerer (Pogg., lxv. 300); 11, 12, Bechi (Am. J. Sci., II. xiv. 61); 13, Scheerer (B. H. Ztg., xix., No. 15); 14, Heinichen (B. H. Ztg., xxii. 27); 15, Lecanu (J. de Pharm., ix. 457); 16, 17, 18, Berthier (Ann. d. M., ix. 419); 19, 20, Boussingault (Pogg., xvii. 393):

	S	Zn	Fe	Cd
1.	33·66	66·34	——	——=100 Arfvedson.
2. Przibram, *fibrous*	33·15	61·40	2·29	1·50=98·34 Löwe.
3. Carinthia, Raibel, *rh. yw.*	32·10	64·22	1·32	*tr.*, Sb and Pb 0·72, H 0·80=99·16 Kersten.
4. Clausthal, *black*	33·04	65·39	1·18	0·79, Cu 0·13, Sb 0·63=101·06 Kuhlemann.
5. N. Jersey, *white*	32·22	67·46	——	*tr.*=99·68 Henry.
6. Phenixville, Pa.	33·82	64·39	——	0·98, Cu 0·32, Pb 0·78=100·29 Smith.
7. Eaton, N. H., *ywh. bn.*	33·22	63·62	3·10	0·6 including loss=100 Jackson.
8. Lyman, N. H.	33·4	55·6	8·4	2·3=99·7 Jackson.
9. Shelburne, N. H.	32·6	52·0	10·0	3·2, Mn 1·3=99·1 Jackson.
10. Christiania, *fibrous*	33·73	53·17	11·79	——, Mn 0·74, Cu *tr.*=99·43 Scheerer.
11. Tuscany, *marmatite*	32·12	50·90	11·44	1·23, Fe S^2 0·75=96·44 Bechi.
12. " "	33·65	48·11	16·23	*tr.*, Cu *tr.*=97·99 Bechi.
13. Titiribi, N. G., *bkh. bn.*	33·82	54·17	11·19	0·82, Mn 0·88=100·88 Scheerer.
14. *Christophite, black*	33·57	44·67	18·25	0·28, Mn 2·66, Sn *tr.*=99·43 Heinichen.
			ZnS	FeS
15. Charente			82·76	13·71=96·47 Lecanu.
16. England, *gray*			91·8	6·4=98·2 Berthier.
17. Cagulin, *brown*			75·5	17·2=92·7 Berthier.
18. Luchon			94·4	5·4=99·8 Berthier.
19. Marmato, *Marmatite*			77·5	22·5=100 Boussingault.
20. " "			76·8	23·2=100 Boussingault.

The *marmatite* of anal. 19 affords the formula 3 ZnS + FeS = 77 Zn S and 23 FeS; of anal. 12, 5 Zn S + 2 FeS; another, of brown color, from near Burbach in Siegen, afforded Schnabel (Pogg., cv 144) 5 ZnS + FeS; Breithaupt's *christophite*=2 ZnS + FeS.

Pyr., etc.—In the open tube sulphurous fumes, and generally changes color. B.B. on charcoal, in R.F., some varieties give at first a reddish-brown coating of oxyd of cadmium, and later a coating of oxyd of zinc, which is yellow while hot and white after cooling. With cobalt solution the zinc coating gives a green color when heated in O.F. Most varieties, after roasting, give with borax a reaction for iron. With soda on charcoal in R.F. a strong green zinc flame. Difficultly fusible.

Dissolves in muriatic acid, during which sulphuretted hydrogen is disengaged. Some specimens phosphoresce when struck with a steel or by friction.

Obs.—Occurs in both crystalline and sedimentary rocks, and is usually associated with galena; also with barite, chalcopyrite, fluorite, siderite, and frequently in silver mines.

Derbyshire, Cumberland, and Cornwall, afford different varieties; also Transylvania; Hungary; the Harz; Sahla in Sweden; Ratieborzitz in Bohemia; many Saxon localities. Splendid crystals are found in Binnenthal. A variety having a divergent fibrous structure and presenting botryoidal forms is met with in Cornwall; at Raibel; and at Geroldseck in Baden.

Abounds with the lead ore of Missouri, Wisconsin, Iowa, and Illinois. In *N. York*, Sullivan Co., near Wurtzboro', it constitutes a large part of a lead vein in millstone grit, and is occasionally in octahedrons; in St. Lawrence Co., brown blende occurs at Cooper's falls, in a vein of carbonate of lime; at Mineral Point with galena, and in Fowler, on the farm of Mr. Belmont, in a vein with iron and copper pyrites traversing serpentine; at the Ancram lead mine in Columbia Co., of yellow and brown colors; in limestone at Lockport and other places, in honey and wax-yellow crystals often transparent; with galena on Flat Creek, two miles south-west of Spraker's Basin. In *Mass.*, at Sterling of a cherry-red color, with galena; also yellowish-brown at the Southampton lead mines; at Hatfield, with galena. In *N. Hamp.*, at the Eaton lead mine; at Warren, a large vein of black blende. In *Maine*, at the Lubec lead mines; also at Bingham, Dexter, and Parsonsfield. In *Conn.*, yellowish-green at Brookfield; at Berlin, of a yellow color; brownish-black at Roxbury, and yellowish-brown at Lane's mine, Monroe. In *N. Jersey*, a *white* variety (*cleiophane* of Nuttall) at Franklin. In *Penn.*, at the Wheatley and Perkiomen lead mines, in handsome crystallizations; near Friedensville, Lehigh Co., a *white* waxy var. In *Virginia*, at Walton's gold mine, Louisa Co., and more abundantly at Austin's lead mines, Wythe Co, where it occurs crystallized, or in radiated crystallizations. In *Michigan*, at Prince vein, Lake Superior, abunda In *Illinois*, near Rosiclare, with galenite and calcite; at Marsden's diggings, near Galena, stalactites, some 6 in. or more through, and covered with cryst. pyrite, and galenite. In *Wisconsi* at Mineral Point, in fine crystals, and many of large size (3 in. through, or so), altered to smit sonite. In *Tennessee*, at Haysboro', near Nashville.

Named *blende* because, while often resembling galena, it yielded no lead, the word in Germ meaning *blind* or *deceiving*. *Sphalerite* is from σφαλερός, *treacherous*.

Alt.—Blende by oxydation changes to zinc vitriol. Calamine ($\dot{Z}n^3\ddot{S}i+1\frac{1}{2}\dot{H}$), smithsonite ($\dot{Z}$ $\ddot{C}$), and limonite occur as pseudomorphs. The sulphate is decomposed by bi-carbonate of lim producing smithsonite; and the alkaline silicates in solution, acting on the sulphate or carbona afford silicate of zinc.

Artif.—Blende may be made in crystals from a solution of sulphate containing some putrifyi animal matter; in an experiment by Gages, using oysters for the animal matter, the shells we turned partly into carbonate of zinc and selenite, and some blende incrusted them. Also may made by subjecting heated oxyd or silicate of zinc to vapors of sulphur.

Rahtite of Shepard (l. c.) is a wholly uncrystalline blende, with G.=4·128, containing iron a copper, and probably a mere mixture of blende and other minerals. Shepard says that it occu "in the upper decomposed portion of the Ducktown copper lode, associated with melaconite a various mixtures of chalcopyrite, redruthite," etc. The specimen analyzed by Mr. Tyler for Pr Shepard was iron-black, while Shepard says that the mineral is "dark lead-gray, with a tinge blue, not unlike some of the ores of antimony." Tyler obtained (l. c.) for the composition of h specimen, S 33·36, Zn 47·86, Fe 6·18, Cu 14·00, giving approximately 10 S, 7 Zn, 1 Fe, 2 Cu, a equivalent to 7 Zn S+Fe S^2+Ȼu S, or 7 of blende, with 1 pyrite and 1 chalcocite (redruthit Since Ȼu (not Cu) replaces Fe and the related metals in the sulphids, the formula cannot be (Z Fe, Cu) S, or that of a cupreous blende.

57. VOLTZITE. Voltzine *Fournet*, Ann. d. M., III. iii. 519, 1833. Oxysulphuret of Zinc. Lebe blende *Breith.*, J. pr. Ch., xv. 1838, B. H. Ztg., xxii. 26. Voltzit *Ramm.*, Handw., 260, 1841.

In implanted spherical globules; structure thin curved lamellar.

H.=4—4·5. G.=3·66—3·81. Lustre vitreous to greasy; or pearly o a cleavage surface. Color dirty rose-red, yellowish, brownish. Opaque o subtranslucent.

Var.—G.=3·66 fr. Rosières, Fournet; 3·691 fr. Geyer; 3·711 fr. Marienberg; 3·777 fr. Corn wall; 3·804 fr. Johanngeorgenstadt.

Comp.—4 Zn S+Zn O=Sulphid of zinc 82·73, oxyd of zinc 17·27=100. Analyses: 1, Fou net (l. c.); 2, Lindaker (Vogl's Min. Joach., 175):

1. Rosières	Zn S 82·92	Zn O 15·34	F̶e 1·84	Resinous subst. *tr.*=100·10	Fournet.
2. Joachimsthal	82·75	17·25=100			Lindaker.

Pyr., etc.—B.B. like blende. In muriatic acid affords fumes of sulphuretted hydrogen.

Obs.—Occurs at Rosières, near Pont Gibaud, in Puy de Dôme; Elias mine near Joachimstha with galenite, blende, native bismuth, etc.; near Marienberg (the *leberblende*); Hochmuth ne Geyer; Cornwall, probably at Redruth; at Bernkastel on the Mosel, in pseudomorphs aft quartz.

Named after the French mining engineer, Voltz.

The supposed artificial voltzite from the Freiberg smelting-works has been shown to b blende.

58. HESSITE. Tellursilber *G. Rose*, Pogg., xviii. 64, 1830. Savodinskite *Huot*, Min., i. 18 1841. Telluric Silver. Hessit *Fröbel*, Grundz. Syst. Kryst., 49, 1843.

Orthorhombic, and resembling chalcocite, Kenngott, Peters. Occurrin planes *O*, *I*, *i-ī*, *i-ĭ*, *m-ĭ*, *i-n̄*, and others. Cleavage indistinct. Massive compact or fine-grained; rarely coarse-granular.

H.=2—3·5. G.=8·3—8·6. Lustre metallic. Color between lead-gra and steel-gray. Sectile. Fracture even.

Comp.—Ag Te=Tellurium 37·2, silver 62·8=100. Silver sometimes replaced in part by gold Analyses: 1, 2, G. Rose (Pogg., xviii. 64); 3, Petz (ib., lvii. 647); 4, Rammelsberg (4th Suppl. 220):

1. Savodinski, Altai		Te 36·96	Ag 62·42	Fe 0·24=99·62 Rose.
2 " "	G.=8·41–8·565	36·89	62·32	0·50=99·71 Rose.
3. Nagyag	G.=8·31–8·45	[37·76]	61·55,	Au 0·69, Fe, Pb, S, *tr.*=100 Petz.
4. Retzbanya		27·96	54·67	Foreign substances 15·25=97·88 Ramm.

Pyr.—In the open tube a faint white sublimate of tellurous acid, which B.B. fuses to colorless globules. On charcoal fuses to a black globule; this treated in R.F. presents on cooling white dendritic points of silver on its surface; with soda gives a globule of silver.

Obs.—Occurs in the Savodinski mine, about 10 versts from the rich silver mine of Zirianovski, in the Altai, in Siberia, in a talcose rock, with pyrite, black blende, and chalcopyrite. Specimens in the museum of Barnaul, on the Ob, are a cubic foot in size. Also found at Nagyag in Transylvania, and at Retzbanya in Hungary; Stanislaus mine, Calaveras Co., Cal.

Kenngott examined crystals from Nagyag, and Peters, from Retzbanya. Hess made the Altai mineral rhombohedral, which Kokscharof does not sustain.

58A. **Petzite.** (Tellursilber *Petz*, Pogg., lvii. 470; Tellurgoldsilber *Hausm.*, Handb., 1847. Petzit *Haid.*, Handb., 1845.) Differs from hessite in gold replacing much of the silver. H.=2·5. G.=8·72–8·83, Petz; 9–9·4, Küstel. Color between steel-gray and iron-black, sometimes with pavonine tarnish. Streak iron-black. Brittle. Composition Au Te+4½ Ag Te, Petz; Au Te+3 Ag Te, Genth. Analyses: 1, Petz (l. c.); 2–4, Genth (Am. J. Sci., II. xlv. 310); 5, Küstel (ib., B. H. Ztg., 1866, 128):

1. Nagyag	Te [34·98]	Ag 46·76	Au 18·26, Fe, Pb, S *tr.*=100 Petz.
2. Stanislaus mine	(½) [32·23]	42·14	25·63=100 Genth.
3. Golden Rule mine	32·68	41·86	25·60=100·14 Genth.
4. " "	[34·16]	40·87	24·97=100 Genth.
5. Stanislaus mine	35·40 ?	40·60	24·80=100·80 Küstel.

Occurs at the localities stated, with other ores of tellurium.

59. DALEMINZITE. Daleminzit *Breith.*, B. H. Ztg., xxi. 98, 1862, xxii. 44, 1863.

Orthorhombic, and isomorphous with chalcocite: $I \wedge I=116°$. Occurring planes O, I, i-$\breve{\imath}$, 2-$\breve{2}$, 1-$\frac{1}{2}$.

H.=2–2·5. G.=7·044–7·049. Physical characters like those of argentite.

Comp.—Ag S, or same as for argentite, it being the same chemical compound under an orthorhombic form.

Pyr.—Same as for argentite.

Obs.—From the Himmelfahrt mine near Freiberg. Much resembles stephanite.

Named from Dalminzien, the ancient name of Freiberg.

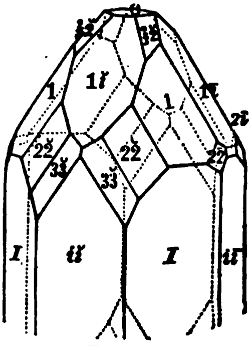
Akanthite is also orthorhombic sulphid of silver, but of very different angles.

60. ACANTHITE. Akanthit *Kenng.*, Pogg., xcv. 462, 1855.

Orthorhombic. $I \wedge I=110° 54'$; $O \wedge 1\text{-}\bar{\imath}=124° 42'$; $a : b : c=1·4442 : 1 : 1·4523$. Observed planes: as in f. 77, with also vertical i-$\breve{2}$, i-$\bar{2}$; domes, $\frac{5}{8}$-$\bar{\imath}$?, $\frac{2}{3}$-$\bar{\imath}$?, $\frac{5}{6}$-$\bar{\imath}$?, $\frac{5}{4}$-$\bar{\imath}$, 2-$\bar{\imath}$, 8-$\breve{\imath}$?; octahedral, $\frac{1}{3}$, $\frac{5}{4}$; $\frac{5}{8}$-$\bar{5}$?; $\frac{1}{2}$-2; $\frac{5}{4}$-$\frac{5}{3}$; $\frac{8}{3}$-$\breve{8}$; 2-$\breve{6}$; $\frac{5}{2}$-5; $\frac{4}{3}$-$\breve{4}$; 20-$\frac{5}{3}$?; 4-$\breve{2}$, $\frac{2}{3}$-$\breve{2}$, 1-$\breve{2}$, $\frac{1}{2}$-$\breve{\imath}$, $\frac{15}{3}$-$\frac{15}{4}$? (Dauber). $O \wedge 1\text{-}\breve{\imath}=135° 10'$; $O \wedge 1=119° 42'$; $O \wedge \frac{2}{3}\text{-}\breve{2}=140° 40'$, $i\text{-}\breve{\imath} \wedge 2\text{-}\breve{2}=138° 33'$, $i\text{-}\breve{\imath} \wedge I=124° 33'$, $1 \wedge 1$, over 1-$\breve{\imath}$,=88° 3′ (obs.) $1 \wedge 1\text{-}\bar{\imath}=150° 31'$ (obs.) $1 \wedge I=140° 18'$, $1\text{-}\bar{\imath} \wedge i\text{-}\bar{\imath}=145° 18'$, $1\text{-}\bar{\imath} \wedge 1\text{-}\bar{\imath}$, over i-$\bar{\imath}$,=110° 36′. Twins: composition parallel to 1-$\bar{\imath}$. Crystals usually slender-pointed prisms. Cleavage indistinct.

H.=2·5 or under. G.=7·16–7·33; 7·16–7·236, from Freiberg; 7·188–7·326 from Joachimsthal. Lustre metallic. Color iron-black or like argentite. Fracture uneven, giving a shining surface. Sectile.

77



Freiberg.

Comp.—Ag S, or like argentite. P. Weselsky obtained (J. pr. Ch., lxxxi. 487) from a Freiberg specimen 86·71 silver, 12·70 sulphur; from a Joachimsthal specimen, 87·4 silver.

Pyr.—Same as for argentite.

Obs.—At Joachimsthal, with pyrite, argentite, and calcite, usually on quartz; also at the Himmelfürst mine, near Freiberg in Saxony, along with argentite and stephanite. The crystals are parallel with those of stromeyerite when 1-ī is made *I*; in that case *I* ∧ *I*=110° 36′, and *I*-ī ∧ 1-ī =89° 40′; while in stromeyerite these angles are 119° 35′ and *i*-ī ∧ 1-ī=91° 44′; and twins are compounded parallel to *I* in each. On cryst., see H. Dauber, Ber. Ak. Wien. xxxix. 685. The prisms 1-ī, and *I*, correspond nearly in angle to the twining form $\frac{4}{3}$-ĭ of chalcocite.

The ore analyzed by W. J. Taylor, and referred by him to stromeyerite, may belong to acanthite, as suggested by Kenngott; but this can be made certain only by ascertaining its crystalline form.

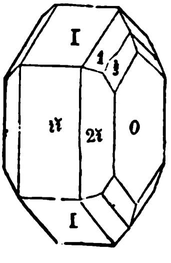
61. CHALCOCITE. Æs rude plumbei coloris pt., *Germ.* Kupferglaserz, *Agric.*, Interpr., 461, 1546. Koppar-Glas pt., Cuprum vitreum, *Wall.*, 282, 1747. Cuivre vitreux *Fr. Trl.* Wall., i. 509, 1753. Kopparmalm, Cuprum sulphure mineralisatum pt., *Cronst.*, 174, 1758. Vitreous Copper, Sulphuret of Copper. Cuivre sulfuré *Fr.* Kupferglanz *Germ.* Copper Glance. Chalcosine *Beud.*, Tr., ii. 408, 1832. Cyprit *Glock.*, Syn., 1847. Redruthite *Nicol*, Min., 1849. Kuprein *Breith.*, B. H. Ztg., xxii. 35, 1863.

Digenit *Breith.*, Pogg., lxi. 673, 1844. Carmenite *H. Hahn*, B. H. Ztg., xxiv. 86, 1865.

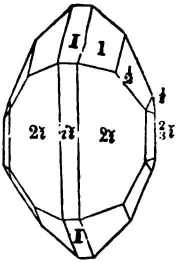
Orthorhombic. *I* ∧ *I*=119° 35′, *O* ∧ 1-ī=120° 57′; *a* : *b* : *c*=1·6676 : 1 : 1·7176. Observed planes: *O*; vertical, *I*, *i*-ĭ, *i* ī, *i*-$\frac{3}{2}$, *i*-3̆; domes, 2-ī, $\frac{4}{3}$-ĭ, 1-ĭ, $\frac{2}{3}$-ĭ, $\frac{1}{2}$-ĭ; octahedral, $\frac{1}{3}$, $\frac{1}{2}$, 1, 4.

O ∧ $\frac{1}{3}$=147° 16′	*O* ∧ $\frac{2}{3}$-ĭ=147° 6′	*O* ∧ 1-ĭ=135° 52′
O ∧ $\frac{1}{2}$=136 2$\frac{1}{2}$	*O* ∧ 2-ĭ=117 16	*i*-3̆ ∧ *i*-3̆=120 25
O ∧ 1=117 24	*O* ∧ $\frac{4}{3}$-ĭ=124 30	1 ∧ 1, mac.,=126 56$\frac{1}{2}$

78

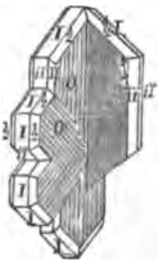


79



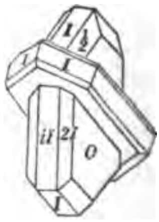
Bristol, Ct.

80



Bristol, Ct.

81



Bristol, Ct.

Cleavage: *I*, indistinct. Twins: (1) composition-face *I*, producing hexagonal, or stellate forms (left half of f. 80); (2) composition-face $\frac{4}{3}$-ĭ, a cruciform twin (f. 80), crossing at angles of 111° and 69°; (3) (f. 81), a cruciform twin, having *O* and *I* of one crystal parallel respectively to *i*-ĭ and *O* of the other; (4) c.-face $\frac{1}{3}$. Also massive, structure granular, or compact and impalpable.

H.=2·5—3. G.=5·5—5·8; 5·7022 Thomson. Lustre metallic. Color and streak blackish lead-gray; often tarnished blue or green; streak sometimes shining. Fracture conchoidal.

Comp.—Ɛu S=Sulphur 20·2, copper 79·8=100. Analyses: 1, Ullmann (Syst. tab. Uebers., 243); 2, 3, Scheerer (Pogg., lxv. 290); 4, Schnabel (Ramm. 4th Supp., 121); 5, C. Bechi (Am. J. Sci., II. xiv. 61); 6, 7, Wilczynsky (Ramm., 5th Suppl., 151, and Min. Ch., 997); 8, P. Collier (private contrib.):

	S	Cu	Fe
1. Siegen	19·00	79·50	0·75, S̈i 1·00=100 25 Ullmann
2. Tellemark, Norway, G.=5·795	20·43	77·76	0·91=99·10 Scheerer.

	S	Cu	Fe
3. Tellemark, Norway, G.=5·521	20·36	79·12	0·28=99·76 Scheerer.
4. Siegen, *massive*	21·50	74·73	1·26, S̈i 2·00=99·49 Schnabel.
5. Mt. Catini	20·50	76·54	1·75=98·79 Bechi.
6. Chili	21·81	74·71	3·33=99·85 Wilczynsky.
7. Montagone, Tuscany	21·90	71·31	6·49=99·70 Rammelsberg.
8. Bristol, Ct.	20·26	79·42	0 33, Ag 0·11=100·12 Collier.

Pyr., etc.—Yields nothing volatile in the closed tube. In the open tube gives off sulphurous fumes. B.B. on charcoal melts to a globule, which boils with spirting: with soda is reduced to metallic copper. Soluble in nitric acid.

Obs.—Cornwall affords splendid crystals where it occurs in veins and beds with other ores of copper, and especially near St. Just. It occurs also at Fassnetburn in Haddingtonshire, in Ayrshire, and in Fair Island, Scotland. The compact and massive varieties occur in Siberia, Hesse, Saxony, the Bannat, etc.; Mt. Catini mines in Tuscany; Mexico, Peru, Bolivia, Chili. Near Angina, Tuscany, a crystal has been obtained, weighing half a pound.

In the United States, compact varieties occur in the red sandstone formation at Simsbury and Cheshire, Conn.; also at Schuyler's mines, N. J. Bristol, Conn., affords large and brilliant crystals, f. 79–81; fig. 80, a crystal, with its striæ and irregularities, compounded by two different methods. Another crystal has a small octahedral plane situated obliquely upon the intersection of 1, ½, and adjoining the brachydiagonal section, which is probably the plane ⅔-2. 2-ĭ ∧ 2-ĭ in the Bristol crystals=125° 43′. In Virginia, in the United States copper mine district, Blue Ridge, Orange Co. Between Newmarket and Taneytown, Maryland, east of the Monocacey, with chalcopyrite. In Arizona, near La Paz; in N. W. Sonora. In Nevada, in Washoe, Humboldt, Churchill and Nye Cos.

The *Argent en epis* or *Cuivre spiciforme* of Haüy, which is merely vegetable matter impregnated with this ore, occurs at Frankenberg in Hessia, and also Mahoopeny, Penn.

Under the name *Cupreine*, Breithaupt separates the larger part of the specimens, referred to chalcocite, on the ground alleged that they are *hexagonal* instead of orthorhombic, and have a lower specific gravity. He gives for the angle between the base and a pyramidal face 117° 53′ approximately, and G.=5·5—5·586 of the mineral from 12 different localities. He cites Scheerer's two analyses above of the Tellemark mineral. Other localities mentioned are Kongsberg in Norway; near Freiberg, Sadisdorf, Deutsch-Neudorf, in Saxony; Schmiedeberg in Silesia; Hettstedt and Sangerhausen in Thuringia; near Siegen; Mt. Catini in Tuscany; Bosgolovsk in Siberia; Kargalinsk Steppes in Orenberg; Cornwall; Eleonora and Ulrique in Mexico; West Coast of Africa. Breithaupt is certainly in error with regard to the Cornwall mineral, as the measurements of Phillips and others, and recently of Maskelyne (in a letter to the author), conclusively prove; and probably in error throughout.

Beudant's name, *chalcosine*, has priority. We change the termination *ine*, which ought to be out of the science, and substitute *c* for *s*. *Chalcite* (χαλκιτις in Greek), Aristotle's name for the common ore of Cyprus, cannot be employed in modern mineralogy, because it has the same pronunciation with *calcite*. But with the added syllable, used above, this objection does not hold. Moreover, the word thus altered does not imply an identity of the species with that of Cyprus, about which there is yet much doubt.

Alt.—Occurs altered to chalcopyrite, bornite, covellite, melaconite.

Specimens are often penetrated with the covellite, or indigo-copper, resulting from the alteration. (A) *Digenite* of Breithaupt (l. c.) is probably a mineral of this kind. Plattner obtained B.B., 70·2 of copper and 0·24 of silver, whence the formula $\text{Ꞓu S} + 2\ \text{Ꞓu S}^2$, making it a compound of 1 chalcocite + 2 covellite. Localities mentioned are Sangerhausen in Thuringia; Szaska in Transylvania; in the Government of Orenburg; Platten in Bohemia; Angola, W. Coast of Africa; Chili, with cuproplumbite.

(B) *Carmenite* of Hahn (l. c.), from Carmen island, in the Gulf of California, approaches digenite. It is an impure chalcocite, containing visibly, as the author finds after personal examination, much covellite. Hahn analyzed the mass by first separating into two parts, one soluble in muriatic acid, and the other not; and the former was then analyzed, and the composition obtained given as that of carmenite; it was S 26·22, Sb 0·97, Cu 71·30, Fe 1·37, Ag 0·05, gangue 0·77=100·68, corresponding to 1 chalcocite + 1 covellite.

(C) HARRISITE of Shepard (Rep. on Canton Mine, cited in Am. J. Sci., II. xxii. 256 and Pratt Am. J. Sci. II. xxiii. 409), from Canton mine, Georgia, and later found at the Polk Co. copper mines in East Tennessee, is chalcocite with the cleavage of galena, and, as Genth has proved, is pseudomorphous after galena. Genth's many analyses of the Tennessee mineral (Am. J. Sci. II. xxxiii. 194) show a variation in composition from that of chalcocite to that of a mixture with 27 p. c. of galena. Unaltered galena has been observed within crystals of harrisite both at the Georgia and Tennessee localities. Its color is dark lead-gray and bluish-black. As Genth observes, it is related to the so-called *cuproplumbite* (p. 42).

Artif.—The double sulphate of copper and iron, in carbonated water containing putrescibl animal matter, afforded Gages malachite, selenite, and some chalcocite.

62. STROMEYERITE. Silberkupferglanz *Hausm. & Strom.*, Gel. Anz. Gött., ii. 1249, 1816 Argent et cuivre sulfuré *Bournon*, Cat., 212, 1817. Sulphuret of Silver and Copper. Argentil erous Sulphuret of Copper. Cuivre sulfuré argentifère *Fr.* Stromeyerine *Beud.*, Tr., ii. 410 1832. Stromeyerite *Shep.*, ii. 211, 1835.

Orthorhombic: isomorphous with chalcocite. *I* ∧ *I*=119° 35′. Observed planes *O*, *i-ĭ*, ½-*ĭ*, ¼; *O* ∧ ¼=154° 16′, *O* ∧ ½-*ĭ*=155° 7′. Also massive compact.

H.=2·5—3. G.=6·2—6·3. Lustre metallic. Color dark steel-gray Streak shining. Fracture subconchoidal.

Comp.—(Ag Ꞓu) S, or Ag S + Ꞓu S=Sulphur 15·8, silver 53·1, copper 31·1=100. **Analyses:** 1 W. J. Taylor (Proc. Ac. Philad., Nov., 1859); 2, Stromeyer (Schw. J., xix. 325); 3, Sander (Pogg. xl. 313); 4—7, Domeyko (Ann. d. M., IV. iii. 9); 8, 9, P. Collier (private contrib.):

	S	Ag	Cu	Fe
1. Copiapo	16·35	69·59	11·12	2·86=99·92 Taylor.
2. Schlangenberg, Siberia	15·782	52·272	30·478	0·333=98·865 Stromeyer.
3. Rudelstadt, Silesia	15·92	52·71	30·95	0·24=99·82 Sander.
4. S. Pedro, Chili	17·83	28·79	53·38	——=100 Domeyko.
5. Catemo, "	19·93	24·04	53·94	2·09=100 Domeyko.
6. " "	20·53	16·58	60·58	2·31=100 Domeyko.
7. " "	21·41	12·08	63·98	2·53=100 Domeyko.
8. Arizona	19·44	14·05	64·02	0·48, Hg 1·30=99·29 Collier.
9. "	19·41	7·42	72·73	0·33=99·89 Collier.

Domeyko's analyses indicate a large proportion of the copper sulphid, No. 4 containing, along with Ag S, as Rammelsberg shows (Min. Chem., 54), 9 Ꞓu S; 5, 6 Ꞓu S; 6, 4 Ꞓu S; 7, 3 Ꞓu Taylor's analysis corresponds to (Ag, Ꞓu, Fe) S.

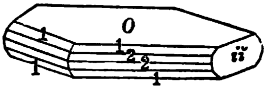
Pyr., etc.—Fuses, but gives no sublimate in the closed tube. In the open tube sulphurous fumes. B.B. on charcoal in O.F. fuses to a semi-malleable globule, which, treated with the fluxes, reacts strongly for copper, and cupelled with lead gives a silver globule. Soluble in nitric acid.

Obs.—Found associated with chalcopyrite at Schlangenberg, near Kolyvan in Siberia; at Rudelstadt, Silesia; also in Chili; at Combavalla in Peru; at Heintzelman mine in Arizona.

Named after Stromeyer, by whom the mineral was first analyzed and established.

63. STERNBERGITE. *Haid.*, Trans. Roy. Soc., Ed., 1827, and Brewst. J., vii. 342.

82



Orthorhombic. *I* ∧ *I*=119° 30′, *O* ∧ 1-*ī*=124° 49′, B. & M.; *a* : *b* : *c*=1·4379 : 1 : 1·7145. *O* ∧ 1=121°, *O* ∧ 2=106° 43′, *O* ∧ 2-*ĭ*=120° 48′. Striæ of *O* macrodiagonal, of sides horizontal. Cleavage: basal highly eminent. Commonly in implanted crystals, forming rose-like or fan-like aggregations. Sometimes compound parallel to *I*.

H.=1—1·5. G.=4·215. Lustre of *O* brightly metallic. Color pinchbeck-brown, occasionally a violet-blue tarnish on 1 and 2. Streak black. Opaque. Thin laminæ flexible; may be smoothed down by the nail when bent, like tin foil. Leaves traces on paper like plumbago.

Comp.—Ag S + 3 Fe S + Fe S^2=4 ($\frac{1}{4}$ Ag + $\frac{3}{4}$ Fe) S + Fe S^2=Sulphur 30·4, silver 34·2, iron 35·4 =100. Ratio of sulphur, iron, and silver more exactly 6 : 4 : 1. Analysis by Zippe (Pogg., xxvii. 890):

Sulphur 30·0 Silver 33·2 Iron 36·0=99·2.

Pyr., etc.—In the open tube sulphurous fumes. B.B. on charcoal gives off sulphur and fuses to a magnetic globule, the surface of which shows separated metallic silver. The washed mineral, treated with the fluxes, gives reaction for iron; on charcoal yields a globule of metallic silver Soluble in aqua-regia with separation of sulphur and chlorid of sliver.

Obs.—Occurs with ores of silver, particularly pyrargyrite and stephanite, at Joachimsthal in Bohemia, and Johanngeorgenstadt in Saxony. Named after Count Casper Sternberg of Prague.

The *Flexible silver ore* (*Argent sulfuré flexible* Bourn., *Biegsamer Silberglanz*) from Himmelsfürst mine, near Freiberg, is referred here. According to Brooke & Miller the figure by Phillips is a distorted figure of argentite.

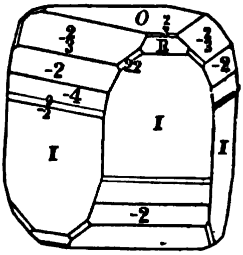
The angles of sternbergite, above given, are from very perfect crystals in Mr. Brooke's collection, which were formerly in the possession of Count Bournon (B. & M., p. 180). The plane $2\text{-}\breve{i}$ is on the edge of $O \wedge i\text{-}\breve{i}$; and besides this, there is another $10\text{-}\breve{i}$, represented by these authors, with also the macrodome $6\text{-}\bar{i}$, and the pyramid $2\text{-}\breve{2}$.

64. CINNABAR. Κιννάβαρις (fr. Spain) *Theophr.* Ἄμμιον *Dioscor.* Minium *Vitruv.*, *Plin.* Minium nativum, *Germ.* Bergzinober, *Agric.*, Interpr., 466, 1546. Cinnabar; Sulphuret of Mercury. Zinnober, Schwefelquecksilber, Merkur-Blende, *Germ.*

Rhombohedral. $R \wedge R = 92° \, 36'$, $R \wedge O = 127° \, 6'$; $a = 1{\cdot}1448$. Observed planes: rhombohedrons, $\frac{1}{8}$, $\frac{1}{4}$, $\frac{3}{8}$, $\frac{2}{5}$, $\frac{1}{2}$, $\frac{2}{3}$, $\frac{4}{5}$, R, $\frac{5}{4}$, $\frac{4}{3}$, $\frac{16}{9}$, 2, $\frac{32}{9}$, 4, $\frac{9}{2}$, $\frac{16}{3}$, 8, $-\frac{9}{2}$, -4, -2, $-\frac{16}{9}$, $-R$, $-\frac{2}{3}$, $-\frac{1}{2}$, $-\frac{2}{5}$, $-\frac{1}{3}$, $-\frac{1}{4}$; pyramids, 22, 62; scalenohedron $\frac{1}{3}^3$; and also O, I. Also granular, massive; sometimes forming superficial coatings.

$O \wedge \frac{1}{2} = 146° \, 32'$ $\frac{4}{5} \wedge \frac{4}{5} = 101° \, 58'$
$O \wedge \frac{2}{3} = 138 \;\; 36$ $\frac{2}{3} \wedge \frac{2}{3} = 110 \;\; 6$
$O \wedge \frac{4}{5} = 133 \;\; 24$ $O \wedge I = 90$
$O \wedge 2 = 110 \;\; 43$ $I \wedge I = 120$
$O \wedge 2 = 71 \;\; 48$

83



Cleavage: I, very perfect. Twins: composition-face O.

H.=2—2.5. G.=8·998, a cleavable variety from Neumarktel. Lustre adamantine, inclining to metallic when dark colored, and to dull in friable varieties. Color cochineal-red, often inclining to brownish-red and lead-gray. Streak scarlet, subtransparent, opaque. Fracture subconchoidal, uneven. Sectile. Polarization circular. Ordinary refraction 2·854, extraordinary 3·201, Descl.

Var.—1. *Ordinary:* either (*a*) *crystallized;* (*b*) *massive*, granular, or compact; bright red to reddish-brown in color; (*c*) *earthy* and bright red.

2. *Hepatic* (Quecksilberlebererz and Quecksilberbranderz, *Germ.*, Inflammable cinnabar), of a liver-brown color, with sometimes a brownish streak, occasionally slaty in structure, though commonly granular or compact. Cinnabar mixed with an organic substance called *idrialine* (q. v.) occurs at Idria.

The *corallinerz* of Idria is a curved lamellar variety of hepatic cinnabar.

Comp.—Hg S (or $Hg^2 \, S^2$)=Sulphur 13·8, quicksilver 86·2=100. Sometimes impure from clay, oxyd of iron, bitumen. Analyses: 1, 2, Klaproth (Beitr., iv. 14); 3, John (John's Ch. Unt., i. 252); 4, 5, Schnabel (Ramm., 4th Suppl., 269); 6. A. Bealey (J. Ch. Soc., iv.); 7, Klaproth (Beitr., iv. 24):

	S	Hg
1. **Neumarktel**	14·25	85·00=99·25 Klaproth.
2. **Japan**	14·75	84·50=99·25 Klaproth.
3. "	17·5	78·4, $\ddot{\bar{F}}$e 1·7, $\ddot{\bar{A}}$l 0·7, Ċa 1·3, $\ddot{\bar{M}}$n 0·2=100 John.
4. **Westphalia**	13·67	86·79=100·46 Schnabel.
5. **Wetzlar**	18·78	84·55, gangue 1·02=99·35 Schnabel.
6. **California**	11·38	69·36, Fe 1·23, Ċa 1·40, $\ddot{\bar{A}}$l 0·61, Ṁg 0·49, S̈i 14·30 Bealey.
7. **Idria**, *hepatic*	13·75	81·80, $\ddot{\bar{F}}$e 0·2, $\ddot{\bar{A}}$l 0·55, Cu 0·02, S̈i 0·65, C 3·3=99·27 Klaproth.

Pyr.—In the closed tube a black sublimate. Carefully heated in the open tube gives sulphurous fumes and metallic mercury, condensing in minute globules on the cold walls of the tube. B.B. on charcoal wholly volatile if pure.

Obs.—Cinnabar occurs in beds in slate rocks and shales, and rarely in granite or porphyry. It has been observed in veins, with ores of iron. The Idria mines are in the Carboniferous form tion; those of New Almaden, California, in partially altered Cretaceous or Tertiary beds.

Good crystals occur in the coal formations of Moschellandsberg and Wolfstein in the Palatinate also in Japan, Mexico, and Brazil. The most important European beds of this ore are at Almade in Spain, and at Idria in Carniola, where it is usually massive. It occurs at Reichenau in Uppe Carinthia; in beds traversing gneiss at Dunbrawa in Transylvania; in graywacke at Windisc Kappel in Carinthia; at Neumarktel in Carniola; at Ripa in Tuscany; at Schemnitz in Hungary in the Urals and Altai; in China abundantly, and in Japan; San Onofre and elsewhere in Mexico at Huanca Velica in Southern Peru, abundant; in the Provinces of Coquimbo; Copiapo in Chili forming extensive mines in California, in the coast ranges at different points from Clear lake in th north (near which there is a vein in a bed of sulphur) to San Luis Obispo in the south, the prir cipal mines in which region are at New Almaden and the vicinity, in Santa Clara Co., about 60 m S.S.E. of San Francisco. Also in Idaho, in limestone, abundant.

This ore is the source of the mercury of commerce, from which it is obtained by sublimatior When pure it is identical with the manufactured *vermilion* of commerce.

The above figure is from an elaborate paper by Schabus, Ber. Ak. Wien, vi. 63.

The name Cinnabar is supposed to come from India, where it is applied to the red resin, dragon's blood. The native cinnabar of Theophrastus is true cinnabar; he speaks of its affordin quicksilver. The Latin name of cinnabar, *minium*, is now given to *red lead*, a substance whic was early used for adulterating cinnabar, and so got at last the name. It has been said (King o Precious Stones) that the word *mine* (miniera, *Ital.*) and *mineral* come from the Latin for quicksilve mine, *miniaria* (Fodina miniaria).

65. TIEMANNITE. Selenquecksilber *Marx*, Schw. J. liv. 223, 1828. Selenid of Mercury Selenmercur, Tiemannit, *Naumann*, Min., 425, 1855.

Massive; compact granular. Cleavage none.

H.=2·5. G.=7·1–7·37, Clausthal; 7·274, fr. Tilkerode. Lustre metallic. Color steel-gray to blackish lead-gray.

Comp.—Selenid of mercury. Perhaps $Hg\ Se$=Selenium 28·4, mercury 71·6=100; but the analyses correspond mostly to $Hg^6\ Se^5$=Selenium 24·8, mercury 75·2=100. Anal. 4 gives Hg^1 Se^{10}. Analyses: 1, 2, Kerl (B. H. Ztg., 1852); 3, Rammelsberg (Pogg., lxxxviii. 39); 4 Schultz (Ramm. Min. Ch., 1010):

	So	S	Hg
1. Zorge	21·27	0·36	65·52, quartz 10·28=99·57 Kerl.
2. "	24·05	0·12	72·26, " 2·86=99·74 Kerl.
3. "	25·5	——	74·5=100 (quartz excluded) Ramm.
4. Tilkerode	23·61	0·70	74·02=98·33 Schultz.

Pyr.—Decrepitates in the closed tube, and, when pure, entirely sublimes, giving a black sublimate, with the upper edge reddish-brown; with soda a sublimate of metallic mercury. In the open tube emits the odor of selenium, and forms a black to reddish-brown sublimate, with a border of white selenate of mercury, the latter sometimes fusing into drops. On charcoal volatilizes, coloring the outer flame azure-blue, and giving a lustrous metallic coating.

Obs.—Occurs with chalcopyrite near Zorge in the Harz; at Tilkerode; near Clausthal; in California, in the vicinity of Clear lake. Named after the discoverer, Tiemann.

A. ONOFRITE of Haidinger (*Selenschwefelquecksilber* H. Rose, Merkurglanz Breith., Char., 1832), from San Onofre, Mexico, first made known by Del Rio, is either a compound or mixture of selenid and sulphid of copper. H. Rose obtained (Pogg., xlvi. 315, 1839) Se 6·49, S 10·30, Hg 81·63=98·12, corresponding to $Hg\ Se+4\ Hg\ S$. It is a fine granular ore, of a dark lead-gray color, shining when rubbed. G.=5·56, Del Rio; powder soils.

66. MILLERITE. Haarkies (as a var. of Schwefelkies) *Wern.*, Bergm. J., 383, 1789; (fr. Johanng.) *Hoffmann*, id., 175, 1791. Fer sulfuré capillaire (as a var. of Pyrite) *H.*, Tr., iv. 1801. Capillary Pyrites. Gediegen Nickel *Klapr.*, Beitr., v. 231, 1810. Schwefelnickel *Berz.*; *Arfvedson*, Ac. H. Stockh., 1822, 427. Nickelkies *Germ.* Sulphuret of Nickel. Nickel sulfuré *Fr.* Harkise *Beud.*, Tr., ii. 400, 1832. Capillose *Chapman*, Min., 135, 1843. Millerit *Haid.*, Handb., 561, 1845. Trichopyrit *Glock.*, Syn., 43, 1847.

Rhombohedral. $R \wedge R=144°\ 8'$, Miller. $a=0·32955$. Observed planes: rhombohedral R, -1, $\frac{1}{2}$, $-\frac{1}{2}$, -3; prismatic I, $i\text{-}2$, $i\text{-}\frac{3}{2}$; $R \wedge I=110°\ 50'$, $I \wedge 3=138°\ 47'$, $\frac{1}{2} \wedge \frac{1}{2}=161°\ 22'$, $O \wedge R=159°\ 10'$.

Cleavage: rhombohedral, perfect. Usual in capillary crystals. Rarely in columnar tufted coatings, partly semi-globular and radiated.

H.=3—3·5. G.= 4·6—5·65; 5·65 fr. Saalfeld, Ramm.; 4·601, fr. Joachimsthal, Kenngott. Lustre metallic. Color brass yellow, inclining to bronze-yellow, with often a gray iridescent tarnish. Streak bright. Brittle.

Comp.—Ni S=Sulphur 35·1, nickel 64·9=100. Analyses: 1, Arfvedson (Ac. H. Stockh., 1822, 427); 2, Rammelsberg (1st Suppl., 67); 3, Genth (Am. J. Sci., II. xxxiii. 195):

	S	Ni	Co	Fe	Cu
1.	34·26	64·35	——	——	——=98·61 Arfvedson.
2. Saalfeld	35·79	61·34	——	1·73	1·14=100 Ramm.
3. Gap mine, Pa.	35·14	63·08	0·58	0·40	0·87, gangue 0·28=100·35 G.

A partly altered millerite afforded Genth (l. c.) S 33·60, Ni, Co 59·96, Fe 1·32, Cu 4·63, gangue 0·54=100·05.

Pyr., etc.—In the open tube sulphurous fumes. B.B. on charcoal fuses to a globule. When roasted, gives with borax and salt of phosphorus a violet bead in O.F., becoming gray in R.F. from reduced metallic nickel. On charcoal in R.F. the roasted mineral gives a coherent metallic mass, attractable by the magnet. Most varieties also show traces of copper, cobalt, and iron with the fluxes.

Obs.—Occurs in capillary crystals, in the cavities and among crystals of other minerals. Found at Joachimsthal in Bohemia; Johanngeorgenstadt; Przibram; Riechelsdorf; Andreasburg; Himmelfahrt mine near Freiberg; Marienberg in Saxony; Cornwall, and other places. Near Merthyr Tydvil, at Dowlais, it is found in regular crystals, occupying cavities in nodules of spathic iron.

Occurs at the Sterling mine, Antwerp, N. Y., in capillary crystals with spathic iron: the largest crystal yet observed was about a fifth of a line in diameter, and in some cases crystals of spathic iron are transfixed by the needles of millerite (Am. J. Sci. II. ix. 287); in Lancaster Co., Pa., at Gap mine, with pyrrhotite, where it occurs in coatings of a radiated fibrous structure, from a line to a third of an inch thick, often with a velvety surface of crystals, or tufts of radiated needles.

The *capillary pyrites* (*Haarkies*) of Werner was true millerite, from Johanngeorgenstadt, according to Hoffman (Min., iv. 168, 1817). But capillary pyrite and marcasite have sometimes gone by the same name.

67. TROILITE. Pyrrhotite pt. Protosulphid of iron. Sulphid of iron of Meteorites. Troilit *Haid.*, Ber. Ak. Wien, xlvii. 283, 1863.

Resembles pyrrhotite. Observed only massive.

H.=4·0. G.=4·75—4·82; 4·787, fr. Seelasgen, Ramm.; 4·817, fr. Sevier Co., Ramm.; 4·75, fr. Knoxville, Smith. Color tomback-brown. Streak black.

Comp.—Fe S (or $Fe^2 S^2$)=Sulphur 36·36, iron 63·64=100. It thus differs from pyrrhotite in being a true protosulphid. Analyses: 1, J. L. Smith (Am. J. Sci., II. xix. 156); 2, Rammelsberg (Pogg., lxxiv. 62); 3, 4, id. (ib., cxxi. 365):

	S	Fe	Ni	Cu
1. Knoxville, Tenn.	35·67	62·38	0·32	*tr.*, $\ddot{\text{Si}}$ 0·56, $\dot{\text{Cu}}$ 0·08=98·91 Smith.
2. Seelasgen	37·16	62·84	——	—=100[a] Ramm.
3. Sevier Co., Tenn.	35·39	62·65	1·96[b]	—=100 Ramm.
4 " "	36·64	61·80	1·56[b]	—=100 Ramm.

[a] Excluding impurities. [b] With some cobalt.

Pyr., etc.—Same as for pyrrhotite.

Obs.—Almost all iron meteorites contain this sulphid of iron in nodules disseminated more or less sparingly through the mass.

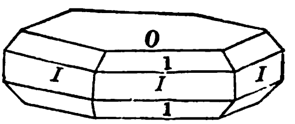
Named after Dominico Troili, who, in 1766, described a meteorite that fell that year at Albareto in Modena, and which contains this species. The meteorite resembles much that of Weston, Conn., in general appearance.

68. PYRRHOTITE. Vattenkies, Pyrites fusca, Minera hepatica, pt., *Wall.*, Min., 209, 212, 1747. Pyrites en prismes hexagonales *Forst.*, Cat., 1772; *Bourn.* de Lisle's Crist., iii. 243, 1783. Magnetischer-Kies *Wern.*, Bergm. J., 383, 1789. Magnetic Pyrites *Kirwan*, 1796. Magnetic Sulphuret of iron. Magnetkies *Germ.* Fer sulfuré magnétique *Fr.* Leberkies pt. *Germ.* Leberkies *Leonh.*, Handb., 665, 1826. Leberkise *Beud.*, Tr., ii. 404, 1832. Magnetopyrite *Glocker*, Grundr., 1839. Pyrrotin pt., Magnetischer Pyrrotin, *Breith.*, J. pr. Ch., iv. 265, 1835.

Hexagonal. *O* ∧ 1=135° 8′; *a*=0·862. Observed planes: *O*, *I*, ½, 1, 1-2, 2-2, *i*-2.

O ∧ 1=90°. *O* ∧ 2-2=119° 53′. 1 ∧ 1=138° 48′.
O ∧ 2=116 28′. 2 ∧ 2=126 52′. *I* ∧ *I*=120.

84



Cleavage: *O*, perfect; *I*, less so. Commonly massive and amorphous; structure granular. H.=3·5—4·5. G.=4·4—4·68. Lustre metallic. Color between bronze-yellow and copper-red, and subject to speedy tarnish. Streak dark grayish-black. Brittle. Magnetic, being attractable in fine powder by a magnet, even when not affecting an ordinary needle.

Var.—1. *Ordinary.* G. fr. Kongsberg, 4·584 Kenngott; fr. Bodenmais, 4·546 Schaffgotsch; fr. Harzburg, 4·580 Ramm.; fr. Xalastoc, Mexico, 4·564 Ramm.; fr. Trumbull, Ct., 4·640 Ramm.

2. *Niccoliferous.* G. of Klefva, 4·674 Berz; of Hilsen, 4·577 Ramm; of Gap mine 4·543 Ramm.

Comp.—(1) Mostly $Fe^7 S^8$=6 Fe S+Fe S^2=Sulphur 39·5, iron 60·5=100; but varying to $Fe^8 S^9$=7 Fe S+Fe S^2, $Fe^9 S^{10}$=8 Fe S+Fe S^2, $Fe^{10} S^{11}$=9 Fe S+Fe S^2. The species is isomorphous with Cd S (greenockite), and Frankenheim wrote the formula Fe S; yet no native pyrrhotite, except that of meteorites (*troilite*), gives this composition. Berzelius found that on heating pyrite it was reduced to $Fe^7 S^8$, and not to Fe S. Rammelsberg obtained in the same way $Fe^7 S^8$, and the other ratios of pyrrhotite.

Analyses: 1, Stromeyer (Gilb. Ann., xviii. 183, 209); 2, 3, Plattner (Pogg., xlvii. 369); 4, 5, Berthier (Ann. d. M., III. xi. 499); 6, H. Rose (Pogg., xlvii.); 7, Schaffgotsch (Pogg., l. 533); 8, Stromeyer (l. c.):

	1. Harz	2. Brazil	3. Fahlun	4. Sitten	5. Sitten	6. Bodenm.	7. Bavaria	8. Barèges
Sulphur	40·15	40·43	40·22	39·0	40·2	38·78	[39·41]	43·63
Iron	59·85	59·63	59·72	61·0	59·8	60·52	60·59	56·37
	100·00 St.	100·06 P.	99·94 P.	100·0 B.	100·0 B.	* R.	100 Sch.	100 St.

* With 0·82 silica=100·12.

Rammelsberg found (Pogg., cxxi. 337) in the P. of Harzburg, Fe 60·00—60·83, G.=4·58; of Trumbull, Ct., 61·03 (mean of 3 anal.), G.=4·64; Harz (Treseburg, same as anal. 1 above), Fe 59·21, G.=4·513. For other analyses, see Middleton, Phil. Mag., III. xxviii. 352; Baumert, Verh. nat. Ver., Bonn, xiv lxxxv.; N. de Leuchtenberg, Bull. Ac. St. Pet., vii. 403.

Analyses of niccoliferous pyrrhotites: 1, Berzelius (Jahresb., xxi, 184); 2, Scheerer (Pogg., lviii. 318); 3, Rammelsberg (Min. Ch., 113); 4, 5, 6, id. (Pogg., cxxi. 361):

	S	Fe	Ni	Co
1. Klefva	38·09	57·64	3·04	0·09, Mn 0·22, Cu 0·45=99·53 Berz.
2. Modum	40·46	56·03	2·80	——, Cu 0·40,=99·69 Scheerer.
3. ?	39·95	58·90	2·60	——=101·45 Ramm.
4. Horbach	40·03	55·96	3·86	——=99·85 Ramm., G.=about 4·7.
5. Hilsen	[40·27]	56·57	3·16	——=100 Ramm.
6. Gap Mine, Pa.	[38·59]	55·82	5·59	——=100 Ramm.

Strecker found nickel in a hexagonal pyrrhotite from Snarum in Norway (B. H. Ztg., xvii. 304).

Pyr., etc.—Unchanged in the closed tube. In the open tube gives sulphurous acid. On charcoal in R.F. fuses to a black magnetic mass; in O.F. is converted into red oxyd, which with fluxes gives only an iron reaction when pure, but many varieties yield small amounts of nickel and cobalt. Decomposed by muriatic acid, with evolution of sulphuretted hydrogen.

Obs.—Occurs at Kongsberg, Modum, Snarum Hilsen, in Norway: Klefva in Sweden; Andreasberg and Treseburg, Harz; Bodenmais in Bavaria; Breitenbrunn, Fahlun, Joachimsthal, N. Tagilsk; Minas Geraes in Spain, in large tabular crystals; the lavas of Vesuvius; Cornwall; Appin in Argyleshire.

In N. America, in Vermont, at Stafford, Corinth, and Shrewsbury; in many parts of Massachusetts; in Connecticut, in Trumbull with topaz, in Monroe, and elsewhere; in N. York, 1½ m. N. of Port Henry, Essex Co.; near Natural Bridge in Diana, Lewis Co.; at O'Neil mine and elsewhere in Orange Co. In N. Jersey, Morris Co., at Hurdstown, cleavable massive. In Pennsylvania, at the Gap mine, Lancaster Co., niccoliferous. In Tennessee, at Ducktown mines, abundant. In Canada, in large veins at St. Jerome, etc.

The niccoliferous pyrrhotite is the ore that affords the most of the nickel of commerce. At the Camden nickel works (N. Jersey) this ore (from the Gap mine) is the principal one used, but along with niccoliferous pyrite and some millerite. Prior to 1864, the whole amount of pure nickel made in the country was not over 100,000 lbs. Since then, up to May, 1867, the Camden works have turned out 105,000 lbs.; and now they produce at the rate of 150,000 lbs. a year (letter from J. Wharton, Esq.).

Named from πυῤῥότης, *reddish*.

Alt.—Occurs altered to pyrite (G. Rose, ZS. G., x. 98); also to limonite and siderite.

(A) KRŒBERITE *D. Forbes* (Phil. Mag., IV. xxix. 9, 1865). Krœberite is a strongly magnetic pyrite, in copper-colored crystals, not yet analyzed, which Forbes says "appears to be principally a subsulphid of iron." The reasons for this opinion are not stated. Named after P. Krœber. It was from between La Paz and Yungas, on the eastern slope of the Andes.

69. GREENOCKITE.

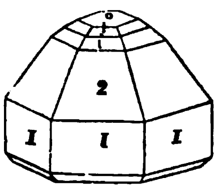
Greenockite *Jameson*, Ed. N. Phil. J., xxviii. 390, 1840. Sulphuret of Cadmium *Connel*, ib., 392. Cadmium-blende. Cadmium sulfuré *Fr.*

Hexagonal; hemihedral, with the opposite extremes dissimilar. $O \wedge 1 = 136° \ 24'$; $a = 0{\cdot}8247$. Observed planes as in the annexed figure, with also 4 and *i*-2.

$O \wedge \frac{1}{2} = 154° \ 32'$ $I \wedge 1 = 133° \ 36'$ $1 \wedge 1$, pyr., $= 139° \ 39'$
$O \wedge 2 = 117 \ 42$ $I \wedge 2 = 152 \ 18$ $2 \wedge 2$, " $= 127 \ 26$

Cleavage: *I*, distinct; *O*, imperfect.

84A



H.=3—3·5. G.=4·8, Brooke; 4·9—4·999, Breithaupt; 4·5, the artificial, Söchting. Lustre adamantine. Color honey-yellow; citron-yellow; orange-yellow—veined parallel with the axis; bronze-yellow. Streak-powder between orange-yellow and brick-red. Nearly transparent. Strong double refraction. Not thermoelectric, Breithaupt.

Comp.—Cd S (or Cd^2S^2)=Sulphur 22·3, cadmium 77·7. Analysis by Connel (loc. cit.): Sulphur 22·56, and cadmium 77·30=99·86.

Pyr., etc.—In the closed tube assumes a carmine-red color while hot, fading to the original yellow on cooling. In the open tube gives sulphurous acid. B.B. on charcoal, either alone or with soda, gives in R.F. a reddish-brown coating. Soluble in muriatic acid, affording sulphuretted hydrogen.

Obs.—Occurs in short hexagonal crystals at Bishoptown, in Renfrewshire, Scotland, in a porphyritic trap and amygdaloid, associated with prehnite; also at Przibram in Bohemia, on blende; at the Ueberoth zinc mine, near Friedensville, Lehigh Co., Pa.

This species is related in form to niccolite and breithauptite. It has been found as a furnace product (Ann. Ch. Pharm., lxxxvii. 34, and Halle Zeitschr., i. 346, 1853).

Named after Lord Greenock (later Earl Cathcart). The first crystal was found near 60 years since by Mr. Brown of Lanfyne, and was taken by him for blende. It was over half an inch across.

70. WURTZITE.

C. Friedel, C. R., lii. 983, 1861. Spiauterit *Breith.*, B. H. Ztg., xxi. 98, 1862, xxv. 193.

Hexagonal. Isomorphous with greenockite. $O \wedge 1 = 129°$ (approximately) Occurring form a quartzoid, with occasionally planes of the cor responding hexagonal prism; the latter planes horizontally striate Cleavage: basal and prismatic.

H.=3·5–4. G.=3·98. Lustre vitreous. Color brownish-black. Stre brown.

Comp.—Zn S, or perhaps more correctly $Zn^3 S^3$. Analysis by C. Friedel (l. c.):

S	Zn	Fe	Pb	Sb	Cu
32·6	55·6	8·0	2·7	0·2	*tr.*=99·1.

The lead and antimony are from the gangue.

Pyr.—Same as for sphalerite or blende.

Obs.—From a silver-mine near Oruro in Bolivia. According to Breithaupt (l. c.) a radiat blende from Przibram (his *spiauterite*) is hexagonal; also that from Albergaria Velha in P tugal; from Quesbesita, Peru, in tabular crystals grouped and forming a crust, some of the cr tals ½ inch across.

Wurtzite and sphalerite are the same compound under distinct crystalline forms—a case dimorphism.

Named after the French chemist, Adolphe Wurtz.

Artif.—May be made in crystals by a long and high heating of amorphous blende (C. R., lx 999); or better by subliming the blende in a current of sulphurous acid, long, transparent, colo less hexagonal prisms having been thus formed (ib., lxiii. 188).

71. NICCOLITE. Kupfernickel [=False Copper, it resembling but not yielding coppe *Hiärne*, Anledn. Malm og Berg., 76, 1694. Cuprum Nicolai [mistaken trl. of Kupf.] *J. Woodwar* Foss., 1728. Kupfernickel, Arsenicum sulphure et cupro mineralisatum, aeris modo rubent *Wall.*, 228, 1747. Niccolum ferro et cobalto arsenicatis et sulphuratis min. (fr. Saxony) *Crons* Ak. H. Stockh., 1751, 1754 (first discov. of metal); Min., 218, 1758. Cuprum min. arsen. fulvu *Linn.*, 1768. Mine de cobalt arsenicale tenant cuivre *Sage*, Min., 58, 1772; *de Lisle*, Crist., i 135, 1783. Niccolum nativum *Bergm.*, Opusc., ii. 440, 1780. Rothnickelkies, Arsenicnicke *Germ.* Copper Nickel, Arsenical Nickel. Nickeline *Beud.*, Tr., ii. 586, 1832. Arsenische Pyrrotin *Breith.*, J. pr. Ch., iv. 266, 1835. Niccolite *Dana.*

Hexagonal; isomorphous with breithauptite. $O \wedge 1 = 136° \ 35'$; *a* 0·81944. Observed planes, *O* and 1; $1 \wedge 1$, pyr.,=139° 48′. Usuall massive, structure nearly impalpable; also reniform with a columna structure; also reticulated and arborescent.

H.=5–5·5. G.=7·33–7·671. Lustre metallic. Color pale coppe red, with a gray to blackish tarnish. Streak pale brownish-black. Opaque Fracture uneven. Brittle.

Comp.—Ni As (or $Ni^2 As^2$)=Arsenic 55·9, nickel 44·1=100; sometimes part of the arsen replaced by antimony. Analyses: 1, Stromeyer (Gel. Anz. Gött. 1817, 204); 2, Pfaff (Schw. J. xxii. 256); 3, Suckow (Verwitt. im Min., 58, Ramm. 4th Suppl., 122); 4, Berthier (Ann. Ch Phys., xiii. 52); 5, Scheerer (Pogg., lxv. 292); 6, Ebelmen (Ann. d. M., IV. xi. 55); 7, Schnabel (Ramm. 4th Suppl., 122); 8, Grunow (ZS. G., ix. 40):

	As	Ni	Fe	Pb	Co	Sb	S
1. Riechelsdorf	54·73	44·21	0·34	0·32	——	——	0·40=100 Strom.
2. "	46·42	48·90	0·34	0·56	——	——	0·80=97·02 Pfaff.
3. "	53·69	45·76	2·70	——	——	——	0·15=102·30 Suckow.
4. Allemont	48·80	39·94	——	——	0·16	8·00	2·00=98·90 Berth.
5. Krageroe, G.=7·662	54·35	44·98	0·21	——	Cu 0·11		0·14=99·79 Scheer.
6. Ayer, G.=7·39	54·05	43·50	0·45	——	0·32	0·05	2·18, gangue 0·20=100·75 E.
7. Westphalia	52·71	45·37	——	——	——	——	0·48, Cu 1·44=100 Schnabel.
8. Sangerhausen	54·89	43·21	0·54	——	——	——	1·35=99·99 Grunow.

An ore from Balen in the Pyrenees afforded Berthier As 33·0, Sb 27·8, Ni 33·0, Fe 1·4, S 2·8 quartz 2·0=100, in which a large part of the arsenic is replaced by antimony.

Pyr., etc.—In the closed tube a faint white crystalline sublimate of arsenous acid. In the open tube arsenous acid, with a trace of sulphurous acid, the assay becoming yellowish-green. On charcoal gives arsenical fumes and fuses to a globule, which, treated with borax glass, affords, by successive oxydation, reactions for iron, cobalt, and nickel. Soluble in nitromuriatic acid.

Obs.—Accompanies cobalt, silver, and copper in the Saxon mines of Annaberg, Schneeberg, etc.; also in Thuringia, Hesse, and Styria, and at Allemont in Dauphiny; occasionally in Cornwall, as at Pengelly and Wheal Chance; formerly at the Hilderstone Hills, Scotland; at Chanarcillo, near Copiapo, and at Huasco, Chili; abundant at Mina de la Rioja, Oriocha, in the Argentine Provinces.

Found at Chatham, Conn., in gneiss, associated with smaltite.

This is an important ore of nickel.

Named from the contained metal. The name of the species should be formed from the Latin word for nickel, *niccolum*, proposed by Cronstedt, and hence should be written *niccoline*, or better *niccolite*, in place of Beudant's *nickeline*. *Nickeline* and *nickeliferous* are not more proper words than would be *copperine* and *copperiferous*.

72. BREITHAUPTITE. Antimonnickel *Stromeyer & Hausm.*, Gel. Anz. Gött., 2001, 1833. Antimonial Nickel; Antimoniet of Nickel. Hartmannite *Chapman*, Min., 1843. Breithauptit *Haid.*, Handb., 559, 1845.

Hexagonal. $O \wedge 1 = 135° 15'$; $a = 0·8585$. Observed planes: O, $\frac{1}{2}$, $\frac{3}{2}$, I. $O \wedge \frac{1}{2} = 153° 38'$, $O \wedge \frac{3}{2} = 123° 55'$. In thin hexagonal plates. Also arborescent and disseminated.

H.=5·5. G.=7·541 Breithaupt. Lustre metallic, splendent. Color in the fresh fracture light copper-red, inclining strongly to violet. Streak reddish-brown. Opaque. Fracture uneven—small subconchoidal. Brittle.

Comp.—Ni Sb (or $Ni^2 Sb^2$)=Antimony 67·4, nickel 32·6=100. Analyses: 1, 2, Stromeyer (Pogg., xxxi. 134):

1.	Sb 63·734	Ni 28·946	Fe 0·866	Galena 6·437=99·983
2.	59·706	27·054	0·842	12·357=99·959

Pyr.—In the open tube white antimonial fumes. On charcoal fuses in R.F., gives off antimonial vapors, and coats the coal white; if lead is present a yellow coating near the assay; treated with soda the odor of arsenic may be distinguished in most specimens.

Obs.—Found in the Harz at Andreasberg, with calcite, galenite, and smaltine. Has been observed as a furnace product, crystallized.

Named after the Saxon mineralogist, Breithaupt.

73. KANEITE. Arseniuret of Manganese *Kane*, Q. J. Sci., II. vi. 382. Kaneit *Haid.*, Handb. 559, 1845.

In botryoidal masses, also amorphous; structure foliated or granular. H. above 5? stated as hard. G.=5·55. Lustre metallic. Color grayish-white, with a black tarnish. Opaque. Fracture uneven. Brittle.

Analysis by Kane (l. c.): Manganese 45·5, arsenic 51·8, and a trace of iron=97·3, corresponding to Mn As=Manganese 42·4, arsenic 57·6=100.

B.B. burns with a blue flame, and falls to powder; at a higher temperature the arsenic evaporates, and covers the charcoal with a white powder. Dissolves in aqua regia, without leaving any residue.

It is supposed to be from Saxony, and was first observed by R. J. Kane, of Dublin, attached to a mass of galenite.

74. SCHREIBERSITE. Schreibersit *Haid.*, Haid. Ber., iii. 69, 1847.

In steel-gray folia and grains. Folia flexible.
H.=6·5 G.=7·01—7·22. Magnetic.

Comp.—Analyses: 1, Patera (Haid. Ber., l. c., and Am. J. Sci., II. viii. 439); 2, Fisher (Am. J. Sci., II. xix. 157); 3, 4, 5, J. L. Smith (ib., xix. 157):

	P	Fe	Ni		C
1. Arva	7·26	87·20	4·24		*undet.*=93·70 Patera.
2. Braunau	11·72	55·43	25·02		1·16, Cl 2·85, $\ddot{S}i$ 0·98=98·16 Fisher.
3. E. Tennessee	13·92	57·22	25·82	Co	0·32, Cu *tr.*, Zn *tr.*, Cl 0·13, $\ddot{S}i$ 1·62, $\ddot{A}l$ 1·63=100·66 S
4. "	*undet.*	56·04	26·43	"	0·41, Cu *tr.*, $\ddot{S}i$, $\ddot{A}l$ *undet.* Smith.
5. "	14·36	56·53	28·12	"	0·28, Cu *tr.*, " " " Smith.

Obs.—Found only in meteoric iron.

The *schreibersite* of *Shepard* (Am. J. Sci., II. ii.), from a meteorite, is supposed to be a "sesq sulphuret of chromium." The name has been changed to *shepardite* by Haidinger. It is contained in Shepard's recent list of meteoric minerals, in ibid., xliii. 28.

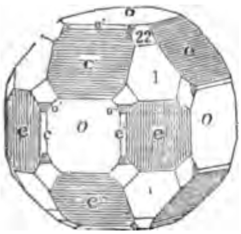
III. PYRITE DIVISION.

[See for list of species, page 34].

75. PYRITE. Σπῖνος *Theophr.* Πυριτης pt. *Dioscor.*, E. cxlii. Pyrites pt. *Plin.*, xxxvi., Pyrites pt., *Arab.* Marchasita, *Germ.* Kis, *Agric.*, 334, 431, 467, 1529, 1546. Pyrites Marchasita (=cryst. Pyr.) *Henckel*, Pyrit., 1725. Kies pt., Svafelkies pt., Pyrites (=mass. and nodular Pyr.), Marchasita (=cryst. Pyr.), *Wall.*, 208, 211, 1747. Pyrites (=glob. var., etc.); Marcasite (=cryst. Pyr.), Mundic (=massive var.) *Hill*, Foss., 324–33 1771. Schwefelkies, Eisenkies, *Germ.* Iron Pyrites, Bisulphuret of iron. Fer sulfuré Xanthopyrites *Glock.*, Handb., 314. 1839.

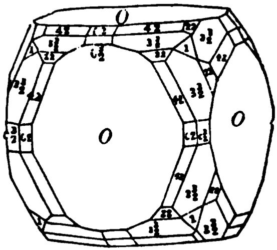
Isometric; pyritohedral. Observed planes: i-2, i-$\frac{3}{2}$, i-3, i-$\frac{10}{3}$; 2-2, 3-3 4-2, 3-$\frac{3}{2}$, 5-$\frac{5}{3}$, $\frac{5}{3}$-$\frac{5}{4}$, 2-$\frac{4}{3}$. Figs. 1, 2, 3, 41–49, 85–88. The cube (f. 1) mo common; the pyritohedron, f. 47, and related forms, f. 41, 46, ver

85



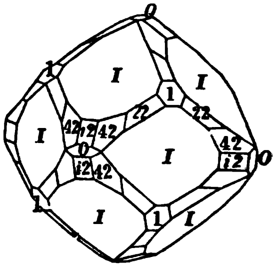
Rossie.

86



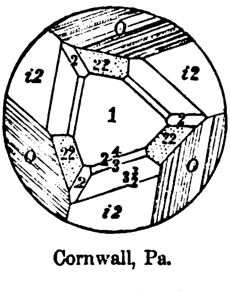
Peru.

87



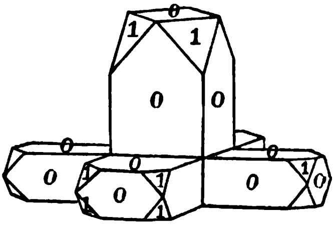
Rossie.

88



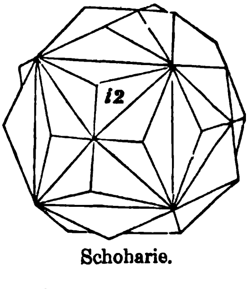
Cornwall, Pa.

89



Middletown, Ct.

90



Schoharie.

common. Cubic faces often striated, with striations of adjoining faces at right angles, and due to oscillatory combination of the cube and pyritohedron, the striæ having the direction of the edges between O and i-2 in f. 46.

Crystals sometimes acicular through elongation of cubic and other forms. Cleavage: cubic and octahedral, more or less distinct. Twins: 1, composition-face *I*; this composition either (*a*) single, or (*b*) repeated parallel to each *I*, producing thus forms like f. 90, consisting of combined pyritohedrons, also a cube, having striations on each face parallel to its sides and meeting at an angle in the diagonals. 2, C.-face *O*, fig. 89. Also reniform, globular, stalactitic, with a crystalline surface; sometimes radiated subfibrous. Also amorphous.

H.=6—6·5. G.=4·83—5·2; 5·185, polished crystals, Zepharovich. Lustre metallic, splendent to glistening. Color a pale brass-yellow, nearly uniform. Streak greenish or brownish-black. Opaque. Fracture conchoidal, uneven. Brittle. Strikes fire with steel.

Comp., Var.—FeS^2=Sulphur 53·3, iron 46·7=100. Nickel, cobalt, and thallium, and also copper, sometimes replace a little of the iron, or else occur as mixtures; and gold is sometimes present, distributed invisibly through it. Thallium occurs in traces in much pyrite, it showing its presence often in the chimneys of furnaces where pyrite, or ores containing it, are roasted.

Var. 1. *Ordinary.* (*a*) In distinct crystals; (*b*) nodular, or concretionary, often radiated within; (*c*) stalactitic; (*d*) amorphous.

2. *Niccoliferous.* Schnabel found 0·168 of nickel in a kind from a silver mine near Eckerhagen. A pyrite from the Kearney ore-bed, Gouverneur, N. Y., is similar; it is pale bronze in color, and radiated botryoidal; H.=5·5; G.=4·863 (Am. J. Sci., II. xv. 444).

3. *Cobaltiferous.* Specimens from Cornwall, Lebanon Co., Pa. (f. 88), afforded J. M. Blake 2 p. c. of cobalt. Fig. 88, by Mr. Blake, represents the planes about an angle of the cube, one of which, 2-⅓, has not been before observed in pyrite, though known in cobaltite (p. 71). The crystals are much distorted.

4. *Cupriferous.* A variety from Cornwall, Lebanon Co., Pa., gave J. C. Booth (Dana's Min., 1854, 55) 2·39 p. c. of copper, affording the formula $(Fe, Cu)S^2$. The analysis gave S 53·37, Fe 44·47, Cu 2·39. It tarnishes readily, assuming the bluish tarnish of steel.

5. *Stanniferous; Ballesterosite* Schulz & Paillette (Bull. G. Fr., II. vii., 16). A kind in cubes, containing tin and zinc, occurring in argillite, 6 m. S. of Ribadeo, in Galicia. Named after Lopez Ballesteros.

6. *Auriferous.* Containing native gold. See under GOLD. The pyrite of most gold regions is auriferous. The fact is not apparent in any of the external characters.

7. *Argentiferous.* From Hungary.

8. *Thalliferous.* The pyrite of the Rammelsberg mine, near Goslar, Prussia, is especially rich in thallium; and also that of Saalfeld. Thallium occurs in the furnaces of the Bethlehem (Pa.) iron works, which W. T. Roepper attributes to the pyrite of the Pennsylvania coal used.

Pyr., etc.—In the closed tube a sublimate of sulphur and a magnetic residue. B.B. on charcoal gives off sulphur, burning with a blue flame, leaving a residue which reacts like pyrrhotite. Insoluble in muriatic acid, but decomposed by nitric acid.

Obs.—Pyrite occurs abundantly in rocks of all ages, from the oldest crystalline to the most recent alluvial deposits. It usually occurs in small cubes, but often modified as above described; also in irregular spheroidal nodules and in veins, in clay slate, argillaceous sandstones, the coal formation, etc. Cubes of gigantic dimensions have been found in some of the Cornish mines; pentagonal dodecahedrons and other forms occur on the island of Elba, sometimes five to six inches in diameter. Large octahedral crystals are found at Persberg in Sweden. Magnificent crystals come from Peru; also from Traversella in Piedmont, twins of which locality are figured by Q. Sella, one of them a large pyritohedron (f. 47) with a small converse pyritohedron (f. 48) astride of each of the six cubic edges. Alston-Moor, Derbyshire, Fahlun in Sweden, Kongsberg in Norway, are well-known localities. The clay at Münden in Hanover, and the chalk at Lewes in Surrey, have afforded some remarkable compound crystals. It has also been met with in the Vesuvian lavas in small irregular crystals.

In *Maine*, at Corinna, Peru, Waterville, and Farmington, in crystals; at Bingham (saw mills), Brooksville, and Jewell's Id., massive. In *N. Hampshire*, at Unity, massive. In *Mass.*, at Heath, in cryst.; at Hawley and Hubbardston, massive. In *Vermont*, at Shoreham, in limestone, crystals abundant; Hartford, in cubes 2–4 in. In *Conn.*, at Lane's mine, Monroe, in octahedrons; Orange and Milford, in cubes in chlorite slate; Middletown lead mine, sometimes acicular, and also scattered over quartz, like f. 89; at Stafford, in mica slate; massive at Colchester, Ashford, Tolland, Stafford, and Union. In *N. York*, at Rossie, fine crystals (f. 85, 87) occur at the lead mine in green shale; at Schoharie, a mile west of the court-house, in single and compound crystals, often highly polished and abundant; in interesting crystals at Johnsburgh and Chester, Warren Co.; in gneiss nea Yonkers; in Orange Co., at Warwick and Deerpark; in Jefferson Co., in Champion and near Oxbo on the banks of Vrooman's lake, in modified octahedrons (f. 7); massive in Franklin, Putnan and Orange Cos., etc. In *Pennsylvania*, in crystals at Little Britain, Lancaster Co.; at Chester Delaware Co.; in Carbon and York Cos.; at Knauertown, Chester Co.; in Cornwall, Lebanon Co in lustrous cubo-octahedrons, and with an elegant steel tarnish, sometimes an inch through; a Pottstown, near French Creek, in large yellow octahedrons. In *Wisconsin*, near Mineral Point In *Illinois*, near Galena, at Marsden's Diggings, in stalactites of great beauty with a surface of crystals. In *N. Car.*, near Greensboro', Guilford Co., in crystals. Auriferous pyrite is common a the mines of Colorado, and many of those of California, as well as in Virginia and the States south

In *Canada*, 2 miles N. W. of Brockville, a cobaltiferous var., in the Laurentian; on the rive Assumption, seignory of Daillebout, and at Escott, a niccoliferous var., containing also som cobalt.

This species affords the greater part of the sulphate of iron and sulphuric acid of commerce and also a considerable portion of the sulphur and alum. The auriferous variety is worked fo gold in many gold regions.

The name *pyrite* is derived from πῦρ, *fire*, and alludes to the sparks from friction. Pliny men tions several things as included under the name (xxxvi. 30): (1) a stone used for grindstones; (2) a kind which so readily fires punk or sulphur that he distinguishes it as *pyrites vivus*, and which may have been flint or a related variety of quartz, as has been supposed, but more probably was *emery*, since he describes it as the heaviest of all; (3) a kind resembling brass or copper; (4) a porous stone, perhaps a sandstone or buhrstone. The brassy kind was in all probability our pyrite. But with it were confounded copper pyrites (chalcopyrite), besides marcasite and pyrrhotite, although these three kinds of pyrites fail of the scintillations. In fact, Dioscorides calls pyrite an ore of copper, yet in the next sentence admits that some kinds contain no copper; and, moreover, he states that the mineral gives sparks. This confounding of iron and copper pyrites is apparent also in the descriptions of the vitriols (sulphates of iron and copper) by Pliny and other ancient writers, and equally so in the mineralogy of the world for more than fifteen centuries after Pliny, as is even now apparent in the principal languages of Europe. *Kupferwasser* (copper-water) of the Germans being the copperas of the English and couperose of the French. It is quite probable that *copperas* and *couperose* are in fact corruptions of the German word, instead of derivatives from *cuprosa* or *cuprirosa*, as usually stated, for the Latin *u* would not have become *ou* in French.

Under the name *marcasite* or *marchasite*, of Spanish or Arabic origin, the older mineralogists Henckel, Wallerius, Linnæus, etc., included distinctively crystallized pyrite, the cubic preëminently; the nodular and other varieties being called *pyrites*, and the less yellow or brownish and softer kinds, *wasserkies*, this last including our *marcasite* and *pyrrhotite*, and some *true pyrite*. Werner first made *pyrrhotite* a distinct species.

Alt.—Pyrite readily changes to a sulphate of iron by oxydation, some sulphur being set free. Also to limonite on its surface, and afterward throughout, by the action of a solution of bicarbonate of lime carrying off the sulphuric acid as change proceeds, and from limonite to red oxyd of iron. Green vitriol, limonite, göthite, hematite, quartz, graphite, ochreous clay, occur as pseudomorphs after pyrite.

Artif.—May be made by the slow reduction of sulphate of sesquioxyd of iron in presence of some carbonate.

76. HAUERITE. Hauerit *Haid.*, Nat. Abh. Wien, i. 101, 107, 4to, 1847.

Isometric; pyritohedral, figs. 2, 7, 6, 8, 44 (O, $3\text{-}\frac{3}{2}$), 41 (O, $i\text{-}3$); the octahedral form most common. Cleavage: cubic imperfect. Crystals sometimes globularly clustered.

H.=4. G.=3·463, v. Hauer. Lustre metallic-adamantine. Color reddish-brown, brownish-black. Streak brownish-red.

Comp.—$Mn\,S^2$=Sulphur 53·7, manganese 46·3=100. Analysis by Patera (l. c., Pogg., lxx. 148):

S	Mn	Fe	$\ddot{Si}$
53·64	42·97	1·30	1·20=99·11.

Pyr.—In the closed tube a sublimate of sulphur; in the open tube sulphurous acid, and becomes green. On charcoal gives sulphur; the roasted mineral reacts for manganese with the fluxes.

Obs.—From Kalinka, Hungary, in clay with gypsum and sulphur, in a region something like a solfatara, trachytic, and other eruptive rocks decomposing and adding to the clay, and the sulphur given off at the same time making depositions of sulphur and sulphids. One crystal found measures 1½ inches through.

77. CUBANITE. Cuban *Breith.*, Pogg., lix. 325, 1843. Cubanite *Chapman.*

Isometric. Massive. Cleavage cubic, and rather more distinct than in ordinary pyrites, Breith. Color between bronze and brass-yellow. Streak dark reddish-bronze, black. H.=4. G.=4·026—4·042 Br.; 4·169 Booth; 4·18 Smith.

Comp.—2 Fe, 1 Cu, 4 S=4 Fe, 1 Ɵu, 8 S=Ɵu S + Fe S + 3 Fe S^2=2 *pyrite* + 1 *chalcopyrite.* Cu S + Fe^2 S^3, Booth, which is the same with the preceding in its atomic proportions.

Analyses: 1, Eastwick (communicated by J. C. Booth); 2, Magee (ib.); 3, Stevens (ib.); 4, Scheidauer (Pogg., lxiv. 280); 5, J. L. Smith (Am. J. Sci., II. xviii. 381):

	S	Cu	Fe	$\bar{Si}$
1.	39·01	19·80	38·01	2·30=99·12 Eastwick.
2.	39·35	21·05	38·80	1·90=101·10 Magee.
3.	39·05	20·12	38·29	2·85=100·31 Stevens.
4.	34·78	22·96	42·51	Pb *tr.*=100·25 Scheidauer.
5.	39·57	18·23	37·10	$\bar{Si}$ $\bar{Fe}$ 4·23=99·13 Smith.

Breithaupt obtained in repeated trials 19 per cent. of copper. Smith in two other incomplete analyses found sulphur 39·20, 39·30, and copper 19·10, 19·00.

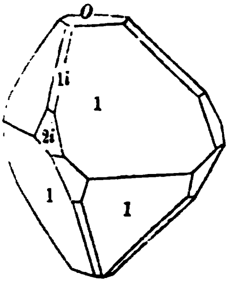
Pyr.—In the closed tube a sulphur sublimate; in the open, sulphurous acid. B.B. on charcoal gives sulphur fumes and fuses to a magnetic globule. The roasted ore reacts for copper and iron with the fluxes; with soda on charcoal gives a globule of metallic iron with copper.

Obs.—From Barracanao. Cuba.

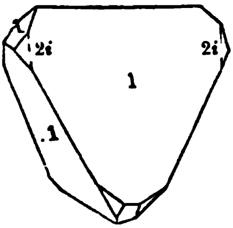
78. CHALCOPYRITE. ? Χαλκῖτις (fr. Cyprus) *Aristotle.* ? Χαλκῖτις, Πυρίτης pt., *Dioscor.*, ? Chalcitis pt., Pyrites pt., *Plin.* Pyrites ærosus pt., Pyrites aureo colore, *Germ.* Geelkis o. Kupferkis *Agric.*, 212, Interpr., 467, 1546. Pyrites pt., *Germ.* Kupferkies, *Gesner*, Foss., 1565. Pyrites flavus, Chalcopyrites, *Henckel*, Pyrit., 1725. Gul Kopparmalm, Cuprum sulphure et ferro mineralisatum, Chalcopyrites, *Wall.*, 284, 1747. Cuivre jaune, Pyrite cuivreuse, *Fr. Trl.* Wall., ii. 514, 1753. Copper Pyrites. Pyritous Copper. Cuivre pyriteux *Fr.* Towanite *B. & M.*, Min., 182, 1852.

Tetragonal; tetrahedral. $O \wedge 1\text{-}i$=135° 25′; $a = 0·98556$. Observed planes: O; vertical, I, $i\text{-}i$, $i\text{-}3$; octahedral or tetrahedral, $\frac{1}{4}$, $\frac{1}{3}$, $\frac{1}{2}$, 1, $\frac{3}{2}$, 2, $1\text{-}i$, $\frac{3}{2}\text{-}i$, $2\text{-}i$; other planes, $\frac{1}{2}\text{-}3$, 5-5.

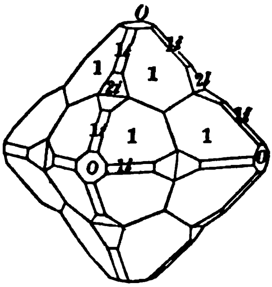
91



92



93



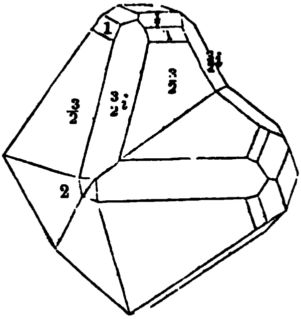
$O \wedge \frac{1}{2}$=145° 8′
$O \wedge 1$=125 40
$O \wedge 2$=109 44

$O \wedge 2\text{-}i$=116° 54′
$O \wedge \frac{3}{2}\text{-}i$=124 5
$1 \wedge 1$, pyr.,=109 53

$2 \wedge 2$, pyr.,=96° 33′
$\frac{3}{2} \wedge \frac{3}{2}$, pyr.,=100 44
$1 \wedge 1$, f. 92,=71 20 and 70 7

Cleavage: 2-*i* sometimes distinct; *O*, indistinct. Twins: compositio face (1) 1-*i*, f. 93, 94; in 93 repeated parallel to 4 terminal edges of a pyramid also similar to fig. 39, through combinations of sphenoids; (2) the plane 1 similar to f. 50, also similar to f. 62, p. 21, bu with the interpenetrating tetrahedrons of th forms in fig. 92; also somewhat similar to fig 119, under tetrahedrite. Often massive an impalpable.

94



H.=3·5–4. G.=4·1–4·3. Lustre metalli Color brass-yellow; subject to tarnish, and ofte iridescent. Streak greenish-black—a little shir ing. Opaque. Fracture conchoidal, uneven.

Comp.—A sulphid of copper and iron, containing 2 of co per, 2 of iron, and 4 of sulphur=Sulphur 34·9, copper 34· iron 30·5=100. Formula $\text{Ɛu}\,S+Fe\,S+Fe\,S^2=2\,(\frac{1}{2}\,\text{Ɛu}+\frac{1}{2}F$ $S+Fe\,S^2$, usually written $\text{Ɛu}\,S+Fe^2\,S^3$, the objection which has already been mentioned (p. 33) Some analyse give other proportions; but probably from mixture with pyrit These are indefinite mixtures of the two, and with the increase of the latter the color become paler.

This species, although tetragonal, is very closely isomorphous with pyrite, the variation from th cubic form being slight, the vertical axis being 0·98556 instead of 1.

Analyses: 1, H. Rose (Gilb., lxxii. 185); 2, Hartwall (Leonh. Handb., 646); 3, 4, E. Becl (Am. J. Sci., II. xiv. 161); 5, D. Forbes (Ed. N. Phil. J., l. 278); 6, J. L. Smith (Am. J. Sci., I xx. 249); 7, Joy (Lyc. N. H. N. York, viii. 125):

1. Sayn	S 35·87	Cu 34·40	Fe 30·47	quartz 0·27=100·01	Rose.
2. Finland	36·33	32·20	30·03	2·23=100·79	Hartwall.
3. Val Castrucci	35·62	34·09	30·29	——=100·00	Bechi.
4. Mt. Catini	36·16	32·79	29·75	0·86=99·56	Bechi.
5. Jemtel'd, Sweden	33·88	32·65	32·77	Mn *tr.*, S̈i 0·32=99·62	Forbes.
6. Phenixville	36·10	32·85	29·93	Pb 0·35=99·23	Smith.
7. Ellenville	86·65	32·43	31·25	" 0·30, S̈i 0·20=100·83	Jo

Traces of selenium have been noticed by Kersten in an ore from Reinsberg near Freiberg; an that from Rammelsberg near Goslar must contain the same, it being one of the furnace product (Rammelsberg, Min. Chem., 120). Thallium is also present in some kinds, and more frequentl present in this ore than in pyrite.

Other analyses: Malaguti and Durocher (Ann. des M., IV. xvii. 229).

Pyr., etc.—In the closed tube decrepitates, and gives a sulphur sublimate; in other reactio like cubanite. Dissolves in nitric acid, excepting the sulphur, and forms a green solution; ar monia in excess changes the green color to a deep blue.

Obs.—Chalcopyrite is the principal ore of copper at the Cornwall mines, and 10,000 to 12,00 tons of pure copper are smelted annually from 150,000 to 160,000 tons of ore. It is there associate with tin ore, galenite, bornite, chalcocite, tetrahedrite, and blende. The copper beds of Fal lun in Sweden, are composed principally of this ore, which occurs in large masses, surrounde by a coating of serpentine, and imbedded in gneiss. At Rammelsberg, near Goslar in the Har it forms a bed in argillaceous schist, and is associated with pyrite, galenite, blende, and minut portions of silver and gold. The Kurprinz mine at Freiberg affords well-defined crystals. I occurs also in the Bannat, Hungary, and Thuringia; in Scotland in Kirkcudbrightshire, Pert shire and elsewhere; in Tuscany (analyses 3, 4); in South Australia; in fine crystals at Cerr Blanco, near Copiapo, Chili.

In *Maine*, at the Lubec lead mines; at Dexter. In *N. Hamp.*, at Franconia, in gneiss; a Unity, on the estate of Jas. Neal; Warren, on Davis's farm; at Eaton, 2 m. N.E of Atkins' tavern; Lyme, E. of E. Village; Haverhill, etc. In *Vermont*, at Stafford, Corinth, Waterbur Shrewsbury. In *Mass.*, at the Southampton lead mines; at Turner's falls on the Connecticu near Deerfield, and at Hatfield and Sterling. In *Connecticut*, at Bristol and Middletown, some times in crystals. In *New York*, at the Ancram lead mine; five miles from Rossie, beyond De Long' mills at the Rossie lead mines, in crystals; in crystals and massive near Wurtzboro', Sullivan Co. very large crystals and massive at Ellenville, Ulster Co. In *Pennsylvania*, at Phenixville; a Pottstown, Chester Co. (Elizabeth mine). In *Maryland*, in the Catoctin mts.; between New market and Taneytown; near Finksbury, Carroll Co., abundant (Patapsco and other mines), with bornite, carrollite, and malachite. In *Virginia*, at the Phenix copper mines, Fauquier Co., and the Walton gold mine, Louisa Co. In *N. Carolina*, near Greensboro', abundant massive (Fenress or North Carolina, and Macculloch mines), along with spathic iron in a quartz gangue. In *Tennessee*, 30 miles from Cleveland, in Polk Co. (Hiwassee mines), with black copper and pyrites.

In *Cal.*, in different mines along a belt between Mariposa Co. and Del Norte Co., on west side of, and parallel to, the chief gold belt; occurring massive in Calaveras Co., at Union, Keystone, Empire, Napoleon, Campo Seco, and Lancha Plana mines, and in crystals on Domingo Creek; in Mariposa Co., at the La Victoire and Haskell claims, and on the Chowchillas river; in Amador Co., at the Newton mine; in El Dorado Co., at the Cosumnes, Hope Valley, Bunker Hill, El Dorado, Excelsior mines; in Plumas Co., at the Genesee and Cosmopolitan mines.

In *Canada*, in Perth and near Sherbrooke; extensively mined at Bruce mines, on Lake Huron.

The Cornwall chalcopyrite is not a rich ore; what is picked for sale at Redruth rarely yielding 12, generally only 7 or 8, and occasionally but 3 or 4 per cent. of metal. Its richness may in general be judged of by the color; if of a fine yellow hue, and readily yielding to the hammer, it may be considered a good ore; but if hard, and pale-yellow, it is poor from admixture with pyrite.

Readily distinguished from pyrite, which it somewhat resembles, by its inferior hardness; it may be cut by the knife, while pyrite will strike fire with steel. The effects of nitric acid are also different. Differs from gold in being brittle, on which account it cannot be cut off in slices, like the latter metal; and, moreover, gold is not attacked by nitric acid.

Occurs as a furnace product near Goslar.

Alt.—Changes on exposure with moisture, especially if heated, to a sulphate. Malachite, covellite, chrysocolla, black copper, chalcocite, and oxyd of iron, are other forms into which it is sometimes altered.

Named from χαλκός, *brass*, and *pyrites*, by Henckel, who observes in his Pyritology (1725) that chalcopyrite is a good distinctive name for the ore. Aristotle calls the copper ore of Cyprus *chalcitis*; and Dioscorides uses the same word; but what ore was intended is doubtful. There is no question that copper-pyrites was included by Greek and Latin authors under the name *pyrites* (q. v., p. 64).

79. BARNHARDTITE. Genth, Am. J. Sci., II. xix. 17, 1855, xxviii. 248.

Compact massive.

H.=3·5. G.=4·521. Lustre metallic. Color bronze-yellow. Streak grayish-black, slightly shining. Fracture conchoidal, uneven. Brittle. Tarnishes easily, giving pavonine tints, or becoming pinchbeck-brown.

Comp.—2 Ꞓu S + Fe S + Fe S^2=1 chalcopyrite+1 chalcocite=Sulphur 30·5, copper 48·2, iron 21·3. Analyses: 1–3, W. J. Taylor, F. A. Genth, and P. Keyser (l. c.); 4, Genth (priv. contrib.):

	S	Fe	Cu
1. Barnhardt's Land	29·40	22·23	47·61, Ag *tr.* Taylor.
2. Pioneer Mills	29·76	22·41	46·69 Genth.
3. " "	30·50	21·08	48·40 Keyser.
4. Bill Williams' Fork	28·96	20·44	50·41 Genth.

In another ore from Barnhardt's land, Taylor found (l. c.) S 32·9, Fe 28·4, Cu 40·2, corresponding to 8 S + 4 Fe + 2½ Ꞓu.

Pyr., etc.—B.B. gives sulphurous fumes, and fuses easily to a magnetic globule. With borax reactions for copper and iron.

Obs.—Occurs in N. Carolina with other copper ores, at Dan Barnhardt's land, Pioneer Mills, Phenix mine, and Vanderburg mine, in Cabarrus Co.; also near Charlotte, Mecklenburg Co.; at Bill Williams' Fork, in California, with chalcopyrite, etc.

It may be a chalcopyrite, partly altered to copper-glance (chalcocite), as would be inferred from Dr. Genth's later observations.

(A) HOMICHLIN Breithaupt (B. H. Ztg., xvii. 385, 424, 1858, xviii. 65, 321) is closely related to the preceding, and may be chalcopyrite partly altered to bornite. Occurs in tetragonal octahedral crystals, but mostly massive; H.=4—5, G.=4·472—4·480; color more bronze-like than in chalcopyrite; streak black.

Analysis by Richter (l. c., xviii. 321): S 30·21, Fe 25·81, Cu 43·76=3 Ꞓu S + 2 Fe S + Fe^2 S^3, or 3 Ꞓu S + 3 Fe S + Fe S^2, corresponding to 1 of *chalcopyrite*, 2 of *chalcocite*, and 2 of *pyrrhotite*, or to 1 of chalcopyrite and 2 of bornite.

Occurs with malachite and other copper ores at Plauen in Voigtland; also said to occur, by Breithaupt, in Bavaria, Duchies of Hesse and Nassau, Silesia, the Harz, at Rheinbreitenbach on the Rhine, in Algeria, in Chili at Remolinos and Tocopilla, and in Japan.

Ducktownite is a blackish copper ore from Ducktown, Tenn., named by Shepard, who found i it 30·76 iron, 26·04 copper, with 43·20 of *undetermined.* G. J. Brush has shown that it is no homogeneous, and only a mixture, grains of pyrite being visible through the mass, and also softer gray mineral, which is probably chalcocite. See Rep. on Mt. Pisgah Copper Mine, N Haven, 1859, and Am. J. Sci., II. xxviii. 129, 1859.

80. STANNITE. Geschwefeltes Zinn (fr. Cornwall) *Klapr.*, Schriften Nat. Fr. Berlin, vii. 169 1787, Beitr., ii. 257, 1797, v. 228, 1810. Zinkies *Wern.*, Bergm. J., 1789, 385, 397. Tin Pyrite *Kirw.*, ii. 300, 1796. Sulphuret of Tin; Bell Metal Ore. Etain sulfuré *Fr.* Stannine *Beud.* Tr., ii. 416, 1832.

Prboably tetragonal, and hemihedral like chalcopyrite, Kenngott Cleavage: parallel to the faces of the cube and dodecahedron indistinct Commonly massive, granular, and disseminated.

H.=4. G.=4·3—4·522; 4·506, fr. Zinnwald, Rammelsberg. Lustr metallic. Streak blackish. Color steel-gray to iron-black, the forme when pure; sometimes a bluish tarnish; often yellowish from the presenc of chalcopyrite. Opaque. Fracture uneven. Brittle.

Comp.—2 (Ȼu, Fe, Zn) S+Sn S^2, which, the ratio of Ȼu, Fe, Zn, being 2 : 1 : 1, correspond to, Sulphur 29·6, tin 27·2, copper 29·3, iron 6·5, zinc 7·5=100. The ratio between the sulphu of the two terms is 1 : 1, as in chalcopyrite. Analyses: 1, Klaproth (Breitr., v. 228); 2, Kude natsch (Pogg., xxxix. 146); 3, Johnston (Rep. G. Cornwall, etc., 1839); 4, Mallet (Am. J. Sci., I xvii. 33); 5, Rammelsberg (Pogg., lxxxviii. 607):

	S	Sn	Cu	Fe	Zn
1. Wheal Rock	30·5	26·5	30·0	12·0	——=99·0 Klaproth.
2 "	29·64	25·55	29·39	12·44	1·77, gangue 1·02=99·81 Kud.
3. St. Michael's Mt.	29·929	31·618	23·549	4·791	10·113=100 Johnston.
4. "	29·46	26·85	29·18	6·73	7·26, gangue 0·16=99·64 Mal.
5. Zinnwald	29·05	25·65	29·38	6·24	9·68=100 Rammelsberg.

Pyr., etc.—In the closed tube decrepitates, and gives a faint sublimate; in the open tub sulphurous acid, and a sublimate of oxyd of tin quite near the assay. B.B. on charcoal fuses to globule, which in O.F. gives off sulphur, and coats the coal with white oxyd of tin; the roaste mineral treated with borax gives reactions for iron and copper.

Decomposed by nitric acid, affording a blue solution, with separation of sulphur and oxyd o tin.

Obs.—Formerly found at Wheal Rock, Cornwall, and at Carn Brea, where it constituted considerable vein, and was accompanied by pyrite, blende, and other minerals; more recently i considerable quantity in granite at St. Michael's Mount, where it is sold as an ore of copper; als at Stenna Gwynn, St. Stevens, and at Wheal Primrose, Wheal Scorrier, and occasionally at Bota lack mine, St. Just; also at the Cronebane mine, Co. Wicklow, in Ireland; Zinnwald, in th Erzgebirge, with blende and galenite. It frequently has the appearance of bronze or bell meta and hence the name *bell-metal ore.*

81. LINNÆITE. Kobolt med Jern och Svafelsyra (fr. Bastnaes) *G. Brandt*, Ak. H. Stockh., 11 1746. Kobalt med förvswafladt Järn, Cobaltum Ferro Sulphurato mineralisatum, *Cronst.*, 21 1758. Cobaltum pyriticosum *Linn.*, 1768; *de Born*, Lithoph., i. 144, 1772. Mine de Coba sulfureuse *de Lisle*, iii. 134, 1783. Kobalt-Glanz pt. *Wern.*, *Kirwan*, *etc.* Svafelbunden Kobo *Hisinger*, Afh., iii. 316, 1810. Kobaltkies *Hausm.*, Handb., 158, 1813. Schwefelkobalt. Su phuret of Cobalt; Cobalt Pyrites. Cobalt sulfuré *Fr.* Koboldine *Beud.*, Tr., ii. 417, 183 Linneit *Haid.*, Handb., 560, 1845. Kobaltnickelkies [not Kobaltkies] *Ramm.*; Siegenite (Müsen) *Dana*, Min., 687, 1850.

Isometric. Figs. 2, 6, 7. Cleavage: cubic, imperfect. Twins: con position-face octahedral. Also massive, granular to compact.

H.=5·5. G.=4·8—5. Lustre metallic. Color pale steel-gray, tarnis ing copper-red. Streak blackish-gray. Fracture uneven or subconchoida

Comp., Var.—2 Co S + Co S^2=Sulphur 42·0, cobalt 58 0=100; but having the cobalt replaced partly by nickel or copper.

Var. 1. *Cupriferous;* **LINNÆITE** Haid. (l. c.). Ore from Bastnaes. The copper has been attributed to mixed chalcopyrite; but, in view of the composition of carrollite, this is probably not true of all of it. The name *linnæite*, after Linnæus, was given distinctively by Haidinger to the *Bastnaes* mineral (l. c.).

2. *Niccoliferous; Nickel-Linnæite* **SIEGENITE** Dana (l. c.). Ore from Müsen, near Siegen and elsewhere. The specimens from Müsen afforded Rammelsberg, in his recent analysis (No. 5), 14·60 of nickel; and he shows that the earlier analyses are erroneous, owing to the fact that a method of separating nickel and cobalt completely was not known when the analyses were made.

Analyses. 1, Hisinger (Afhandl., iii. 319); 2, Wernekink (Schw. J., xxxix. 306, and Leonh. ZS. f. Min., 1826); 3, Schnabel (Ramm., 4th Suppl., 117); 4, Ebbinghaus (ib.); 5, Rammelsberg (J. pr. Ch., lxxxvi. 340); 6–8, Genth (Am. J. Sci., II. xxiii. 419):

	S	Co	Ni	Fe	Cu
1. Bastnaes	38·50	43·20	——	3·53	14·40, gangue 0·33=99·96 Hisinger.
2. Müsen	42·52	53·35	——	2·30	0·97=98·87 Wernekink.
3. " *Sieg.*	41·98	22·09	33·64	2·29	——=100 Schnabel. G.=4·8.
4. " *Sieg.*	42·30	11·00	42·64	4·69	——=100·63 Ebb. G.=5·0.
5. "	43·04	40·77	14·60	——	0·49=98·90 Ramm.
6. Mineral Hill, *Sieg.*	39·70ᵃ	25·69	29·56	1·96	2·23, Insol. 0 45=99·59 Genth.
7. " *Sieg.*	41·15	[50·76]		3·20	3·68, Insol. 1·26=100 Genth.
8. Missouri, *Sieg.*	41·54	21·34	30·53	3·37	——, Pb 0·39, Cu, Sb *tr.*, Insol. 1·07=98·24 [Genth.

Pyr., etc.—The variety from Müsen gives, in the closed tube, a sulphur sublimate; in the open tube, sulphurous fumes, with a faint sublimate of arsenous acid. B.B. on charcoal gives arsenical and sulphurous odors, and fuses to a magnetic globule. The roasted mineral gives with the fluxes reactions for nickel, cobalt, and iron. Soluble in nitric acid, with separation of sulphur.

Obs.—In gneiss, with chalcopyrite, at Bastnaes, near Riddarhyttan, Sweden; at Müsen, near Siegen, in Prussia, with heavy spar and spathic iron; at Siegen (*siegenite*), in octahedrons; at Mine la Motte, in Missouri, mostly massive, sometimes octahedral and cubo-octahedral crystals; and at Mineral Hill, in Maryland, in a vein in chlorite slate, with chalcopyrite, bornite, blende, pyrite, etc.

Alt.—Occurs altered to yellow earthy cobalt so-called (*gelb Erdkobalt*), which is a mixture of erythrite and pitticite.

82. CARROLLITE. *Faber*, Am. J. Sci., II. xiii. 418, 1852.

Isometric. Rarely in octahedrons. Massive. Fracture subconchoidal or uneven.

H.=5·5. G.= 4·85, Smith and Brush. Lustre metallic. Color light steel-gray, with a faint reddish hue.

Comp.—Cu S + Co^2 S^3; or its equivalent Ꞓu S + Co S + Co S^2 (obtained by doubling the number of atoms), which may be written 2 ($\frac{1}{2}$ Ꞓu + $\frac{1}{2}$ Co) S + 3 Co S^2: analogous to Cuban. Analyses · 1—3, Smith and Brush (Am. J. Sci., II. xvi. 367); 4, Genth (ib., xxiii. 418):

	S	Co	Ni	Fe	Cu	As
1. Patapsco mine	41·93	37·25	1·54	1·26	17·48	*tr.*=99·46 S. & B.
2. "	40·94	38·21	1·54	1·55	17·79	*tr.*=100·03 S. & B.
3. "	40·99	37·65	1·54	1·40	19·18	*tr.*=100·76 S. & B.
4. "	41·71	38·70	1·70	0·46	17·55,	quartz 0·07=100·19 G.

Faber obtained in an incorrect analysis (l. c.) S 27·04, Co 28·50, Ni 1·50, Fe 5·31, Cu 32·99, As 1·81, silica 2·15=99·30.

Pyr.—Like siegenite, except that the roasted mineral reacts for copper with the fluxes.

Obs.—In Carroll Co., Maryland, at Patapsco mine, near Finksburg; and also at Springfield mine, associated and mixed with chalcopyrite and chalcocite.

This species may prove to be identical with the Bastnaes linnæite (or true linnæite), on a new analysis of the latter, both being cupriferous.

83. SMALTITE. ? Cobaltum cineraceum *Agric.*, 459, 1529. Koboltmalm, Koboltglants, Minera Cobalti cinerea, Cobaltum arsenico mineralisatum, pt. (Cobaltite here included), *Wall.*, 231 1747. ? Cobaltum Ferro et Arsenico mineralisatum, Glants-Cobalt (fr. Schneeberg), *Cronst.*, 212 1758. Mine de Cobalt grise *De Lisle*, Crist., 333, 1772; Mine de Cobalt arsenicale *De Lisle*, iii 123, 1783. Weisser Speisskobold, Grauer Speisskobold, *Wern.* Gray Cobalt ore *Kirw.*, 1796 Tin-white cobalt. Speiskobalt *Hausm.*, Handb., 155, 1813. Smaltine *Beud.*, Tr., ii. 584, 1852.

Isometric. Observed planes: *O*, 1, 2-2, *I*, also an undetermined tetrahexahedron. Figures 1, 2, 5, 6, 8, 9. Cleavage: octahedral, distinct. Cubic, in traces. Also massive and in reticulated and other imitative shapes.

H.=5·5—6. G.=6·4 to 7·2. Lustre metallic. Color tin-white, inclining, when massive, to steel-gray, sometimes iridescent, or grayish from tarnish. Streak grayish-black. Fracture granular and uneven. Brittle.

Comp., Var.—For typical kind (Co, Fe, Ni) As^2= (if Co, Fe, and Ni be present in equal parts) Arsenic 72·1, cobalt 9·4, nickel 9·5, iron 9·0=100. It is probable that nickel is never wholly absent, although not detected in some of the earlier analyses; and in some kinds it is the principal metal. The varieties based on the proportions of cobalt, nickel, and iron, are the following:

Var. 1. *Cobaltic*; SMALTINE. Contains little nickel or iron.

2. *Niccoliferous*; CHLOANTHITE *Breith.* (B. H. Ztg., iv. 1845; Weissnickelkies pt., Weissnickelerz, Arsenik-Nickel, *Germ.*; White Nickel; Rammelsbergit *Haid.*, Handb., 560, 1845; Chathamite *Shep.*, Am. J. Sci., xlvii. 351, 1844). Contains much nickel, the cobalt simetimes nearly wanting.

3. *Ferriferous*; SAFFLORITE *Breith.* (Grauer Speiskobold *Wern.*; Eisenkobalterz *Hausm.*; Eisenkobaltkies *v. Kob.*). Contains over 10 p. c. of iron with cobalt, or with cobalt and nickel.

But the atomic proportion of arsenic and other elements often varies much from the normal above stated, and without correspondence with the three groups just pointed out. These variations lead to the following groups, as distinguished by Rammelsberg, which, however, blend more or less with one another:

A. Composition R As^2, with R=Co, Fe, and some Ni. Includes some of Nos. 1, 2, and 3, above.

B. R As^2, with R=Ni, Fe, and some Co. Includes most *chloanthite*, No. 2. Anal. 6 to 12.

C. R As + R As^2. Anal. 13 to 15. Includes some of Nos. 2 and 3.

D. R As^2 + 2 R As^3. Anal. 16 to 21. Includes some of 1 and 2. In this last the arsenic constitutes 73—76 p. c., and the mineral approximates to *Skutterudite.*

Analyses: Series A. 1, Varrentrapp (Pogg., xlviii. 505); 2, Hofmann (Pogg., xxv. 485); 3, Kobell (Grundz. Min., 300); 4, Klauer (Ramm., 5th Suppl., 225); 5, Lange (Ramm., Min. Ch., 24).—Series B. 6, Booth (Am. J. Sci., xxix. 241); 7, Rammelsberg (J. pr. Ch., lv. 486); 8, 9, id. (1st Suppl., 15); 10, F. Marian (Vogl's Min. Joach., 158); 11, C. U. Shepard (Am. J. Sci., xlvii. 351); 12, Genth (This Min., 512, 1854).—Series C. 13, Jäckel (Rose's Kryst. Ch., 53); 14, Rammelsberg (5th Suppl., 225); 15, Salvetal & Wertheim (These, Paris, 1854, 79).—Series D. 16, Stromeyer (Gel. Anz. Gött., 1817, 72); 17, Sartorius (Ann. Ch. Pharm., lxvi. 278); 18, 19, B. W Bull (Rose's Kryst. Ch., 52); 20, Karstedt (Ramm., 5th Suppl., 225); 21, Marian (l. c.):

A.		As	Co	Ni	Fe	Cu	
1.	Tunaberg	69·46	23·44	——	4.95	——,	S 0·90=98·75 Varr.
2.	Schneeberg	70·37	13·95	1·79	11·71	1·39,	S 0·66, Bi 0·01=99·88 Hofm.
3.	"	71·08	9·44	——	18·48	*tr.*	S *tr.*, Bi 1·00=100 Kob.
4.	Riechelsdorf	68·73	16·37	12·15	2·30	0·45	=100 Klauer.
5.	Schneeberg	73·55	6·28	14·49	5·20	——,	S 0·27=99·79 Lange.
B.	G. of mineral of anal. 7, 6·411; 8 and 9, 6·735; 10, 6·28—6·89.						
6.	Riechelsdorf	72·64	3·37	20·74	3·25	——	=100 Booth.
7.	Allemont	71·11	——	18·71	6·82	——,	S 2·29=98·93 Ramm.
8.	Kamsdorf	70·34	——	28·40	*tr.*	——	=98·74 Ramm.
9.	"	70·93	——	29·50	*tr.*	——	=100·43 Ramm.
10.	Joachimsthal	71·47	3·62	21·18	2·83	0·29,	S 0·58=99·97 Marian.
11.	Chatham, Ct.	70·00	1·35	12·19	17·70	——	=101·21 Shepard.
12.	"	70·11	3·82	9·44	11·85	——,	S 4·78=100 Genth.
C.	G. of min. of anal. 13, 6·84; 14, 6·874.						
13.	Riechelsdorf	66·02	21·21	——	11·60	1·90,	S 0·49, Bi 0·04=101·26 Jäckel.
14.	"	60·42	10·80	25·87	0·80	——,	S 2·11=100 Ramm.
15.	Schneeberg	58·71	3·01	35·00	0·80	——,	S 2·80=100·32 Salv. & W.

D. G. of min. of anal. 19, 6·537; 21, 6·807.

		As	Co	Ni	Fe	Cu	
16.	Riechelsdorf	74·21	20·31	——	8·42	0·16,	S 0·88=98·98 Strom.
17.	"	73·53	9·17	14·06	2·24	——,	S 0·94=99·94 Sartorius.
18.	"	76·09	4·56	12·25	6·82	——	=99·72 Bull.
19.	Schneeberg	75·85	3·32	12·04	6·52	0·94	=98·67 Bull.
20.	"	74·80	3·79	12·86	7·33	——,	S 0·85=99·63 Karst.
21.	Joachimsthal	74·52	11·72	1·81	5·26	1·00,	S 1·81=99·72 Marian.

J. L. Smith found over 8 p. c. of copper in a smaltine from Atacama, his analysis affording (Gilliss's Exped., ii. 102) As 70·85, Co 24·18, Ni 1·23, Fe 4·05, Cu 8·41, S 0·08=100·75.

Pyr., etc.—In the closed tube gives a sublimate of metallic arsenic; in the open tube a white sublimate of arsenous acid, and sometimes traces of sulphurous acid. B.B. on charcoal gives an arsenical odor, and fuses to a globule, which, treated with successive portions of borax-glass, affords reactions for iron, cobalt, and nickel.

Obs.—Usually occurs in veins, accompanying ores of cobalt or nickel, and ores of silver and copper; also, in some instances, with niccolite and arsenopyrite; often having a coating of annabergite.

Occurs with silver and copper at Freiberg, Annaberg, and particularly Schneeberg in Saxony; at Joachimsthal in Bohemia, the reticulated varieties are frequently found imbedded in calc spar, and also at Wheal Sparnon in Cornwall; at Riechelsdorf in Hesse, in veins in the copper schist; at Tunaberg in Sweden; Allemont in Dauphiné; at the silver mines of Tres Puntas and others in Chili, but only in small quantities. Also in crystals at Mine La Motte, Missouri. See analyses above for the varieties at these localities.

At Chatham, Conn., the chloanthite (chathamite) occurs in mica slate, associated generally with arsenopyrite and sometimes with niccolite.

This species and the cobaltite were confounded by the mineralogists of last century; and although right chemical distinctions were early indicated by those of Sweden, doubts continued until the analyses by John and Stromeyer in 1811 and 1817. Romé de Lisle brought out and figured correctly the crystallographic distinctions in 1772 and 1783; but the value of his determinations were not generally appreciated.

Alt.—Occurs altered to erythrite (arsenate of cobalt), a change due to the oxydation of the arsenic and cobalt on exposure to moisture.

84. SKUTTERUDITE. Tesseral-Kies, Hartkobaltkies, *Breith.*, Pogg., ix. 115, 1827. Arsenikkobaltkies *Scheerer*, Pogg., xlii. 546, 1837. Hartkobalterz *Hausm.*, Handb., 69, 1847. Skutterudit *Haid.*, Handb., 560, 1845. Modumite *Nicol*, Min., 457, 1849.

Isometric. Observed planes *O*, *I*, 1, 2, $\frac{3}{2}$, 2-2, *i*-3, 2-$\frac{3}{2}$. Figs. 1, 2, 3, 10. Cleavage: cubic, distinct; *I*, in traces. Also massive granular.

H.=6. G.=6·74—6·84. Lustre bright metallic. Color between tin-white and pale lead-gray, sometimes iridescent.

Comp.—Co As^2=Arsenic 79·2, cobalt 20·8=100. Analyses: 1, Scheeror (l. c.); 2, 3, Wöhler (Pogg., xliii. 591):

			As	Co	Fe	
1.	Skutterud		As 77·84	Co 20·01	Fe 1·51	S 0·69=100·05 Scheerer.
2.	"	*cryst.*	79·2	18·5	1·3	=99·0 Wöhler.
3.	"	*mass.*	79·0	19·5	1·4	=99·9 Wöhler.

Pyr.—Reactions like those of smaltite, but gives a more copious sublimate of metallic arsenic in the closed tube.

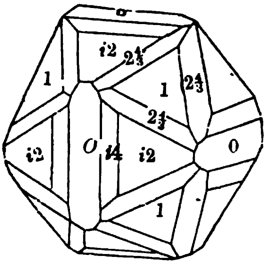
Obs.—From Skutterud, near Modum, in Norway, in a hornblendic gangue in gneiss, with sphene and cobaltite, and the crystals sometimes implanted on those of cobaltite.

85. COBALTITE. Cobaltum cum ferro sulfurato et arsenicato mineralisatum, Glants-Kobolt pt. (fr. Tunaberg), *Cronst.*, 213, 1758. Mine de Cobalt blanche *de Lisle*, Crist., 334, 1772. Mine de Cobalt arsenico-sulfureuse *de Lisle*, Crist., iii. 129, 1783. Glanz-Kobold *Wern.* Kobalt-Glanz *Germ.* Cobalt gris pt. *H.* Glance Cobalt; Bright-White Cobalt. Glanzkobaltkies *Glock.*, Grundr., 1831. Cobaltine *Beud.*, Tr. ii. 450, 1832.

Isometric; pyritohedral. Observed planes, as in the annexed figure;

f. 46, 47. Cleavage: cubic, perfect. Planes *O* striated. Also massive granular or compact.

95



H.=5·5. G.=6—6·3. Lustre metallic. Colo silver-white, inclined to red; also steel-gray, witl a violet tinge, or grayish-black when containin much iron. Streak grayish-black. Fracture un even and lamellar. Brittle.

Comp., Var.—Co S^2+Co As^2, or Co (S, As)^2=Sulphur 19·3 arsenic 45·2, cobalt 35·5=100. The cobalt is sometimes largel replaced by iron, and sparingly by copper.

Var. 1. *Ordinary.* Contains little iron. Anal. 1—6.

2. *Ferriferous;* FERROCOBALTITE (Stahlkobalt *Ramm.*, 4th Suppl. 116, 5th Suppl., 148, 1853; Ferrocobaltine *Dana*, Min., 58, 1854] Contains much iron (anal. 7—9); from the Hamberg mine, Siegen

Analyses: 1, Stromeyer (Schw. J., xix. 336); 2, Schnabel (Ramm., 3d Suppl., 65); 3, Huberd (Ramm., 4th Suppl, 116); 4, Patera (ib.); 5, Ebbinghaus (ib.); 6, 7, Schnabel (ib.); 8, Schnabe (ib., 5th Suppl., 149); 9, Heidingsfeld (ib.):

	S	As	Co	Fe
1. Skutterud	20·08	43·46	33·10	3·23=99·87 Stromeyer.
2. Siegen	19·10	44·75	29·77	6·38=100 Schnabel.
5. Skutterud	20·25	42·97	32·07	3·42, quartz 1·63=100·34 Ebbinghaus.
6. Siegen, *massive*	19·35	45·31	33·71	1·63=99·99 Schnabel.
7. " *plumose*	19·98	42·53	8·67	25·98 Sb 2·84=100 Schnabel.
8. " "	20·86	42·94	8·92	28·03=100·75 Schnabel.
9. " "	19·08	43·14	9·62	24·99, Sb 1·04, Cu 2·36, gangue 0·52=100·75 Heid

The analyses of supposed cobaltite by Patera and Huberdt are given under ALLOCLASITE.

Pyr., etc.—Unaltered in the closed tube. In the open tube, gives sulphurous fumes, and crystalline sublimate of arsenous acid. B.B. on charcoal gives off sulphur and arsenic, and fuses to a magnetic globule; with borax a cobalt-blue color. Soluble in warm nitric acid, separatin arsenous acid and sulphur.

Obs.—Occurs at Tunaberg, Riddarhyttan, and Hokansbö, in Sweden, in large, splendid, well defined crystals; also at Skutterud in Norway. Other localities are at Querbach in Silesia, Sieger in Westphalia, and Botallack mine, near St. Just, in Cornwall. The most productive mines are those of Vena in Sweden, where it occurs in mica slate; these mines were first opened in 1809.

This species and smaltite afford the greater part of the smalt of commerce. It is also employed in porcelain painting.

86. GERSDORFFITE. Nicoolum Ferro et Cobalto Arsenicatis et Sulphuratis mineralisatum, Kupfernickel, pt. (*white* var. fr. Loos), *Cronst.*, 218, 1758, Ak. H. Stockh., 1751, 1754. [The species later taken for Kupfernickel and Cobalt ore, until 1818.] Nickelglanz, Weisses Nickelerz, *Pfaff*, Schw. J., xxii. 260, 1818; *Berz.*, Ak. H. Stockh., 1820. Sulfo-arséniure de nickel *Beud.*, 1824, Nickelarsenikglanz, Nickelarsenikkies, Arseniknickelglanz, *Germ.* Nickel Glance. Disomose *Beud.*, Tr., ii. 418, 1832. Tombazite pt. *Breith.*, J. pr. Ch., xv. 330, 1838. Gersdorffit (fr. Schladming) pt. *Löwe*, Pogg., lv. 503, 1842. Amoibit pt. *v. Kob.*, J. pr. Ch., xxxiii. 402, 1844.

Isometric; pyritohedral. Observed planes *O*, 1, *i*-2. Figs. 2, 6, 7, 46. Cleavage: cubic, rather perfect. Also lamellar and granular massive.

H.=5·5. G.=5·6—6·9. Lustre metallic. Color silver-white—steel-gray, often tarnished gray or grayish-black. Streak grayish-black. Fracture uneven.

Comp., Var.—Normal, Ni S^2+Ni As^2, or Ni (S, As)^2=Arsenic 45·5, sulphur 19·4, nickel 35·1=100. But the composition varies in atomic proportions rather widely, and the species is not yet fully understood.

Var. 1. *Normal.* Having the above composition.

2. Löwe's *gersdorffite* (No. 10) affords 1 [Ni S^2+Ni As^2]+½ niccolite (p. 60), corresponding to At. ratio for As, S, Ni, 3 : 2 : 3. Löwe deduced 4 : 3 : 4, the formula from which would differ only in the last member being ½ niccolite. Anal. 9 falls in with this formula.

3. Von Kobell's *amoibite* (anal. 17) afforded him, 4 As+3 S+4 Ni=Arsenic 47·4, sulphur 15·2, nickel 37·4. 4 As+3 S+4½ Ni is nearer the analysis. The mineral occurs at Lichtenberg in the Fichtelgebirge in light steel-gray octahedrons, having H.=4.

4. H.=4. Pless's analyses (Nos. 12–14), and also Bogen's of the ore of Siegen (No. 15), correspond to 2 Ni S+Ni As^2. This ore may be named *plessite.*

5. *Dobschauite.* Anal. 18 corresponds to At. ratio for As, S, (Ni, Fe, Co), 2 : 1 : 2, giving the formula 1 [R S^2+R As^2]+2 niccolite.

Analyses: 1, Berzelius (l. c.); 2, Rammelsberg (Pogg., lxviii. 511); 3, 4, Schnabel (Verh. Ver. Bonn, viii. 307, Ramm. Min.-Ch., 65); 5, Bergemann (J. pr. Ch., lxxv. 244); 6, Döbereiner (Schw. J., xxvi. 270); 7, Rammelsberg (Handw., ii. 14); 8, Heidingsfeld (Ramm., 5th Suppl., 174); 9–11, Löwe (Ramm., 2d Suppl., 102, Pogg., lv. 503); 12–14, Pless (Ann. Ch. Pharm., li. 250); 15, Bogen (B. H. Ztg., xxiii. 55); 16, Bergemann (J. pr. Ch., lxxix. 412); 17, v. Kobell (J. pr. Ch., xxxiii. 402); 18, Zerjäu (Anz. Ak. Wien, 1866, 173):

	As	S	Ni	Fe	Co
1. Loos, Sweden	45·37	19·34	29·94	4·11	0·92^a, Ši 0·9=100·58 Berzelius.
2. Harzgerode, G. 5·65	44·01	18·83	30·30	6·00	—— Sb 0·86=100 Ramm.
3. Müsen, *cryst.*	46·02	18·94	32·66	2·38	——=100 Schnabel.
4. Ems, *massive*	38·92	17·82	35·27	4·97	2·23, Cu 2·75=101·96 Schnabel.
5. " *cryst.*	45·02	19·04	34·18	1·02	0·27, Sb 0·61=100·14 Bergemann.
6. Kamsdorf	48·	14·	27·^{c}	11·	——=100 Döbereiner.
7. Lobenstein	48·02	20·16	31·82	——	——=100 Rammelsberg.
8. "	46·12	18·96	33·04	1·81	0·60, Cu 0·11, Sb 0·33=100·97 Heid.
9. Prakendorf	46·10	16·25	28·75	8·70	——=100 Löwe.
10. Schladming, *Gersdorff.*	49·83	14·13	26·14	9·55	——=99·65 Löwe.
11. " G. 6·7—6·9	42·52	14·22	38·42	2·09	——, quartz 1·87=99·12 Löwe.
12. " *cryst.*, G. 6·64	39·04	16·35	19·59	11·13	14·12=100·23 Pless.
13. " "	39·88	16·11	27·90	14·97	0·83=99·69 Pless.
14. " "	39·40	16·91	28·62	12·19	2·88=100 Pless.
15. Siegen	37·52	17·49	40·97	4·19	——=100·17 Bogen.
16. Ems, *massive*	33·25	21·51	22·79	16·64	1·64, Cu 4·01, Sb 0·62=100·46 B.
17. *Amoibite,* G. 6·08	45·34^b	14·00	37·34	2·50	*tr.*, Pb 0·82=100 Kobell.
18. Dobschau	49·73	9·41	25·83	5·20	7·46, Ši 1·63=99·26 Zerjäu.

^{a} with some Cu. ^{b} by loss. ^{c} with some Co.

Pyr., etc.—In the closed tube decrepitates, and gives a yellowish-brown sublimate of sulphid of arsenic. In the open tube yields sulphurous fumes, and a white sublimate of arsenous acid. B.B. on charcoal gives sulphurous and garlic odors and fuses to a globule, which, with borax-glass gives at first an iron reaction, and, by treatment with fresh portions of the flux, cobalt and nickel are successively oxydized.

Decomposed by nitric acid, forming a green solution, with separation of sulphur and arsenous acid.

Obs.—Occurs at Loos in Helsingland, Sweden; in the Albertine mine, near Harzgerode in the Harz, with chalcopyrite, galenite, calcite, fluor-spar, and quartz; at Schladming in Styria; Kamsdorf in Lower Thuringia; Haueisen, near Lobenstein, Voigtland; at the quicksilver mine (anal. 4) and at Pfingstweise (anal. 5), near Ems. Also found as an incrustation of cubes, with planes 1 and 2-2, on decomposed galenite and blende, at Phenixville, Pa.

87. ULLMANNITE. Nickelspiesglaserz (fr. Siegen) *Ullmann* (his discov. in 1803), Syst.-Tab., 166, 379, 1814. Nickelspiessglanzerz *Hausm.*, Handb., 192, 1813. Antimonnickelglanz, Nickelantimonglanz, Antimon-Arseniknickelglanz, *Germ.* Nickel Stibine; Nickeliferous Gray Antimony. Antimoine sulfuré nickelifère *H.*, 1822. Ullmannit *Fröbel*, 1843.

Isometric. Observed planes, *O*, 1, *I*; f. 5, 6, 7. Cleavage: cubic, perfect. Occurs also massive; structure granular.

H.=5—5·5. G.=6·2—6·51; 6·352—6·506, Harzgerode, Ramm. Lustre metallic. Color steel-gray, inclining to silver-white. Brittle.

Comp.—Ni S^2+Ni (Sb, As)^2, Ramm., or Ni (S, Sb, As)^2=(arsenic excluded) Nickel 27·7, antimony 57·2, sulphur 15·1=100. The arsenic is sometimes wanting, as in anal. 3, 4. Analyses:

1, Klaproth (Beitr., vi. 329); 2, Ullmann (Syst. tab. Uebers., 394); 3, 4, H. Rose (Pogg., xv. 588) 5, Rammelsberg (Pogg., lxiv. 189):

	As	Sb	S	Ni
1. Freusberg	11·75	47·75	15·25	25·25=100 Klaproth.
2. Siegen	9·94	47·56	16·40	26·10=100 Ullmann.
3. "	——	55·76	15·98	27·36=99·10 H. Rose.
4. "	——	54·47	15·55	28·04=98·06 H. Rose.
5. Harzgerode	2·65	50·84	17·38	29·43, Fe 1·83=102·13 Ramm.

Pyr., etc.—In the closed tube gives a faint white sublimate. In the open tube sulphurous and antimonous fumes, the latter condensing on the walls of the tube as a white non-volatile sublimate. B.B. on charcoal fuses to a globule, boils, and emits antimonous vapors, which coat the coal white; treated with borax-glass reacts like gersdorffite. Some varieties contain arsenic. Decomposed by nitric acid, forming a green solution, with separation of sulphur and antimonous acid.

Obs.—Occurs in the Duchy of Nassau, in the mines of Freusburg, with galenite and chalcopyrite; in Siegen, Prussia; at Harzgerode and Lobenstein.

Rammelsberg calls an ore from the Harz *bournonit-nickelglanz*. It occurs in cubes; H.=4·5. G.=5·635—5·706. Analysis (Pogg., lxxvii. 254):

As	Sb	S	Ni	Co	Pb	Cu	Fe
28·00	19·53	16·86	27·04	1·60	5·13	1·33	0·51=100

It comes from Wolfsberg in the Harz.

88. CORYNITE. Korynit *v. Zepharovich*, Ber. Ak. Wien, li. 117, 1865.

Isometric. In octahedrons, with convex faces. Also in globular groups. H.=4·5—5. G.=5·994; 5·95—6·029, v. Z. Lustre metallic. Color silver-white, inclined to steel-gray on fresh fracture; streak black. Opaque. Fracture uneven.

Comp.—$Ni\,S^2 + Ni\,(As, Sb)^2$, or like ullmannite, and differing in that the arsenic present exceeds in amount the antimony. Analysis: v. Payer (l. c.):

As	Sb	S	Ni	Fe
37·83	13·45	17·19	28·86	1·98=99·31

Pyr., etc.—In the open tube affords sulphurous acid and a crystalline white sublimate. In the mattrass also finally a narrow yellowish-red and a broader yellow zone. B.B. on charcoal fuses easily at surface, yielding fumes of sulphurous acid and antimony. With borax-glass reactions of iron, cobalt, and finally nickel, with an arsenical odor.

Obs.—From Olsa, in Carinthia, with bournonite; crystals about 2½ mm. through.

Named from Κορύνη, *a club.*

89. LAURITE. Laurit *Wöhler*, Ann. Ch. Pharm., cxxxix. 116.

Isometric. In small octahedrons, with faces of the cube, and 2-2, *i*-2. Cleavage: octahedral distinct.

H. above 7. G.=6·99, v. Waltershausen. Lustre metallic, bright. Color dark iron-black; powder dark-gray. Brittle.

Comp.—Sulphid of osmium and ruthenium Perhaps $12\,Ru^2 S^3 + Os\,S^4$, or $Ru\,S^2\,[+\frac{1}{20}\,Ru^4\,Os]$ =Sulphur 32·12, Ru 62·88, Os 5·00=100. Analysis: Wöhler (l. c.):

S 31·79 [Os 3·03] Ru 65·18=100

The osmium was determined by the loss, and the ruthenium was not wholly pure from it, the amount used for analysis having been but 0·3145 grain.

Pyr., etc.—Heated it decrepitates. B.B. infusible, giving first sulphurous and then osmic acid fumes. Not acted upon by aqua regia, or by heating with bisulphate of potash.

Obs.—From the platinum washings of Borneo. Found among fine-grained platinum which had been brought from Borneo.

90. MARCASITE. Not Marchasite [=Cryst. Pyrite] *Arab.*, *Agric.*, 1546; *Henckel*, 1725; *Wall.*, 1747; *Cronst.*, 1758; *Linn.*, 1768; *de Lisle*, 1783. ? Pyrites argenteo colore, *Germ.* Wasserkies o. Weisserkies, *Agric.* Interpr., 477, 1546; Ferrum jecoris colore, *Germ.* Lebererz, pt., *Agric.*, ib., 469. Vattenkies [=Wasserkies] pt., Pyrites fuscus pt., P. aquosus pt., *Wall.*, 212, '747. Swafwelkies pt. *Cronst.*, 184, 1758. Pyrites lamellosus *Born.*, Lithoph., ii. 106, 1772 P. aquosus? *id.*, 107. Pyrites rhomboidales pt. *de Lisle*, Crist., 1772, iii. 242, 1783. Pyrites lamelleuse en crêtes de coq [=Cockscomb Pyrites] *Forst.*, Cat., 1772; *de Lisle*, Crist., iii. 2 2, 1783. Pyrites fuscus lamellosus *Wall.*, ii. 134, 1778. Strahlkies, Leberkies [=Radiated Pyrites, Hepatic Pyrites] pt., *Wern.*, Bergm. J., 1789. Fer sulfuré var. radié *H.*, Tr., 1801, *Brongn.*, Tr., 1807. Wasserkies (Dichter o. Leberkies, Strahlkies, Haarkies pt.) *Hausm.*, Handb., 149, 1813. Fer sulfuré blanc pt. *H.* White Pyrites *Aikin*, Min., 1814. Fer sulfuré prismatique rhomboidale *Bourn.*, Cat., 301, 1817. Prismatic Iron Pyrites *James.*, iii. 297, 1820. Kammkies, Speerkies, Zellkies pt., *Germ.* Cockscomb, Spear, and Cellular Pyrites. Markasit *Haid.*, Handb., 467, 561, 1845.

Orthorhombic. $I \wedge I = 106° 5'$, $O \wedge 1\text{-}\bar{i} = 122° 26'$, $a : b : c = 1{\cdot}5737 : 1 : 1{\cdot}3287$.

$O \wedge 1 = 116° 55'$
$O \wedge \frac{1}{3}\text{-}\breve{i} = 158\ 27$
$O \wedge 1\text{-}\breve{i} = 130\ 10$
$1 \wedge 1$, mac., $= 115° 10'$
$1 \wedge 1$, brach., $= 89\ 6$
$1 \wedge 1$, bas., $= 126\ 10$
$1\text{-}\bar{i} \wedge 1\text{-}\bar{i} = 64° 52'$
$1\text{-}\breve{i} \wedge 1\text{-}\breve{i} = 80\ 20$
$I \wedge i\text{-}\breve{i} = 126\ 57$

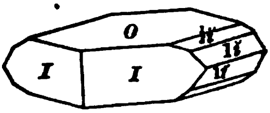
Cleavage: *I* rather perfect; 1-ĭ in traces. Twins: plane of composition *I*, sometimes consisting of five individuals, united by the acute lateral angle (f. 97); also others with composition parallel to 1-ī. Also globular, reniform, and other imitative shapes—structure straight columnar; often massive, columnar, or granular.

H.=6—6·5. G.=4·678—4·847. Lustre metallic. Color pale bronze-yellow, sometimes inclined to green or gray. Streak grayish or brownish-black. Fracture uneven. Brittle.

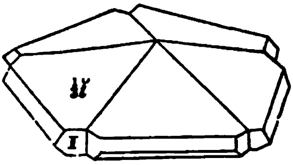
O		
		$\frac{1}{4}\text{-}\breve{i}$
		$\frac{1}{3}\text{-}\breve{i}$
		$\frac{1}{2}\text{-}\breve{i}$
$1\text{-}\bar{i}$	1	$1\text{-}\breve{i}$
	I	$i\text{-}\breve{i}$

Observed planes.

96



97



Comp., Var.—Fe S^2, like pyrite.

The varieties that have been recognized depend mainly on state of crystallization.

1. *Radiated* (*Strahlkies*): Radiated; also the simple crystals.
2. *Cockscomb P.* (*Kammkies*): Aggregations of flattened crystals into crest-like forms.
3. *Spear P.* (*Speerkies*): Twin crystals, with reëntering angles a little like the head of a spear in form.
4. *Capillary* (*Haarkies*): In capillary crystallizations.
5. *Hepatic P.* (*Leberkies* and *Pyrites fuscus* pt.): The massive of dull colors, being named from [illegible], *liver*; but including, among the older mineralogists especially, brown specimens of any pyrite, altered more or less to limonite.
6. *Cellular P.* (*Zellkies*): In cellular specimens, formed by the incrustation of the crystals of other minerals that have disappeared; partly pyrite.
7. *Arsenical:* Nearly white in color (in part *kyrosite* Breith., and *weisskupfererz*); contains a trace of arsenic.

Analyses: 1, Hatchett (Phil. Trans., 325, 1804); 2, 3, Berzelius (Schw. J., xxvii. 67); 4, Scheidhauer (Pogg., lxiv. 282); 5, Trapp (B. H. Ztg., xxiii. 55):

	Fe	S
1.	46·4	53·6=100 Hatchett.
2.	45·66	54·34=100 Berzelius.
3. *Spear P.*	45·07	52·35, Mn 0·70, $\ddot{S}i$ 0·80=99·92 Berzelius.
4. *Kyrosite*	45 60	53·05, Cu 1·41, As 0·93=100·99 Scheidhauer.
5. Münsterthal, Baden	46·93	51·95=98·88 Trapp.

Pyr.—Like pyrite. Very liable to decomposition; more so than pyrite.

The *kyrosite* Breith., called also *weisskupfererz*, Char., 1823, 111, 246, and *arsenid of copper*, is from the Mine Briccius, near Annaberg. A Chilian *weisskupfererz* contains, according to Plattner (Breith., in Pogg, lviii. 281), 12·9 p. c. of copper, besides iron and sulphur, but no arsenic. Another so called, from Schneeberg, is, according to v. Kobell (J. pr. Ch., lxxi. 159), impure marcasite. *Weisskupfererz* (also called *weisskupfer* and *weisserz*) occurs as the name of a species in all the mineralogical works of last century, from Henckel's Pyrotology, in 1725, where it is called a whitish copper ore, and placed near tetrahedrite; and the light color, from Henckel down, is attributed to the presence of arsenic. It has finally been run out as mostly impure marcasite; and the domeykite and related species (p. 36) are now the only true white copper.

Obs.—The spear variety occurs abundantly in the plastic clay of the brown coal formation at Littwitz and Altsattell, near Carlsbad in Bohemia. and is extensively mined for its sulphur and the manufacture of the sulphate of iron. The radiated variety occurs at the same place; also at Joachimsthal, and in several parts of Saxony. The cockscomb variety occurs with galenite and fluor-spar in Derbyshire; crystals near Castleton in Derbyshire; near Alston Moor in Cumberland; near Tavistock in Devonshire; and radiated at East Wheal Rose and elsewhere in Cornwall.

At Warwick, N. Y., it occurs in simple and compound crystals, in granite, with zircon. Hustis's farm, in Phillipstown, N. Y., affords small crystals, referred by Beck to this species, occurring in magnesian limestone. Massive fibrous varieties abound throughout the mica slate of New England, particularly at Cummington, Mass., where it is associated with cummingtonite and garnet. Occurs at Lane's mine, in Monroe, Conn., and in the topaz and fluor vein in Trumbull; also in gneiss at East Haddam; at Haverhill, N. H., with common pyrite. In Canada in Neebing, a few miles east of the Kamanistiquia R.

Marcasite is employed in the manufacture of sulphur, sulphuric acid, and sulphate of iron, though less frequently than pyrite. Its color is considerably paler than that of ordinary pyrite.

The word *marcasite*, of Arabic or Moorish origin (and variously used by old writers), was the name of common crystallized pyrite among miners and mineralogists in later centuries, until near the close of the last. It was first given to this species by Haidinger in 1845.

The species is probably recognized by Agricola under the name *wasserkies* and *lebererz;* and also under the same by Cronstedt; and it is *Wasserkies* of Hausmann in both editions of his great work. This name, wasserkies (pyrites aquosus, as Cronstedt translates it), is little applicable; yet may have arisen from the greater tendency of the mineral to become moist and alter to vitriol than pyrite—if it be not an early corruption, as Agricola seems to think (see above), of *Weisserkies* (white iron pyrites). It appears to have been used also for easily decomposable pyrite; and *pyrrhotite* was also included under its other name, *pyrites fuscus.* The rhombic crystallization is mentioned by de Lisle; but Hauy long afterward considered it only an irregularity of common iron pyrites. *Marcasite* is made by Breithaupt (J. pr. Ch., iv. 257, 1835) a generic name for the various species of pyrites.

LONCHIDITE *Breit. & Plattn.*, Pogg., lxxvii. 135 (Kausimkies, Br. Char., 254, 1832). This mineral appears to be a mixture of marcasite and mispickel. Breithaupt gives for it the angles $104^\circ 20'$ for $I \wedge I$, and $100^\circ 36'$ for the brachydome. H.=6·5. G.=4·925—5. Color tin-white, sometimes greenish or grayish; streak black. Analysis by Plattner (loc. cit.), S 49·61, As 4·40, Fe 44·23, Co 0·35, Cu 0·75. Pb 0 20=99·54, equivalent to 24 of marcasite ($Fe\,S^2$) and 1 of $Fe\,As^2$. From Freiberg, Schneeberg, and Cornwall.

Alt.—Limonite and pyrite occur as pseudomorphs after marcasite.

91. LÖLLINGITE. Prismatic Arsenical Pyrites (communic. by Mohs) pt. *Jameson*, iii. 272, 1820. Axotomer Arsenik-Kies pt. *Mohs*, Grundr., 525, 1823. Arsenikalkies, Arsenikeisen, Arseneisen. pt., *Germ.* Leucopyrite pt. *Shep.*, Min., ii. 9, 1835. Arsenosiderit pt. *Glock.*, Grundr., 321, 1839. Mohsine pt. *Chapman*, 1843. Löllingit pt. *Haid.*, Handb., 559, 1845. Sätersbergit *Kenng.*, Min., 111, 1853. Leucopyrite *Dana*, Min., 1868.

Orthorhombic. Form like that of arsenopyrite, and probably the same in angles with that of löllingite. Also massive.

H.=5–5·5. G.=6·8–8·71; 6·80 from Andreasberg, Illing; 7·09, from Fossum, Scheerer; 7·28 from Breitenbrunn, Behncke; 8·67–8·71 from Schladming, Weidenbusch. Lustre metallic. Color between silver-white and steel-gray. Streak grayish-black. Fracture uneven. Brittle.

Comp.—Fe As^2=Arsenic 72·8, iron 27·2=100; or (Fe, Ni, Co) As^2. Analyses; 1, 2, Scheerer (Pogg., xlix 536, l. 153); 3, Weidenbusch (Rose's Kryst. Ch., 54); 4, Behncke (Pogg., xcviii. 187); 5, Illing (ZS. nat. Ver. Halle, 1854, 339):

	As	S	Fe
1. Fossum, Norway	70·09	1·33	27·39=98·81 Scheerer.
2. " "	70·22	1·28	28·14=99·64 Scheerer.
3. Schladming	72·18	0·70	26·48=99·36 Weid.
4. Breitenbrunn	69·85	1·10	27·41, Sb 1·05=99·41 Behncke.
5. Andreasberg	70·59	1·65	28·67=100·91 Illing.

Pyr.—In the closed tube gives a sublimate of metallic arsenic; in the open tube a white sublimate of arsenous acid, with traces of sulphurous fumes. B.B. on charcoal gives the odor of arsenic; in O.F. a white coating of arsenous acid, and in R.F. a magnetic globule. With the fluxes the roasted mineral reacts only for iron.

Obs.—Occurs with copper nickel at Schladming; at Ehrenfriedersdorf, in Saxony; at Sätersberg, near Fossum, in Norway.

A crystal of arsenical iron, weighing two or three ounces, was found in Bedford Co., Penn., but it is not known under what circumstances; and in Randolph Co., N. C., a mass of nearly two pounds weight. Whether these were leucopyrite or lölingite is uncertain. Also found at Paris, Maine.

The name leucopyrite is derived from λευκός, *white*, and *pyrites*; it was given by Shepard in 1835.

92. **RAMMELSBERGITE.** Weissnickelkies *Hoffm.*, Pogg., xv. 491, 1829. Rammelsbergite *Dana*, Min., 61, 1854. [Not Rammelsbergite (Syn. of Chloanthite) *Haid.*, Handb., 1845.]

Orthorhombic; *I* ∧ *I*=123°—124°?

H.=5·25–5·75. G.=7·099–7·188 Breith. Slightly ductile. Otherwise like the preceding.

Comp.—Ni As^2, like chloanthite=Arsenic 71·7, nickel 28·3=100. Analysis: 1, Hoffmann (l. c.):

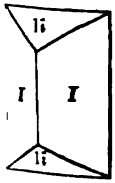
	As	Ni	Bi	Cu	S
Schneeberg	71·30	28·14	2·19	1·50	0·14=102·27

Pyr.—In the closed tube gives a sublimate of metallic arsenic; other reactions the same as with niccolite (p. 60).

Obs.—Occurs at Schneeberg and at Riechelsdorf. It was first separated from the isometric white nickel by Breithaupt.

93. **LEUCOPYRITE.** Syn. same as for LÖLLINGITE (p. 76), with also Glanzarsenikkies *Breith.*, J. pr. Ch., iv. 260, 261, 1835. Mohsine pt. *Chapman*, Pract. Min., 138, 1843. Löllingit pt. *Haid.*, 1845. Geierite (fr. Geyer) *Breith.*, B. H. Ztg., xxv. 167, 1866. Löllingite *Dana*, Min., 1868.

97A



Orthorhombic. Form like that of mispickel, 1-ī ∧ 1-ī=122° Rose, 122° 20′ Breith. Cleavage: rather perfect in one direction. Also massive.

H.=5–5·5. G.=6·2–7·43; 6·246 from Geyer; 7·00–7·228 from Reichenstein. In other physical characters like leucopyrite.

Comp.—Fe As+Fe As^2=Arsenic 66·8, iron 33·2=100. Analyses: 1, Meyer (Pogg., l. 154); 2, Karsten (Eisenhütt., ii. 19); 3, Weidenbusch (Rose's Kryst. Chem., 54); 4, Behncke (Pogg., xcviii. 187); 5, Hofmann (Pogg., xv. 485):

	As	S	Fe
1. Reichenstein	63·14	1·63	30·24, gangue 3·55=98·56 Meyer.
2. "	65·88	1·77	32·35=100 Karsten.
3. "	65·61	1·09	31·51, gangue 1·04=99·25 Weid.
4. Geyer	58·94	6·07	32·92, Sb 1·37=99·30 B.
5. Reichenstein	65·99	1·94	28·06, gangue 2·17=98·16 Hofmann.

The last analysis affords a composition intermediate between those of leucopyrite and lölingite The 4th is between this species and mispickel, and has been called *geyerite.* It is tin-white, wit black streak. G.=6·321—6·246 Behncke, 6·550 Breith.

Pyr.—Same as for leucopyrite.

Obs.—At Reichenstein in Silesia, in serpentine, with arsenopyrite; at Geyer in Saxony, i crystals, having distinctly the form of arsenopyrite, and massive, mixed with quartz; at Löling near Huttenberg in Carinthia, in siderite, along with bismuth and scorodite.

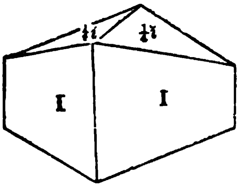
Named by Chapman after Mohs, by whom the mineral was first described, and who mention Löling as the first locality at which it was found; but as *mohsite* was previously given to a variet of menaccanite, Haidinger's name is here adopted.

94. ARSENOPYRITE, or MISPICKEL. ? Lapis subrutilus atque non fere aliter ac argent spuma splendens et friabilis, *Germ.* Mistpuckel, *Agric.*, Interpr., 465, 1546. Pyrites candidus Wasserkies pt., *Gesner*, Foss., 1565. Arsenikaliskkies, Mispickel, *Henckel*, Pyrit., 1725 Arsenikaliskkies, Hvit Kies (=Pyrites albus), Mispickel, Arsenik-Sten, *Wall.*, 227, 228, 1747 Mispickel, Pyrite blanche, *Fr. trl.* Wall., 1753. Arsenikkies *Wern.*, 1789. Rauschgelbkies Fer arsenical *Fr.* Arsenical Pyrites. Dalarnit, Giftkies, Glanzarsenikkies, *Breith.*, J. pr. Ch., iv. 259, 261, 1835. Arsenopyrite *Glock.*, Syn., 38, 1847.

Danaite=Cobaltic Mispickel (fr. Franconia) *Hayes*, Am. J. Sci., xxiv. 386, 1833. **Kobaltarsenikkies** *Germ.* ? Vermontit (fr. U. S.) *Breith.*, l. c. Akontit (fr. Sweden) *Breith.*, l. c. **Thalheimit**, Giftkies, *Breith.*, B. H. Ztg., xxv. 167, 1866.

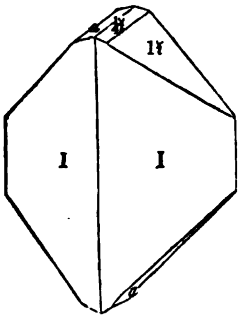
Orthorhombic. $I \wedge I=111° 53'$, $O \wedge 1\text{-}\bar{i}=119° 37'$; $a : b : c=1·7588$ 1 : 1·4793. But $I \wedge I$ varying from 111° to 112° 30′, and $1\text{-}\bar{i} \wedge 1\text{-}\bar{i}$ from 119° 30′ to 121° 30′. Observed planes: see f. 98, 99, 100.

98



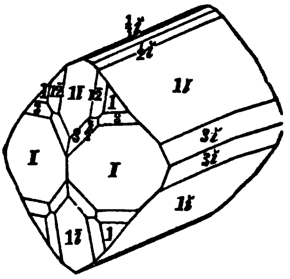
Franconia, N. H.

99



Franconia, N.H., and Kent, N.Y.

100



Danaite.

$O \wedge 1\text{-}2=118° 18'$
$O \wedge 1=115\ 12$
$O \wedge 3=98\ 55$
$O \wedge 3\text{-}\frac{3}{2}=99\ 37$

$O \wedge \frac{1}{3}\text{-}\breve{i}=158° 23'$
$O \wedge \frac{1}{2}\text{-}\breve{i}=149\ 16$
$O \wedge 1\text{-}\breve{i}=130\ 4$
$O \wedge 3\text{-}\breve{i}=105\ 40$

$1\text{-}\bar{i} \wedge 1\text{-}\bar{i}$, bas.,$=120° 46'$
$1\text{-}\breve{i} \wedge 1\text{-}\breve{i}$, bas.,$=99\ 52$
$3\text{-}\breve{i} \wedge 3\text{-}\breve{i}$, ib.,$=148\ 40$
$\frac{1}{2}\text{-}\breve{i} \wedge \frac{1}{2}\text{-}\breve{i}$, top,$=118\ 32$

Cleavage: I rather distinct; O, faint traces. Twins: composition-face I, and $1\text{-}\bar{i}$. Also columnar, straight, and divergent; granular, or compact.

H.=5·5—6. G.=6·0—6·4; 6·269, Franconia, Kenngott. Lustre metallic. Color silver-white, inclining to steel-gray. Streak dark grayish-black. Fracture uneven. Brittle.

Comp., Var.—$FeS^2 + FeAs^2 = Fe(As, S)^2$ = Arsenic 46·0, sulphur 19·6, iron 34·4=100. Part of the iron sometimes replaced by cobalt.

Var. 1. *Ordinary*. Containing little or no cobalt.

Breithaupt makes I ∧ I=111° 1′ and 1-ī ∧ 1-ī=120° 52′ for cryst. fr. Dalarne, Sweden (his *dalarnite*) and G.=5·66—5·69; 111° 27′ for id. fr. Freiberg, Chemnitz, Munzig, Villarica, Brazil, Riesengebirge, Zinnwald, Altenberg, with G.=5·839—6·053; 112° 4′ and 120° 30′, for id. fr. Thalheim near Stolberg in the Erzgebirge, Schlackenwald, Cornwall, with G.=6·155—6·221 (*giftkies* and *thalheimite*, Breith.). For M. of Mt. Sorata, G.=6·255 D. Forbes.

2. *Cobaltic: Danaite.* Containing 4 to 10 p. c. of cobalt, and giving the formula $(Co, Fe)(As, S)^2$. I ∧ I in cryst. fr. Franconia, N. H., 112° 1′—112°, 1-ī ∧ 1-ī=121° 30′, 1-ĭ ∧ 1-ī=100° 15′, Teschemacher; I ∧ I=112° 33′, 1-ī ∧ 1-ī=121° 20′, 1-ĭ ∧ 1-ĭ=99° 54′, Kenngott. In cryst. from Skutterud, I ∧ I=111° 40′—112° 2′, 1-ī ∧ 1-ī=121° 30′, Schoerer. *Vermontite* and *akontite* are cobaltiferous (Breith.). The vermontite is supposed to be from Vermont [Franconia?]; it gave him I ∧ I=111° 38′, and G.=6·207. The akontite is from Hokansbö and Vena, in Sweden, and gave I ∧ I=110° 29′, with G.=6·008 and 6·059. For D. from Mt. Sorata, fibrous, G.=6·94, granular 5·86, D. Forbes. The *danaite* was named after J. Freeman Dana, who first made known the Franconia locality.

3. *Niccoliferous.* Containing nickel.

4. *Argentiferous.* Containing a little silver, and occurring in acicular crystals (Weisserz pt. *Wern.*; Fer arsenical argentifère *H.* From Braünsdorf, in Saxony.

Analyses: 1, Stromeyer (Schw. J., x. 404); 2, Chevreul (Gill. Ann., xvii. 84); 3, Thomson (Ann. Lyc., N. York, iii. 85); 4, Baldo (Jahrb. Min., 1866, 594); 5, Weidenbusch (Rose's Kryst. Ch., 56); 6, v. Hauer (Jahrb. G. Reichs, iv. 400); 7, Freitag (Ramm. Min. Ch., 58); 8—11, Behncke (Pogg., xcviii. 184); 12, Potyka (Pogg., cvii. 304); 13, D. Forbes (Phil. Mag., IV. xxix. 6); 14, Krœber (ib., xxix. 8); 15 16, Winkler (B. H. Ztg., xxv. 167); 17, D. Forbes (l. c.); 18, Scheerer (Pogg., xlii. 546); 19, Wöhler (Pogg., xliii. 591); 20, A. A. Hayes (Am. J. Sci., xxiv. 386); 21, J. L. Smith (Gillis's Exped., ii. 102); 22, D. Forbes (l. c.):

		As	S	Fe	Co
1.	Freiberg	42·88	21·08	36·04	——=100 Stromeyer.
2.	"	43·418	20·132	34·938	——=98·488 Chevreul.
3.	"	45·74	19·60	33·98	——=99·32 Thomson.
4.	Orawicza	43·85	20 60	35·59	——=100·04 Baldo.
5.	Reichenstein	45·92	19·26	33·08	——, gangue 1·97=100·23 Weid.
6.	Muhlbach	45·00	21·36	33·52	——=99·88 Hauer.
7.	Johannisberg	41·91	21·14	36·95	——=100 Freitag.
8.	Sahla, Swed.	42·05	18·52	37·65	——, Sb 1·10=99·32 B. G.=5·82.
9.	Altenberg, Sil.	43·78	20·25	34·35	——, Sb 1·05=99·43 B. G.=6·042.
10.	Freiberg, Sax.	44·83	20·38	34·32	——=99·53 B. G.=6·046.
11.	Landeshuth, Sil.	44·02	19·71	34·83	——, Sb 0·92=99·54 B. G.=6·067.
12.	Sahla	43·26	19·13	34·78	——, Sb 1·29, Bi 0·14=98·60 Potyka. G.=6·095.
13.	Inquisivi	46·95	18·12	34·93	*tr.*=100 D. Forbes.
14.	Bolivia	43·68	16·76	34·93	0·09, Ni 4·74, Ag 0·09, Au 0·002, Sb *tr.*=100·202 Krœber.
15.	Thalheim	44·00	19·77	34·02	——, gangue 0·92=98·71 Winkler.
16.	Ehrenfriedersdorf	44·97	19·89	33·75	1·03, gangue 0·22=99·86 Winkler.
17.	Mt. Sorata	45·46	19·53	34·47	0·44, Ni 0·03, Mn 0·14=100·07 Forbes.
18.	Skutterud, *Cobaltif.*	46·76	17·34	26·36	9·01=100·47 Scheerer.
19.	" "	47·45	17·48	30·91	4·75=100·59 Wöhler.
20.	Franconia, *Danaite*	41·44	17·84	32·94	6·45=98·67 Hayes.
21.	Copiapo	44·30	20·25	30·21	5·84=100·60 Smith.
22.	Mt. Sorata	42·83	18·27	29·22	3·11, Ni 0·81, Mn 5·12, Bi 0·64=100 Forbes.

Jordan has analyzed arsenopyrite from near Andreasberg (J. pr. Chem., x. 436) and obtained As 55·000, S 8·344, Fe 36·437, Ag 0·011=99·792, giving nearly the formula $2 FeS + 3 FeAs^2$ = Arsenic 56·7, sulphur 8·0, iron 35·2=100. Jordan made out 3 As, S, 3 Fe, which requires arsenic 52·9, sulphur 7·5 iron 39·6=100.

Bæntsch obtained from an ore from the coal formation of Merseburg (ZS. Ver. Halle, vii. 372) As 38·23, S 21·70, Fe 35·97, S̈i 3·27, Mg, Ċa *trace*=99·17; G.=5·36—5·66; giving the formula

2 Fe As^2+3 Fe S^2. Analysis 11, by Behncke, corresponds to 7 Fe, 6 S, 6 As. The discrepancy in these cases may be owing to impurities.

Pyr., etc.—In the closed tube at first gives a red sublimate of sulphid of arsenic, then a black lustrous sublimate of metallic arsenic. In the open tube gives sulphurous fumes and a white sublimate of arsenous acid. B.B. on charcoal reacts like leucopyrite. The varieties containing cobalt give a blue color with borax-glass when fused in O.F. with successive portions of flux until all the iron is oxydized. Gives fire with steel, emitting an alliaceous odor. Decomposed by nitric acid with separation of arsenous acid and sulphur.

Obs.—Found principally in crystalline rocks, and its usual mineral associates are ores of silver, lead, and tin, pyrite, chalcopyrite, and blende. Occurs also in serpentine.

Abundant at Freiberg and Munzig, where it occurs in veins; at Reichenstein in Silesia, in serpentine; in beds at Breitenbrunn and Raschau, Andreasberg, and Joachimsthal; at Tunaberg in Swedon; at Skutterud in Norway; at Wheal Mawdlin and Unanimity, Cornwall, and at other localities; in Devonshire at the Tamar mines.

In *New Hampshire*, in fine crystallizations in gneiss, at Franconia (*danaite*) associated with chalcopyrite; also at Jackson, and at Haverhill. In *Maine*, at Blue Hill, Corinna; Newfield (Bond's mountain), and Thomaston (Owl's head). In *Vermont*, at Brookfield, Waterbury, and Stockbridge. In *Mass.*, at Worcester and Sterling. In *Conn.*, at Chatham, with smaltite and niccolite; at Monroe with wolfram and pyrite; at Derby in an old mine, associated with quartz; at Mine Hill, Roxbury, in fine crystals with siderite. In *New Jersey*, at Franklin. In *N. York*, massive, in Lewis, ten miles south of Keeseville, Essex Co., with hornblende; in crystals and massive, near Edenville, on Hopkins's farm, and elsewhere in Orange Co., with scorodite, iron sinter, and thin scales of gypsum; also in fine crystals at two localities a few rods apart, four or five miles north-west of Carmel, near Brown's serpentine quarry in Kent, Putnam Co. In *California*, Nevada Co., Grass valley, at the Betsey mine, and also at Meadow lake. with gold, the *danaite* in crystals sometimes penetrated by gold. In S. America, in the San Baldomero mine of Mt. Sorata in Bolivia, both the mispickel and danaite, the former having crystallized out of the latter and the most abundant ore: also both at Inquisivi in Bolivia; also, *niccoliferous* var., between La Paz and Yungas in Bolivia (anal. by Krœber).

Alt.—Pseudomorphs consisting of pyrite.

94A. PLINIAN.—Plinian *Breith.*, Pogg., lxix. 430, 1846, B. H. Ztg., xxv. 168, 1866. Var. of Mispickel *G. Rose*, Pogg., lxxvi. 84. Monoclinic, according to Breithaupt, who figures the planes, *P* (1-ĭ), *M* (ĭ-ĭ), *I*, with *h* between *P* and *I*, and *o* below *I*, in the same zone with *P*, *h*, *I*. $I \wedge I = 61°\ 30^2$, *P* to vertical axis $51°\ 36' = P \wedge M$, $P \wedge h = 146°\ 0'$, $M \wedge h = 134°\ 20'$, $o \wedge h = 115°\ 55'$, $o \wedge i = 117°\ 33'$, $o \wedge M = 103°\ 15'$, $h \wedge h = 119°\ 0'$, *P* on edge $hh = 161°\ 12'$, *M* on edge $hh = 114°\ 12'$. **Cleavage:** *P* and *M* distinct. Also massive.

H.=5·5—6. G.=6·272—6·292, fr. St. Gothard; 6·299—6·307. fr. Ehrenfried. Lustre metallic. Color tin-white; streak black.

Composition: Fe S^2+Fe As^2, or Fe (S, As)^2, like arsenopyrite. Analysis by Plattner (Pogg., lxix. 430): As 45·46, S 20·07, Fe 34·46=99·99.

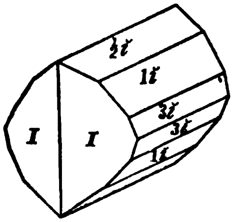
From Ehrenfriedersdorf in crystals, also from St. Gothard, according to Breithaupt.

95. GLAUCODOT. Glaucodot *Breith. & Plattn.*, Pogg., lxvii. 127, 1849.

Orthorhombic. $I \wedge I = 112°\ 36'$; form like that of arsenopyrite. Cleavage: basal perfect; prismatic less so. Also massive.

H.=5. G.=5·975—6·003. Lustre metallic. Color grayish tin-white. Streak black.

101



Comp.—(Co, Fe) S^2+(Co, Fe) As^2, with Co to Fe as 2 : 1 (or Co, Fe) (S, As)^2=Sulphur 19·4, arsenic 45·5, cobalt 23·8, iron 11·3=100. Analysis: Plattner (l. c.):

	As	S	Co[a]	Fe	
Chili	43·20	20·21	24·77	11·90	100·08 Plattner.

[a] With trace of nickel.

Pyr.—In the closed tube gives a faint sublimate of arsenous acid. In the open tube sulphurous fumes and a sublimate of arsenous acid. B.B. on charcoal in R.F. gives off sulphur and arsenic, fusing to a feebly magnetic globule, which is black on the surface, but on the fracture has a light bronze color and a metallic lustre. Treated with borax in R.F. until the globule has a bright metallic surface, the flux shows a strong reaction for iron; if the remaining globule is treated with a fresh portion of borax in O.F., the flux becomes colored smalt-blue from oxydized cobalt.

Obs.—Occurs in chlorite slate with cobaltite, in the province of Huasco, Chili. The supposed glaucodot of Orawicza is *alloclasite* (p. 81.)

96. PACITE. Rhombites Pacites, Pasit (fr. La Paz), *Breith.*, B. H. Ztg., xxv. 167, 1866.

Orthorhombic. $I \wedge I = 115° \ 24'$. $1\text{-}\bar{\imath} \wedge 1\text{-}\bar{\imath}$, over O, 119° 56′. Occurring planes O, I, $1\text{-}\bar{\imath}$. Measurements only approximative. Cleavage: I rather indistinct. Also massive.

H.=4—4·5. G.=6·297—6·303, Weisbach. Lustre metallic. Color tin-white, inclining to steel-gray; streak black.

Comp.—$\mathrm{Fe\,S^2 + 4\,Fe\,As^2}$ = Arsenic 63·56, sulphur 6·78, iron 29·66 = 100. Analysis by Winkler (l. c.):

As 64·84 S 7·01 Fe 24·35 Co 0·13 Cu 0·11 Bi 0·10 Au, Ag 0·006 gangue 2·88 = 99·426.

Obs.—From La Paz in Bolivia, in masses and thin plates in the gangue, with native gold and bismuth.

Named from the locality, or its Latin signification, *pax*, *peace*.

97. ALLOCLASITE. Alloklas *Tschermak*, Ber. Ak. Wien, liii. 220, 1866, Glaucodot pt. *Breith.*

Orthorhombic. $I \wedge I = 106°$; $O \wedge 1\text{-}\bar{\imath} = 118°$; $1\text{-}\bar{\imath} \wedge 1\text{-}\bar{\imath} = 58°$. Cleavage: O and I perfect.

H.=4·5. G.=6·6. Color steel-gray. Streak nearly black.

Comp.—$\mathrm{2\,Co\,S^2 + Co\,As^2 + 4\,Bi\,As}$, or a compound related to glaucodot and cobaltite + 4 Bi As; or $\mathrm{3\,Co\,S + 3\,Co\,As + 2\,As\,S^2}$, Tschermak.

Analyses: 1, Hein (l. c.); 2, 3, Hubert & Patera (Jahrb. Min., 1848, 325):

	S	As	Bi	Au	Fe	Zn	Co	Ni	
1. Orawicza	16·22	32·69	30·15	0·68	5·58	2·41	10·17	1·55	= 99·45 Hein.
2. "	16·60	37·20	18·40	tr.	4·85	——	25·60	——	= 102·65 Hubert.
3[a]. "	19·78	43·63	——	——	4·56	——	32·02	——	= 99·99 Patera.

[a] After subtracting gold, silica, and bismuth.

Pyr., etc.—B.B. on charcoal gives arsenic fumes, and a bismuth coating. Fuses to a dull globule. Soluble in nitric acid, leaving a residue of gold.

Obs.—Occurs at Orawicza, Hungary.

Named from ἄλλος, κλάω, because its cleavage differs from that of arsenopyrite and marcasite, which it resembles.

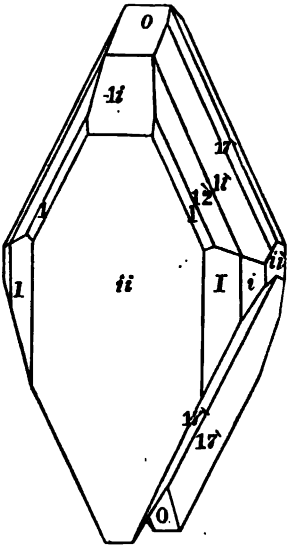
98. SYLVANITE. Weissgolderz *Müller v. Reichenstein*, Ph. Arb. eintr. Fr. Wien, Qu. 3, 48. Or blanc d'Offenbanya, ou graphique, Aurum graphicum, *v. Born*, Cat. de Raab, ii. 467, 1790. Prismatisches weisses Golderz *v. Fichtel*, Min. Bemerk. Carpathen, ii. 108, 1791, Min., 124, 1794; Aurum bismuticum *Schmeisser*, Min., ii. 28, 1795. Schrifterz *Esmark*, N. Bergm. J., ii. 10, 1798; *Wern.*, 1800. Sylvane graphique *Broch.*, 1800. Tellure ferrifère et aurifère *H.*, 1801. Schrift-Tellur *Hausm.*, 1813. Graphic Tellurium *Aikin*, 1814. Goldtellur. Telluro auro-argentifere *H.*, 1822. Sylvane *Beud.*, Tr., 1832. Sylvanit *Necker*, Min., 1835. Aurotellurite *Dana*, Min., 390, 1837.

Or gris jaunatre *v. Born*, l. c., 1790. Gelberz *Karsten*, Tab., 56, 1800. Sylvane blanc *Broch.*, 1800. Tellure aurifère et plombifère pt. *H.*, 1801. Weiss-Sylvanerz *Wern.*, 1800, Ludwig, i. 55, 1803. Weisstellur *Hausm.*, 1813. Yellow Tellurium *Aikin*, 1814. Müllerine *Beud.*, Tr., ii. 541, 1832. Müllerite.

Monoclinic, Rose, Koksch. $C = 55° \ 21\tfrac{1}{2}'$, $I \wedge I = 94° \ 26'$, $O \wedge 1\text{-}\grave{\imath} = 121° \ 21'$; $a : b : c = 1{\cdot}7732 : 1 : 0{\cdot}889$, Koksch. Observed planes: O; vertical, I, $i\text{-}i$, $i\text{-}\grave{\imath}$, $i\text{-}\grave{2}$; domes, $-1\text{-}i$, $\tfrac{1}{2}\text{-}\grave{\imath}$, $1\text{-}\grave{\imath}$; octahedral, $\tfrac{1}{2}\text{-}\grave{2}$, $1\text{-}\grave{2}$, $1\text{-}\grave{7}$.

$$
\begin{array}{lll}
O \wedge i\text{-}i = 124° \ 39\tfrac{1}{2}' & i\text{-}i \wedge I = 137° \ 13' & i\text{-}i \wedge 1\text{-}\grave{2} = 128° \ 24' \\
O \wedge -1\text{-}i = 144 & i\text{-}\grave{\imath} \wedge i\text{-}\grave{2} = 151 \ \ 37 & i\text{-}i \wedge i\text{-}\grave{\imath} = 107 \ \ 12 \\
O \wedge 1 = 132 \ \ 26\tfrac{1}{2} & i\text{-}i \wedge 1 = 141 \ \ 54 & i\text{-}i \wedge 1\text{-}7 = 99 \ \ 44\tfrac{1}{2}
\end{array}
$$

102



Cleavage: *i-i* distinct. Twins: composition face *i-i*, as in the figure. Also massive; imperfectly columnar to granular.

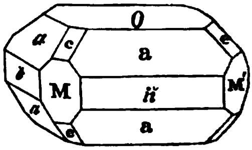
H.=1·5–2. G.=7·9–8·33; 8·28, Petz. Lustre metallic. Streak and color pure steel-gray to silver-white, and sometimes nearly brass-yellow. Fracture uneven.

Comp., Var.—(Ag, Au) Te^3= (if Ag : Au=1 : 1) Tellurium 55·8, gold 28·5, silver 15·7=100. Antimony sometimes replaces part of the tellurium, and lead part of the other metals.

Var. 1. *Sylvanite.* (Schrifterz *Wern.*, etc., 1st par. Syn.) Containing little or no lead. G.=7·5—8·5. Anal. 1–7. The angles given above are of this variety, and are from Kokscharof.

2. *Müllerite.* Gelberz *Karsten*, Weisstellur *Wern.*, etc., 2d par. Syn.) Containing much lead. Anal. 8–10. Haidinger gives the annexed figure and angles for the *weisstellur*, making it different in dimensions from the preceding. M ∧ M=105° 30′, O ∧ a=108° 30′, O ∧ *a*=143° 5′. It is from Nagyag. G.=7·99–8·33. The yellow color does not distinguish the two varieties, and the propriety of separating them is doubtful. Much of the so-called *gelberz* (yellow ore) is not mullerite, as shown by Petz's analyses.

103.



Analyses: 1, Klaproth (Beitr., iii. 16); 2, Berzelius (Jahresb., xiii. 162, analysis imperfect); 3–9, Petz (Pogg., lvii. 472); 10, Klaproth (Beitr., iii. 20):

		Te	Sb	Au	Ag	Pb
1. Offenbanya		60·	——	30·	10·	——=100 Klaproth.
2. "		52·	*tr.*	24·0	11·3	1·5, Cu, Fe, S, As *tr.* B.
3. "	G.=8·28	59·97	0·58	26·97	11·47	0·25, Cu 0·76=100 P.
4. "		58·81	0·66	26·47	11·31	2·75=100 Petz.
5. *White cryst.*	G.=8·27	55·39	2·50	24·89	14·68	2·54=100 Petz.
6. "	G.=7·99	48·40	8·42	28·98	10·69	3·51=100 Petz.
7. *Yellow cryst.*	G.=8·33	51·52	5·75	27·10	7·47	8·16=100 Petz.
8. " *massive*		44·54	8·54	25·31	10·40	11·21=100 Petz.
9. " "		49·96	3·82	29·62	2·78	13·82=100 Petz.
10. Müllerite, *Gelberz*		44·75	——	26·75	8·50	19·50, S 0·5=100 K.

Pyr., etc.—In the open tube gives a white sublimate, which near the assay is gray; when treated with the blowpipe flame the sublimate fuses to clear transparent drops. B.B. on charcoal fuses to a dark-gray globule, covering the coal with a white coating, which treated in R.F. disappears, giving a bluish-green color to the flame; after long blowing a yellow, malleable metallic globule is obtained. Most varieties give a faint coating of oxyd of lead and antimony on charcoal.

Obs.—With gold, at Offenbanya in Transylvania, in narrow veins, which traverse porphyry; also at Nagyag in the same country. In California, Calaveras Co., at the Melones and Stanislaus mines.

Named from Transylvania, the country in which it occurs, and in allusion to *sylvanium*, one of the names at first proposed for the metal tellurium. Called *graphic* because of a resemblance in the arrangement of the crystals to writing characters.

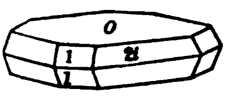
For Kokscharof's paper on cryst., see Bull. Ac. St. Pet., ix. 192. His *b*, *c*, *a* are *c*, *a*, *m* of Brooke and Miller.

99. NAGYAGITE. Aurum Galena, Ferro, et particulis volatilibus mineralisatum, *Scopoli*, Ann. Hist. Nat., iii. 107; *v. Born*, Lithoph., i. 68, 1772. Nagiakererz *Wern.* Bergm. J., 1789. Or gris lamelleux *v. Born*, Cat. de Raab, 1790. Blättererz *Karst.*, Tab., 56, 1800. Foliated Tellurium; Black Tellurium. Elasmose *Beud.*, Tr., ii. 539, 1832. Elasmosine *Huot*, Min., i. 185. 1841. Nagyagite *Haid.*, Handb., 566, 1845.

Tetragonal. *O* ∧ 1-*i*=127° 37′; *a*=1·298. Observed planes as in the annexed figure. *O* ∧ 1=118° 37′, 1 ∧ 1=103° 14′, *O* ∧ 2-*i*=111° 4′, 2-*i* ∧ 2-*i*, bas.,=137° 52′. Cleavage: basal. Also granularly massive, particles of various sizes; generally foliated.

H.=1—1·5. G.=6·85—7·2. Lustre metallic, splendent. Streak and color blackish lead-gray. Opaque. Sectile. Flexible in thin laminæ.

104



Comp.—Analyses: 1, Klaproth (Beitr., iii. 32); 2, Brandes (Schw. J., xxxv. 409); 3, P. Schönlein (J. pr. Ch., lx. 166); 4, 5, Folbert (Verh. Sieb. Ver. Nat. Hermannstadt, viii. 99, and Kenng. Ueb., 1856); 6, S. J. Kappel (Jahresb., 1859, 770):

	Te	S	Pb	Au	Ag	Cu
1.	32·2	3·0	54·0	9·0	0·5	1·3=100 Klaproth.
2.	31·96	3·07	55·49	8·44	*tr.*	1·14=100·10 Brandes.
3.	30·52	8·07	50·78	9·11	0·53	0·99=100 Schönlein.
4.	17·22	9·76	60·83	5·84	——	—— Sb 3·69, Se *tr.*=97·34 Folbert.
5.	18·04	9·68	60·27	5·98	——	—— Sb 3·86, Se *tr.*=97·83 Folbert.
6.	15·11	8·56	60·10	12·75	1·82	—— Se 1·66=100 Kappel.

Schönlein found in other trials, Pb 51·01, 51·06, Te 26·67, S 9·62, 10·59; and Petz obtained (Pogg., lvii. 478), 8·54, 7·81, 6·48 per cent. of gold. Schönlein's and Folbert's analyses (3–5) correspond to 2 (Pb, Au)+3 (Te, Sb, S) Ramm. In Schönlein's, Te : S=1 : 3 nearly; in Folbert's Te+Sb : S=1 : 2. The formula for the latter may be written R Te + R S^3.

Pyr., etc.—In the open tube gives, near the assay, a grayish sublimate of antimonate and tellurate, with perhaps some sulphate of lead; farther up the tube the sublimate consists of antimonous acid, which volatilizes when treated with the flame, and tellurous acid, which at a high temperature fuses into colorless drops. B.B. on charcoal forms two coatings: one white and volatile, consisting of a mixture of antimonite, tellurite, and sulphate of lead; and the other yellow, less volatile, of oxyd of lead quite near the assay. If the mineral is treated for some time in O.F. a malleable globule of gold remains; this cupelled with a little assay lead assumes a pure gold color. Decomposed by nitro-muriatic acid.

Obs.—At Nagyag and Offenbanya in Transylvania, in foliated masses and crystalline plates, accompanying, at the former place, rhodonite, blende, and gold; and at the latter, associated with antimonial ores. Folbert states that the Nagyag crystals examined by him were hexagonal and not of the tetragonal system, and had G.=6·680, or not exceeding this.

Berthier has analyzed another ore very similar to the above in physical characters, consisting of Tellurium 13·0, sulphur 11·7, lead 63·1, gold 6·7, antimony 4·5, copper 1·0=100; corresponding to 21S, 6Te, 4Sb, 18Pb, 2Au, but probably impure with sulphuret of antimony. It is called *Blatterine* by Huot, Min., i. 189, 1841.

(A) SILBERPHYLLINGLANZ *Breith.* (Schw. J., i. 178, 1828), occurring in gneiss at Deutsch-Pilsen, Hungary, appears to be related to nagyagite. Its color is blackish-gray; structure foliated massive, it having one perfect cleavage; H.=1·2; G.=5·8—5·9.

According to Plattner (Probirkunst, 3d edit., 421) the constituents are antimony, lead, tellurium, gold, silver, and sulphur—4·9 p. c. of gold, 0·3 of silver—the sulphur probably in combination with the antimony and lead. Only a trace of selenium was found, contrary to the earlier determinations of Harkort and Breithaupt.

100. COVELLITE. *Freiesleben*, Geogn. Arb., iii. 129 (fr. Sangerhausen); Kupferindig *Breith.*, in Hoffm. Min., iv. 2, 178, 1817. Indigo-Copper; Blue Copper. Covelline, Sulfure de cuivre du Vesuve, *Beud.*, ii. 409, 1832. Breithauptite *Chapm.*, Min., 125, 1843. Cantonite *Pratt*, Am. J. Sci., II. xxii. 449, xxiii. 409.

Hexagonal. Observed planes: *O*, *I*; with faces of two hexagonal pyramids 1 and ¼; basal edge of 1,155° 24′; 1 ∧ ¼=150° 24′ Kenngott. Cleavage: basal, very perfect. Rarely in crystals. Commonly massive or spheroidal; surface, sometimes crystalline.

H.=1·5—2. G. of crystals=4·590, 4·636, Zepharovich. Lustre of crystals submetallic, inclining to resinous, a little pearly on cleavage-face; subresinous or dull when massive. Color indigo-blue or darker. Streak lead-gray to black, shining. Opaque. Thin leaves, flexible.

Comp.—$\text{Ꞓu}\ S^2$=$Cu\ S$=Sulphur 33·5, copper 66·5=100. Analyses: 1, Walchner (Schw. J., xlix. 158); 2, Covelli (Ann. Ch. Phys., xxxv. 105); 3, C. v. Hauer (Ber. Ak. Wien, xii. 22):

	S	Cu	Fe
1. Badenweiler	32·64	64·773	0·462, Pb 1·046=98·921 Walchner.
2. Vesuvius	32·0	66·0	——=98·0 Covelli.
3. Leogang	34·30	64·56	1·14=100 Hauer.

A Dillenberg covellite afforded Grimm (Jahresb., 1850, 702) 66·82 bisulphid of copper, 3·96 pyrite, 18·63 quartz, and 10·57 $\overline{F}e\ \ddot{M}n\ \dot{H}$.

Analysis of ore of Algodon bay, Bolivia, by v. Bibra, in J. pr. Ch., xcvi. 202.

Pyr.—In the closed tube gives a sublimate of sulphur; in the open tube sulphurous fumes. B.B. on charcoal burns with a blue flame, emitting the odor of sulphur, and fuses to a globule, which reacts like chalcocite.

Obs.—With other copper ores near Badenweiler at Leogang in Salzburg, where it is sometimes in small crystals of the form above described; at Kielce in Poland; Sangerhausen in Saxony; Mansfeld, Thuringia; Vesuvius, on lava; common in Chili; at Algodon bay in Bolivia.

Named after Covelli, the discoverer of the Vesuvian covellite, by Beudant, and without reference to the ore as previously described.

Covellite is a result of the alteration of other ores of copper, and is often mixed with chalcocite or copper-glance, from which it has been derived. (See *Digenite* and *Carmenite*, p. 53.)

(A) CANTONITE is covellite from the Canton mine, Georgia, occurring in cubes, with a cubical cleavage. It is associated with *harrisite* (pseudomorphs of chalcocite after galenite, see p. 53), and is regarded by Genth as a pseudomorph of covellite after the harrisite. Genth obtained in his analysis (l. c., xxiii. 417), S 32·76, Se *trace*, Ag 0·36, Cu 65·60, Pb 0·11, Fe 0·25, insoluble 0·16 =99·24.

(B) ALISONITE *Field*.—Alisonite is an indigo-copper, containing a much larger proportion of lead than the cantonite; but it is probably, like that, a result of the alteration of galenite. The color is a deep indigo-blue, tarnishing on exposure; G.=6·10; H.=2·5—3. Analyses by F. Field (1, Am. J. Sci., II. xxvii. 387; and 2, J. Ch. Soc., xiv. 160):

	S	Cu	Pb
1.	17·00	53·63	28·25=98·88
2.	17·69	53·28	28·81=99·78

Corresponding to 3 $\text{Ꞓu}\ S + Pb\ S$=S 17·78, Cu 53·34, Pb 28·88. It occurs at "Mina Grande" near Coquimbo, Chili, associated with cerussite, malachite, and vanadate of lead and copper.

3. SULPHARSENITES, SULPHANTIMONITES, SULPHO-BISMUTHITES.*

The species here included are arranged according to the amount of the basic metal (lead, silver, copper, iron), beginning with those in which the proportion is the smallest. Several of the species require more investigation:

	R : S : A	R : S+A	F
101. CHALCOSTIBITE, III.	1 : 4 : 2	1 : 6	$\text{Ꞓu}\ S + Sb^2S^3$
102. EMPLECTITE, III.	1 : 4 : 2	1 : 6	$\text{Ꞓu}\ S + Bi^2S^3$
103. CHIVIATITE, III.	? 1 · 5½ : 3		? $(\text{Ꞓu}, Pb)\ S + \frac{2}{3}\ Bi^2S^3$

---

* In the table of species the system of crystallization is indicated by Roman numerals

I. Isometric System.
II. Tetragonal System.
III. Orthorhombic System.
IV. Monoclinic System.
V. Triclinic System.
VI. Hexagonal System.

	R : S : A	R : S+A	F
104. BERTHIERITE, III.	1 : 4 : 2	1 : 6	Fe S+Sb^{2}S^3
105. SARTORITE, III.	1 : 4 : 2	1 : 6	Pb S+As^{2}S^3
106. ZINKENITE, III.	1 : 4 : 2	1 : 6	Pb S+Sb^{2}S^3
107. JORDANITE, III.			
108. MIARGYRITE, IV.	1 : 4 : 2	1 : 6	Ag S+Sb^{2}S^3
109. PLAGIONITE, IV.	1 : $\frac{17}{5}$: $\frac{8}{5}$	1 : 5	Pb S+Sb^{2}S^3+$\frac{1}{4}$ Pb S
110. BINNITE, I.	? 1 : 3 : $\frac{4}{3}$	1 : 4$\frac{1}{3}$	$\frac{3}{2}$ Ꞓu S+As^{2}S^3
111. BRONGNIARDITE, I.	1 : $\frac{5}{2}$: 1	1 : 3$\frac{1}{2}$	2 (Pb, Ag) S+Sb^{2}S^3
112. JAMESONITE, III.	1 : $\frac{5}{2}$: 1	1 : 3$\frac{1}{2}$	2 (Pb, Fe) S+Sb^{2}S^3
113. DUFRENOYSITE, III.	1 : $\frac{5}{2}$: 1	1 : 3$\frac{1}{2}$	2 Pb S+As^{2}S^3
114. FREIESLEBENITE, IV.	1 : $\frac{11}{5}$: $\frac{4}{5}$	1 : 3	$\frac{5}{2}$ (Pb, Ag) S+Sb^{2}S^3
115. PYROSTILPNITE, IV.			
116. RITTINGERITE, IV.			
117. PYRARGYRITE, VI.	1 : 2 : $\frac{2}{3}$	1 : 2$\frac{2}{3}$	3 Ag S+Sb^{2}S^3
118. PROUSTITE, VI.	1 : 2 : $\frac{2}{3}$	1 : 2$\frac{2}{3}$	3 Ag S+As^{2}S^3
119. BOURNONITE, III.	1 : 2 : $\frac{2}{3}$	1 : 2$\frac{2}{3}$	3 (Ꞓu, Pb) S+Sb^{2}S^3
120. STYLOTYPITE, III.	1 : 2 : $\frac{2}{3}$	1 : 2$\frac{2}{3}$	3 (Ꞓu, Ag, Fe) S+Sb^{2}S^3
121. WITTICHENITE, III.	1 : 2 : $\frac{2}{3}$	1 : 2$\frac{2}{3}$	3 Ꞓu S+Bi^{2}S^3
122. BOULANGERITE, III.	1 : 2 : $\frac{2}{3}$	1 : 2$\frac{2}{3}$	3 Pb S+Sb^{2}S^3
123. KOBELLITE, III.	1 : 2 : $\frac{2}{3}$	1 : 2$\frac{2}{3}$	3 Pb S+(Bi, Sb)^{2}S^3
124. AIKINITE, III.	1 : 2 : $\frac{2}{3}$	1 : 2$\frac{2}{3}$	3 (Ꞓu, Pb) S+Bi^{2}S^3
125. TETRAHEDRITE, I.	1 : $\frac{7}{4}$: $\frac{2}{4}$	1 : 2$\frac{1}{4}$	4 (Ꞓu, Ag, Hg) S+(Sb, As)^{2}S^3
126. POLYTELITE			
127. TENNANTITE, I.	1 : $\frac{7}{4}$: $\frac{2}{4}$	1 : 2$\frac{1}{4}$	4 (Ꞓu, Fe) S+As^{2}S^3
128. MENEGHINITE, IV.	1 : $\frac{7}{4}$: $\frac{2}{4}$	1 : 2$\frac{1}{4}$	4 Pb S+Sb^{2}S^3
129. GEOCRONITE, III.	1 : $\frac{8}{5}$: $\frac{2}{5}$	1 : 2	5 Pb S+(Sb, As)^{2}S^3
130. STEPHANITE, III.	1 : $\frac{8}{5}$: $\frac{2}{5}$	1 : 2	5 Ag S+Sb^{2}S^3
131. POLYBASITE, III.	1 : $\frac{13}{10}$: $\frac{2}{10}$	1 : 1$\frac{1}{2}$	10 (Ag, Ꞓu) S+(Sb, As)^{2}S^3
132. ENARGITE	1 : 4 : 3		3 Ꞓu S+As^{2}S^5
133. XANTHOCONITE			

APPENDIX.—134. CLAYITE, I. Pb, Cu, S, As, Sb. 135. BOLIVIANITE, III. Ag, S, Sb.

101. CHALCOSTIBITE. Kupferantimonglanz *Zinken*, Pogg., xxxv. 357, 1835. Sulphuret of Copper and Antimony; Antimonial Copper. Rosite *Huot*, Min. i. 197, 1841. Chalkostibit *Glock.*, Syn., 32, 1847. Wolfsbergite *Nicol*, Min., 484, 1849.

Orthorhombic. $I \wedge I = 101°$, $i\text{-}\breve{2} \wedge i\text{-}\breve{2} = 138° 12'$, $i\text{-}\breve{2} \wedge i\text{-}\breve{\imath} = 112° 24'$. In small aggregated tabular prisms presenting the planes O, I, $i\text{-}\breve{2}$, $i\text{-}\breve{\imath}$. Cleavage: $i\text{-}\breve{\imath}$, very perfect; O, less so.

H.=3—4. G.=4·748, H. Rose; 5·015, Breith. Lustre metallic. Streak black. Color between lead-gray and iron-gray. Opaque. Fracture conchoidal.

Comp.—Ꞓu S+Sb^2 S^3=Sulphur 25·7, antimony 48·9, copper 25·4=100. Analyses: 1, H. Rose (l. c.); 2, T. Richter (B. H. Ztg., 1857, No. 27):

	S	Sb	Cu	Fe	Pb
1. Wolfsberg	26·34	46·81	24·46	1·39	0·56=99·56 Rose.
2. Guadiz	25·29	48·30	25·36	1·23	——=100·18 Richter.

The iron is supposed to exist as pyrite, and the lead as feather ore.

Pyr., etc.—In the closed tube decrepitates at first, and then fuses, giving a faint sublimate of sulphid of antimony, which on cooling is dark red; in the open tube gives sulphurous and antimonous fumes, the latter forming a white sublimate. B.B. on charcoal fuses to a globule, emitting antimonous fumes, coating the coal white; the globule treated with borax reacts for iron; with soda gives a globule of metallic copper.

Decomposed by nitric acid, with separation of sulphur and oxyd of antimony.

Obs.—From Wolfsberg in the Harz, in nests imbedded in quartz; and at Guadiz, Spain. It is usually covered with a coating of pyrite. Glocker's name antedates Nicoll's. *Rosite* has an earlier use.

102. EMPLECTITE. Wismuth-Kupfererz (fr. Tannenbaum) *Selb*, Tasch. Min., xi. 441, 451 1817. Kupferwismuthglanz *R. Schneider*, Pogg., xc. 166, 1853. Emplektit *Kenng.*, Min. Forsch., 125, 1853. Tannenite *Dana*, Min., 73, 1854. Hemichalcit *v. Kob.*, Gesch. Min., 600, 1864.

Orthorhombic. $I \wedge I=92^\circ\ 20'$, $O \wedge 1\text{-}\bar{i}=141^\circ\ 8'$. In thin striated flattened prisms. Observed planes, I, $i\text{-}\bar{i}$, $i\text{-}\frac{\bar{3}}{2}$, $i\text{-}\frac{\bar{6}}{5}$, $i\text{-}\breve{2}$, $i\text{-}\breve{7}$, $1\text{-}\bar{i}$, $\frac{1}{3}\text{-}\bar{i}$. $i\text{-}\bar{i} \wedge 1\text{-}\bar{i}=128^\circ\ 52'$, $i\text{-}\bar{i} \wedge \frac{1}{3}\text{-}\bar{i}=104^\circ\ 55'$, $i\text{-}\bar{i} \wedge i\text{-}\frac{\bar{3}}{2}=147^\circ\ 23'$, $i\text{-}\bar{i} \wedge i\text{-}\breve{2}=117^\circ\ 30'$, $i\text{-}\frac{\bar{3}}{2} \wedge i\text{-}\frac{\bar{3}}{2}=114^\circ\ 46'$, $i\text{-}\breve{2} \wedge i\text{-}\breve{2}$, ov. $i\text{-}\bar{i}=55^\circ$, $1\text{-}\bar{i} \wedge 1\text{-}\bar{i}$, top, $=102^\circ\ 16'$.

Lustre bright metallic. Color grayish to tin-white.

Comp.—Ɵu S + $Bi^2\,S^3$=Sulphur 19·1, bismuth 62·0, copper 18·9=100. Analyses: R. Schneider (Pogg., xc. 166):

(½) Sulphur 18·83	Bismuth 62·16	Copper 18·72=99·71	
" 22·4	" 52·7	" 20·6	Iron 4·1=99·8

Pyr., etc.—In the open tube gives sulphurous fumes. B.B. on charcoal fuses easily, with frothing and spirting; treated with soda coats the coal dark-yellow from oxyd of bismuth, and gives a globule of copper.

Decomposed by nitric acid, with separation of sulphur.

Obs.—From the mines of Tannenbaum, near Schwarzenberg, Saxony; also from Cerro Blanco in Copiapo, Chili (Ann. d. M., IV. v. 459).

On cryst., see Dauber, Pogg., xcii. 241; Weisbach, Pogg., cxxviii. 435.

103. CHIVIATITE. Chiviatit *Ramm.*, Pogg., lxxxviii. 320.

Foliated massive; cleavable in three directions in one zone, one making an angle with the second of 153°, and with the third of 133°, Miller.

G.=6·920. Lustre metallic. Color lead-gray,

Comp.—(Ɵu, Pb) S + $\frac{3}{2}$ $Bi^2\,S^3$=Sulphur 17·76, bismuth 62·96, lead 16·72, copper 2·56=100 Analysis by Rammelsberg (l. c.):

S	Bi	Pb	Cu	Fe	Ag	insol.
18·00	60·95	16·73	2·42	1·02	*tr.*	0·59=99·71

Pyr.—Same as for aikinite, Ramm.

Obs.—From Chiviato, in Peru; along with pyrite and barite. Resembles bismuth-glance.

104. BERTHIERITE. Haidingerite *Berthier*, Ann. Ch. Phys., xxxv. 351, 1827. Berthierit *Haid.*, Ed. J. Sci., vii. 353, 1827.

In elongated prisms or massive; a longitudinal cleavage rather indistinct. Also fibrous massive, plumose; also granular.

H.=2—3. G.=4—4·3. Lustre metallic, less splendent than stibnite. Color dark steel-gray, inclining to pinchbeck-brown; surface often covered with iridescent spots.

Comp.—Fe S + $Sb^2\,S^3$=Sulphur 29·9, antimony 57·0, iron 13·1=100. Analyses: 1, 2, 3, Berthier (Ann. Ch. Phys., xxxv. 51); 4, Rammelsberg (Pogg., xl. 153); 5, Pettko (Haid. Ber., i 62); 6, v. Hauer (Jahrb. G. Reichs., iv. 635); 7, Sackur (Ramm., Min. Chem., 988); 8, Ramm. (ZS. G., xviii. 244):

	S	Sb	Fe	Zn
1. Chazelles	30·3	52·0	16·0	0·30=98·6 Berthier.
2. Martouret	28·81	61·34	9·85	——=100 Berthier.
3. Anglar	29·18	58·65	12·17	——=100 Berthier

	S	Sb	Fe	Zn
4. Bräunsdorf	31·32	54·70	11·43	0·74, Mn 2·54=100·73 Ramm.
5. Arany Idka	29·27	57·88	12·85	——=100 Pettko. G.=4·043.
6. Bräunsdorf	30·53	59·31	10·16	——=100·73 Hauer.
7. "	28·77	56·91	10·55	—— Mn 3·73=99·96 Sackur.
8. S. Antonio, Cal.	29·12	56·61	10·09	—— Mn 3·56=99·38 Ramm.

Anal. 3–8 correspond to the above formula.

No. 1=$3FeS+2Sb^2S^3$=Sulphur 30·5, antimony 51·7, iron 17·8=100.
No. 2=$3FeS+4Sb^2S^3$=Sulphur 29·6, antimony 60·0, iron 10·4=100.

Pyr., etc.—In the closed tube fuses, and gives a faint sublimate of sulphur; with a strong heat yields a black sublimate of sulphid of antimony, which on cooling becomes brownish-red. In the open tube gives off fumes of sulphur and antimony, reacting like stibnite. B.B. on charcoal gives off sulphur and antimony fumes, coats the coal white, and the antimony is expelled, leaving a black magnetic slag, which with the fluxes reacts for iron.

Dissolves readily in muriatic acid, giving out sulphuretted hydrogen.

Obs.—At Chazelles and Martouret in Auvergne, associated with quartz, calcite, and pyrite; in the Vosges, Commune of Lalaye, containing about 32 of Sb to 18 of Fe; at Anglar in La Creuse; also at Bräunsdorf in Saxony, and at Padstow in Cornwall; at Arany Idka in Hungary; at Real San Antonio, Lower California, massive; near Fredericton, N. Brunswick.

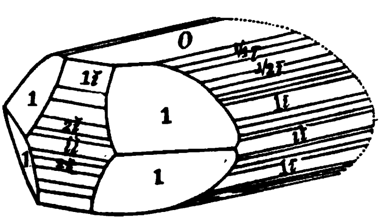
Yields antimony, but of inferior quality.

105. SARTORITE. Skleroklas + Arsenomelan *v. Waltershausen*, Pogg., xciv. 115, 1855, c. 537. Skleroklas *v. Rath*, ib., cxxii. 380. Binnit *C. Heusser*, Pogg. xciv. 335, 1855, xcvii. 120. Dufrenoysite, pt., *Duf.*, Tr., pl. 235, f. 66. *Descl.*, Ann. d. M., V. viii. 389, 1855. Arsenomelan *Petersen*, Offenb. Ver., vii. 13, 1866. Sartorite *Dana*.

Orthorhombic. $I \wedge I$=123° 21′, $O \wedge$ 1-ī=131° 3′; $a : b : c$=1·1483 : 1 : 1·8553. Observed planes: O (broad); in zone *i*-ī (all narrow, the crystals elongated and channelled in this direction) $\frac{1}{8}$-ī, $\frac{1}{4}$-ī, $\frac{6}{14}$-ī, $\frac{5}{11}$-ī, ? $\frac{1}{2}$-ī, $\frac{5}{9}$-ī, $\frac{4}{7}$-ī, $\frac{4}{5}$-ī, 1-ī, $\frac{5}{4}$-ī, $\frac{5}{3}$-ī, ? 5-ī, 10-ī, *i*-ī; in zone *i*-ĭ, 1-ĭ, ^{4}-ĭ, $\frac{3}{2}$-ĭ, 2-ĭ, 4-ĭ, *i*-ĭ; 1 (large planes), v. Rath.

$O \wedge 1$=127° 28½′, calc.
$O \wedge 1$=126 40, meas.
$O \wedge$ 1-ī=130 15, meas.
$O \wedge$ 2-ī=128 56.
1 ∧ 1, brach.,=91 22
1 ∧ 1, macrod.,=135 46
1 ∧ 1, bas.,=105 3
1 ∧ 1-ĭ=135 41
1 ∧ 1-ī=157 53

105



Crystals slender. Cleavage: O quite distinct.

H.=3. G.=5·393. Lustre metallic. Color dark lead-gray; streak reddish-brown. Opaque. Brittle.

Comp.—$PbS+As^2S^3$=Sulphur 26·39, arsenic 30·93, lead 42·68=100. Analyses: 1, Waltershausen (Pogg., xcvii. 124); 2, 3, Stockar-Escher (Kenng. Ueb., 56–57, 176):

	S	As	Pb	Ag	Fe
1. Binnen	25·91	28·56	44·56	0·42	0·45=99·90 Walt.
2.	25·30	26·33	46·83	1·62	——=100·08 S.-E.
3. "	25·77	26·82	47·39	——	——=99·98 S.-E.

Von Waltershausen states that his analysis (No. 1) was made on striated crystals, which proves it to pertain to this species as defined by v. Rath (l. c.). The other two analyses by Stockar-

Escher may have been made on material containing portions of the other prismatic species of the locality; yet in the sulphur and arsenic they agree with the other analysis, and diverge but little in the lead.

Pyr., etc.—Nearly the same as for dufrenoysite, but differing in strong decrepitation.

Obs.—From the Binnin valley with dufrenoysite and binnite. As the name Scleroclase is inapplicable, and the mineral was first announced by Sartorius v. Waltershausen, the species may be appropriately called *Sartorite*.

106. ZINKENITE. Zinkenit *G. Rose*, Pogg., vii. 91, 1826.

Orthorhombic. $I\wedge I=120° 39'$, Rose; $120° 34'$, Kenngott. Usual in twins, as hexagonal prisms, with a low hexagonal pyramid at summit; angle at pyramidal edge$=165$ $26'$; I on face of pyramid$=104° 42'$. Lateral faces longitudinally striated. Sometimes columnar, fibrous, or massive. Cleavage not distinct.

H.=3–3·5. G.=5·30–5·35. Lustre metallic. Color and streak steel-gray. Opaque. Fracture slightly uneven.

Comp.—$PbS+Sb^2S^3$=Sulphur 22·1, antimony 42·6, lead 35·3=100. Analyses: 1, 2, H. Rose Pogg., viii. 99); 3, Kerl (B. H. Ztg., 1853, No. 2):

1. Wolfsberg	S 22·58	Sb 44·39	Pb 31·84	Cu 0·42=99·23	Rose.
2. "	*undet.*	44·11	31·97	*undet.*	Rose.
3. "	21·22	43·98	30·84	Ag 0·12, Fe 1·45=97·61	K.

Pyr., etc.—Decrepitates and fuses very easily; in the closed tube gives a faint sublimate of sulphur, and sulphid of antimony; in the open tube sulphurous fumes and a white sublimate of oxyd of antimony. B.B. on charcoal is almost entirely volatilized, giving a coating which on the outer edge is white, and near the assay dark yellow; with soda in R.F. yields globules of lead.

Soluble in hot muriatic acid with evolution of sulphuretted hydrogen and separation of chlorid of lead on cooling.

Obs.—Occurs in the antimony mine of Wolfsberg in the Harz; the groups of columnar crystals occur on a massive variety in quartz; the crystals sometimes over half an inch long, and two or three lines broad, frequently extremely thin and forming fibrous masses. Has been reported from St. Trudpert in the Schwarzwald. Named in honor of Mr. Zinken, the director of the Anhalt mines, by G. Rose.

Resembles stibnite and bournonite, but may be distinguished by its superior hardness and specific gravity.

Kenngott makes the crystallization monoclinic, and the pyramidal planes oblique basal planes; but such twins with pyramids so formed are not known among monoclinic species.

107. JORDANITE. Jordanit *v. Rath*, Verh. Nat. Ver. Bonn, March, 1864, Pogg., cxxii. 387, 1864.

Orthorhombic. $I\wedge I=123° 29'$; $O\wedge 1\text{-}\bar{i}=128° 27'$; $a:b:c=1·2595:1:1·8604$. Observed planes: O; in zone $i\text{-}\breve{i}$, $\frac{3}{4}\text{-}\breve{i}$, $\frac{6}{7}\text{-}\breve{i}$, $\frac{6}{5}\text{-}\breve{i}$, $\frac{3}{2}\text{-}\breve{i}$- $\frac{12}{7}\text{-}\breve{i}$, $2\text{-}\breve{i}$, $3\text{-}\breve{i}$, $6\text{-}\breve{i}$; in zone 1, $\frac{1}{3}$, $\frac{2}{7}$, $\frac{1}{2}$, $\frac{3}{5}$, $\frac{3}{4}$, $\frac{6}{7}$, 1, $\frac{3}{2}$, I. Planes all narrow, except O; crystals hexagonal in general form.

$O\wedge 2\text{-}\breve{i}=126° 27'$ $O\wedge \frac{12}{7}\text{-}\breve{i}=130° 45'$ $O\wedge \frac{3}{2}=115° 0'$
$O\wedge \frac{3}{2}\text{-}\breve{i}=134$ 34 $O\wedge 1\text{-}\breve{i}=124$ 58 $O\wedge \frac{1}{2}=144$ $26\frac{1}{2}$

Twins: composition-face I; forms hexagonal, arragonite-like. Cleavage: $i\text{-}\breve{i}$ distinct. Streak pure black.

COMP.—Undetermined.

PYR., ETC.—Nearly as for sartorite.

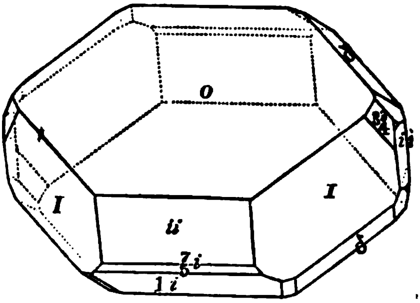
OBS.—From the Binnen valley, with sartorite (q. v.). Approaches closely sartorite in its planes and angles, but differs in occurring in twin crystals, and in its black streak.

Named after Dr. Jordan of Saarbruck, who furnished vom Rath with his specimens.

108. MIARGYRITE. Hemiprismatische Rubin-Blende (fr. Bräunsdorf) *Mohs*, Grundr., 606, 1824. Miargyrit *H. Rose*, Pogg., xv. 469, 1829. Hypargyrite, Hypargyron-Blende (fr. Clausthal), *Breith.*, Char., 286, 333, 1832. Kenngottite (fr. Felsobanya) *Haid.*, Ber. Ak. Wien, xxii. 236 1856.

Monoclinic. $C=48° 14'$, $I\wedge I=106° 31'$, $O\wedge 1\text{-}\grave{i}=136° 8'$; $a:b:c=1·2883:1:0·9991$, Naumann. Observed planes: O; vertical, I, $i\text{-}i$, $i\text{-}\grave{i}$, $i\text{-}2$,

i-$\frac{5}{3}$; domes $\frac{1}{8}$-i, $\frac{1}{3}$-i, $\frac{3}{4}$-i, 1-i, $\frac{7}{6}$-i, 1-$\grave{i}$, 3-$\grave{i}$; octahedral, $\frac{3}{4}$; $\frac{5}{16}$-5, $\frac{5}{6}$-$\frac{5}{2}$, $\frac{9}{11}$-$\frac{3}{2}$, $\frac{4}{5}$-$\frac{4}{3}$; ?$\frac{7}{4}$-$\frac{7}{4}$, 4-$\frac{4}{3}$, 1-$\frac{3}{2}$, 3-$\frac{3}{2}$, $\frac{3}{2}$-$\grave{3}$, 9-$\frac{9}{4}$.



$O \wedge i$-i=131° 46′ $O \wedge \frac{1}{2}$-i=139° 58′
$O \wedge I$ =122 16 $O \wedge 1$-i= 98 24
$O \wedge \frac{3}{4}$ =109 16 i-$i \wedge 1$-i=129 50

Observed angles by Weisbach, from Braünsdorf crystals: $I \wedge I$=104° 36′ –105° 50′; $O \wedge i$-i=132° 28′, 134° 15′, 127° 11′, 131° 35′; i-$i \wedge 1$-i=129° 17′, 129°, 49′.

Crystals thick tabular, or stout, or short prismatic, pyramidal. Lateral planes deeply striated. Cleavage: $\frac{1}{2}$-i, 1-i imperfect.

H.=2–2·5. G.=5·2–5·4; mostly 5·22–5·24. Lustre submetallic-adamantine. Color iron-black. Streak dark cherry-red. Opaque, except in thin splinters, which, by transmitted light, are deep blood-red. Fracture subconchoidal.

Comp.—$Ag\,S+Sb^2\,S^3$=Sulphur 21·8, antimony 41·5, silver 36·7=100. Analysis by H. Rose (Pogg., xv. 469):

S 21·95 Sb 39.14 Ag 36·40 Cu 1·06 Fe 0·62=99·17.

The *kenngottite* (l. c.) which Weisbach refers here (Pogg., cxxv. 457), has not been analyzed; von Hauer found in it (Pogg., xcviii. 165) about 30 p. c. of silver; G.=6·06. *Hypargyrite* is a massive variety; G.=4·779—4·890, Breith.; it afforded Plattner (l. c.) 35 p. c. of silver. For Weisbach's measurements see Pogg., l. c.

Pyr., etc.—In the closed tube decrepitates, fuses easily, and gives a sublimate of sulphid of antimony; in the open tube sulphurous and antimonous fumes, the latter as a white sublimate. B.B. on charcoal fuses quietly with emission of sulphur and antimony fumes to a gray bead, which after continued treatment in O.F. leaves a bright globule of silver. If the silver globule be treated with phosphorus salt in O.F., the green glass thus obtained shows traces of copper when fused with tin in R.F.

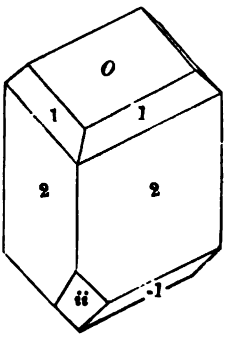
Decomposed by nitric acid, with separation of sulphur and oxyd of antimony.

Obs.—At Braünsdorf, near Freiberg in Saxony, associated with tetrahedrite, pyrargyrite, etc.; Felsobanya (*kenngottite*) with pyrite, galenite, blende, barite; Przibram in Bohemia; Clausthal (*hypargyrite*); Guadalajara in Spain; at Parenos, and the mine Sta. M. de Catorce, near Potosi; also at Molinares, Mexico, with diallogite.

Named from *μείων*, *less*, *ἄργυρος*, *silver*, because it contains less silver than some kindred ores.

109. PLAGIONITE. Plagionit *G. Rose*, Pogg., xxviii. 421, 1833.

Monoclinic. C=72° 28′, $I \wedge I$=85° 25′, $O \wedge 1$-i= 158° 9′, Rose; $a : b : c$ = 0·37015 : 1 : 0·8802. Observed planes as in f. 107.



$O \wedge 1$=154° 20′ $O \wedge i$-i=107° 32′
$O \wedge 2$=138 52 $1 \wedge 1$=142 3
$O \wedge -1$=149 $2 \wedge 2$=120 49

Crystals thick tabular; the plane O shining and smooth; others striated. Cleavage: 2, perfect, but seldom affording smooth surfaces. Also massive, granular.

H.=2·5. G.=5·4. Lustre metallic. Color blackish lead-gray. Opaque. Brittle.

Comp.—$PbS + Sb^2S^3 + \frac{1}{4}PbS$=Sulphur 21·3, antimony 38·2, lead 40·5. Analyses: 1, H. Ro (Pogg., xxviii. 428); 2, Kudernatsch (Pogg., xxxvii. 588); 3, Schultz (Ramm. Min. Ch., 1006):

1.	Wolfsberg	S 21·53	Sb 37·94	Pb 40·52=99·99 Rose.
2.	"	21·49	37·53	40·98=100 Kudernatsch.
3.	"	21·10	37·84	39·36, Cu 1·27=99·53 Schultz.

Pyr.—Same as in zinkenite.

Obs.—At Wolfsberg in geodes and druses of crystals in massive plagionite, or crystallized quartz, and was discovered by Zincken. Named, in allusion to its unusually oblique crystalliz tion, from πλάγιος, *oblique*.

Taking the planes 2, 2, as the lateral faces of the fundamental prism, the lateral angle is near the same as in freieslebenite.

110. BINNITE. Dufrenoysite *v. Waltershausen*, Pogg., xciv. 119, 1855; *C. Heusser*, Pog xciv. 334, xcvii. 115. Binnite *Descl.*, Ann. d. M., V. viii. 389, 1855.

Isometric. Figures 3, 14, and others: observed planes: *O*, *I*, 2-2, wit 1, $\frac{3}{2}$, and 6-6, on some crystals. Cleavage not distinct.

H.=4·5. G.=4·477. Lustre metallic. Color on fresh fracture blac sometimes brownish or greenish. Streak cherry-red. Brittle.

Comp.—From anal. 1, $\frac{3}{2}$ Ȼu S + As^2S^3=Sulphur 29·7, arsenic 31·1, copper 39·2=100. Fro anal. 2, Ȼu S + $\frac{1}{3}As^2S^5$, or like enargite. Analyses: 1, Uhrlaub (Pogg., xciv. 117); 2, Stock Escher (Kenng. Uebers., 1856–57, 174):

	S	As	Cu	Pb	Ag	Fe
1.	27·55	30·06	37·74	2·75	1·23	0·82=100·15 Uhr.
2.	32·73	18·98	46·24	—	1·91	—=99·86 S.-E.

Pyr.—In the closed tube, gives a sublimate of sulphid of arsenic; in the open tube a cryst line sublimate of arsenous acid, with sulphurous fumes. B.B. on charcoal gives an arsenic odor and a faint white coating, fuses with intumescence to a dull iron-black, magnetic globul which, according to Wiser, is surrounded by a coating of oxyd of zinc. The globule yields met lic copper with soda.

Obs.—In dolomite, in the valley of Binnen, with realgar, orpiment, blende, pyrite, sartorit and dufrenoysite.

111. BRONGNIARDITE. *Damour*, Ann. d. M., IV. xvi. 227, 1849.

Isometric. In octahedrons with truncated edges (1, I), Damour. Massiv without cleavage.

H. above 3. G.=5·950. Lustre like that of bournonite. Color an streak grayish-black.

Comp.—$PbS + AgS + Sb^2S^3$, or $2(Pb, Ag)S + Sb^2S^3$=Sulphur 19·4, antimony 29·5, silver 26· lead 25·0=100. Analyses: Damour (l. c.):

	S	Sb	Ag	Pb	Cu	Fe	Zn
1.	19·38	29·95	25·03	24·74	0·54	0·30	0·40=100·34.
2.	19·21	29·60	24·46	25·05	0·61	0·26	0·32=99·51.
3.	19·14	29·75	24·81	24·94	0·70	0·22	0·37=99·93.

Pyr., etc.—In the closed tube a feeble orange sublimate with a white one above; in the op tube fuses, affords an odor of sulphur and a white sublimate of oxyd of antimony. B.B. on cha coal decrepitates, fuses easily, giving off an odor of sulphur and white vapors; after roastin yields a globule of silver, with a yellow coating of oxyd of lead. Rapidly attacked by concentrat nitric acid.

Obs.—From Mexico.

112. JAMESONITE. Grey antimony pt. *Jam.*, Syst., iii. 390, 1820. Axotomous Antimon Glance *Jam.*, Man., 285. Axotomer Antimon-Glanz *Mohs*, Grundr., 586, 1824. Jamesoni *Haid.*, Trl. Mohs's Min., i. 451 (iii. 26), 1825.

Bleischimmer *Pfaff*, Schw. J., xxvii. 1. Pfaffite *Huot*, i. 192, 1841.

Antimonialisk Fädererz pt., Minera antimonii plumosa pt., *Wall.*, 1747; Federerz *Germ.*, Mine d'antimoine au plumes *Fr.*; Feather ore, Plumose Antimonial Ore, pt. (rest mostly Stibnite), *through last cent.* Antimoine sulfuré capillaire pt. [or var. of Stibnite] *H.*, Tr., 1801; Haarförmiges Grauspiessglanzerz pt. *Karst.*, Tab., 52, 1800; Haarf. Antimonglanz *Mohs*, 1824, *Leonh.*, 1826. Federerz of Wolfsberg *H. Rose*, Pogg., xv. 471, 1829; *Beud.*, Tr., ii. 425, 1832. Federerz var. of Jamesonite, *v. Kob.*, Char., ii. 175, 1831. Wolfsbergite *Huot.*, Min., i. 193. Plumosit *Haid.*, Handb., 569, 1845. Plumites *Glock.*, Syn., 30, 1847. Heteromorphit *Ramm.*, Pogg., lxxvii. 240, 1849. Federerz, var. of Jamesonite, *Ramm.*, Min. Ch., 71, 1860.

Orthorhombic. $I \wedge I = 101° 20'$ and $78° 40'$. Observed planes *I*, *i-ĭ*. Cleavage basal, highly perfect; *I* and *i-ĭ* less perfect. Usually in acicular crystals. Also fibrous massive, parallel or divergent; also in capillary forms; also amorphous massive.

H.=2–3. G.=5·5–5·8; 5·564, from Cornwall, Haidinger; 5·616, from Estremadura, Schaffgotsch; 5·601, from Arany Idka, Löwe; 5·6788, massive, Ramm.

Var.—*a*, well crystallized; *b*, fibrous or columnar, sometimes diverging; *c*, capillary, or cobweb-like; *d*, granular or compact.

The capillary is *feather ore* (Federerz *Germ.*) regarded as a species by nearly all the mineralogists of last century, but including capillary stibnite; made a variety of stibnite by v. Born, Karsten, Haüy, Mohs, Leonhard, and other authors, until 1829; and a distinct species again by most authors after the analysis by Rose in 1829; but referred to jamesonite by v. Kobell in 1830, and Rammelsberg in 1860. An *amorphous* variety occurs with the feather ore at Wolfsberg (anal. 7), for which Rammelsberg gives the hardness 3·0, and G.=5·6788.

Comp.—$2(\text{Pb, Fe})\,\text{S}+\text{Sb}^2\text{S}^3$=(if Fe : Pb=1 : 4) Sulphur 21·1, antimony 32·2, lead 43·7, iron 3·0=100. But excluding the iron as sulphid, Rose makes the formula $\frac{3}{2}\,\text{Pb}\,\text{S}+\text{Sb}^2\text{S}^3$=Sulphur 20·7, antimony 34·8, lead 4·45=100. Von Zepharovich sustains the first formula (Sitz. Ak. Wien, 57, 169). Analyses 5 to 10 of feather ore agree well with the preceding, whence Rammelsberg's reference to jamesonite.

Analyses: 1, 2, H. Rose (Pogg., viii. 101); 3, Schaffgotsch (Pogg., xxxviii. 403); 4, A. Löwe (Haid. Ber., i. 62); 5, H. Rose (Pogg., xv. 471); 6, Rammelsberg (Pogg., Ann., lxxvii. 241; 7, Poselger (ib., Ramm., Min. Ch., 71); 8–10, C. Bechi (Am. J. Sci., II. xiv. 60):

	S	Sb	Pb	Fe	Cu	Zn
1. Cornwall	22·15	34·40	40·75	2·30	0·13	——=99·73 Rose.
2. "	22·53	34·90	38·71	2·65	0·19	0·74=99·72 Rose.
3. Estremadura	21·78	32·62	39·97	3·63	——	0·42, Bi 1·06=99·48 Sch.
4. Arany Idka	18·59	33·10	40·82	2·99	1·78	0·35, Ag 1·48, Bi 0·22=99·33 Löwe.
5. Wolfsberg, *feather ore*	19·72	31·04	46·87	1·30	——	0·08=99·01 Rose.
6. " "	20·23	[31·96]	44·32	2·93	0·56	——=100 Ramm.
7. Wolfsberg, *massive*	20·52	[31·54]	44·0	2·91	1·03	——=100 Poselger.
8. Tuscany, *capil.*	18·89	30·19	47·68	0·26	1·11	1·08=98·71 Bechi.
9. " *acic.*	19·25	29·24	49·31	——	2·00	0·21=100·01 Bechi.
10. " *capil.*	20·53	32·16	43·38	0·94	1·25	1·74=100 Bechi.

Pyr.—Same as for zinkenite.

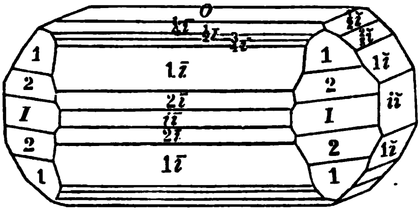
Obs.—*Jamesonite* occurs principally in Cornwall, associated with quartz and minute crystals of bournonite; occasionally also in Siberia, Hungary, at Valentia d'Alcantara in Spain, and Brazil. Its perfect cleavage at right angles with the vertical axis is sufficient to distinguish it from the species it resembles. Named after Prof. Jameson of Edinburgh.

The *feather ore* occurs at Wölfsberg in the Eastern Harz; also at Andreasberg and Clausthal; at Freiberg and Schemnitz; in the Anhalt at Pfaffenberg and Meiseberg; in Tuscany, near Bottino; at Chonta in Peru.

Zundererz, or Bergzunderz [=Tinder Ore] of G. Lehmann (Mem. Ac. Berlin, 20, 1758), which is soft like tinder and dark dirty red in color, has been referred to kermesite, but proves to be jamesonite or feather ore mixed with red silver and arsenopyrite. Bornträger obtained in an analysis (J. pr. Ch., xxxvi. 40) S 19·57, As 12·60, Sb 16·88, Pb 40·06, Ag 2·56, Fe 4·52=96·19. From Andreasberg and Clausthal in the Harz.

113. DUFRENOYSITE. Dufrenoysite *Damour*, Ann. Ch. Phys., III. xiv. 379, 1845. G hardit *Ramm.*, Berz. Ch. Min., 229, 256, 1847. Arsenomelan and Scleroclase pt. *v. Walte* Pogg., xciv. 115, 1855. Dufrenoysite pt. *Descl.*, Ann. d. M., V. viii. 389. Skleroklas *Pete* Offenb. Ver., vii. 13, Jahrb. Min., 1867, 203.

108



Orthorhombic. $I \wedge I$=93° 39′, $O \wedge$ 1-ī=121° 30′, $a:b:c$=1·6318 : 1·0658. Observed planes: O; ve cal, I, i-ĭ, i-ī; domes, ½-ĭ, ⅔-ĭ, 1-ĭ, ½-ī, ⅔-ī, 1-ī, 2-ī; octahedral, 1, 2. O ∧ =123° 9′, $O \wedge$ ½-ĭ=142° 34′, $O \wedge$ 2- 107° 2′, $O \wedge 1$=114° 5′, $O \wedge 2$=102° 1 ∧ 1-ī=141° 20½, 1 ∧ 1-ī=138° 15′ Rath. Usual in thick rectangu tables. Cleavage: O perfect. A massive.

H.=3. G.=5·549, Damour; 5·56 Landolt; 5·569, v.Rath. Lustre metallic. Color blackish lead-gray; str reddish-brown. Opaque. Brittle.

Comp.—2 Pb S+As^2S^3=Sulphur 22·10, arsenic 20·72, lead 57·18=100. Analyses: 1 Damour (l. c.); 3, 4, Landolt & Berendies (Dissert. de Dufrenoysite, 1864, Pogg., cxxii. 374):

		S	As	Pb	Ag	Fe	Cu	
1.	Binnen	22·49	20·69	55·40	0·21	0·44	0·31	=99·54 Damour.
2.	"	22·30	20·87	56·61	0·71	0·82	0·22	=101·03 Damour.
3.	"	23·27	21·76	53·62	0·05	0·30	——	=99·0 L. & B.
4.	"	23·11	21·35	52·02	*undet.*			L. & B.

Analyses of dufrenoysite have been published by Uhrlaub and Nason (Pogg., c. 537), and Stockar Escher (Keung. Forsch., '56, '57, 176); but as they were made without discriminating species, and give intermediate results, they are not cited here in detail. Peterson has also lished two analyses (l. c.), and gives the following as the mean of 17 anal. by the chemists mentioned and himself:

	S	As	Pb	Ag	Fe	Cu	
1.	24·31	24·25	50·86	0·41	——	?	=99·83

Peterson in one analysis obtained S 23·22, As 25·83, Pb 50·74, Ag 0·21; and in the other S 2 As 23·93, Pb 51·32, Ag 0·12. He makes the formula [2 Pb S+As^2S^3]+[Pb S+As^2 S^3]=Pb ⅔ As^2 S^3.

Pyr., etc.—Easily fuses and gives a sublimate of sulphur and sulphuret of arsenic; in open tube a smell of sulphur only, with a sublimate of sulphur in upper part of tube, an arsenous acid below. On charcoal decrepitates, melts, yields fumes of arsenic and a globul lead, which on cupellation yields silver.

Obs.—From the valley of Binnen in the St. Gothard Alps, in crystalline dolomite, along sartorite, jordanite, binnite, realgar, orpiment, blende, pyrite. The crystals are sometime inch across.

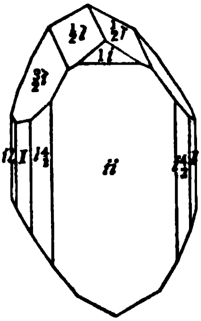
Damour, who first studied the arsenio-sulphids of Binnen, analyzed the massive ore and na it *dufrenoysite.* He inferred that the crystallization was monometric from some associated crys and so published it. This led von Waltershausen and Heusser to call the monometric min dufrenoysite. and the latter to name the trimetric *binnite.* Von Waltershausen, after studying prismatic mineral, made out of the species *arsenomelan* and *scleroclase*, yet partly on hypothe grounds. Recently it has been found that three orthorhombic minerals exist at the locality, as nounced by vom Rath, who identifies one, by specific gravity and composition, with Damo *dufrenoysite*; another he makes *scleroclase* of von Waltershausen (sartorite, p. 87); and the o he names *jordanite* (p. 88).

114. **FREIESLEBENITE.** Mine d'antimoine grise tenant argent (fr. Himmelsfürst) *de Lisle*, Descr. de Min., 35, 1773, Crist., iii. 54, 1783. Dunkles Weissgultigerz (id. loc., known since 1720) *Klapr.*, Beitr., i. 173, 1795. Schilf-Glaserz *Freiesleben*, Geogn. Arb., vi. 97, 1817. Antimonial Sulphuret of Silver, Sulphuret of Silver and Antimony. Argent sulfuré antimonifère et cuprifère *Levy*, Descr. Min. Heuland, 1838. Donacargyrite *Chapm.*, Min., 128, 1843. Freieslebenit *Haid.*, 569, 1845.

Monoclinic. $C=87° 46'$, $I \wedge I=119° 12'$, $O \wedge 1\text{-}\grave{i}=137° 10'$ (B. & M.); $a:b:c=1{\cdot}5802:1:1{\cdot}7032$. Observed planes: O; vertical, I, $i\text{-}i$, $i\text{-}\grave{i}$, $i\text{-}\frac{4}{3}$, $i\text{-}3$, $i\text{-}\frac{6}{5}$, $i\text{-}\frac{5}{3}$, $i\text{-}2$; domes, $1\text{-}i$, $\frac{1}{2}\text{-}\grave{i}$, $1\text{-}\grave{i}$, $\frac{3}{2}\text{-}\grave{i}$, $2\text{-}\grave{i}$; octahedral, $\frac{1}{2}$, 1, 1-4, 1-2, $\frac{3}{2}\text{-}3$.

$O \wedge 1\text{-}i=123° 55'$ $\quad$ $1\text{-}2 \wedge 1\text{-}2$, front, $=152° 36'$
$O \wedge \frac{1}{2}\text{-}\grave{i}=156\ 8$ $\quad$ $i\text{-}\frac{4}{3} \wedge i\text{-}\frac{4}{3}$ " $=132\ 48$
$O \wedge 2\text{-}\grave{i}=118\ 21$ $\quad$ $i\text{-}3 \wedge i\text{-}3$ " $=157\ 54$
$1 \wedge 1$, front, $=128\ 2$ $\quad$ $1\text{-}\grave{i} \wedge 1\text{-}\grave{i}$, top, $=94\ 20$
$1\text{-}4 \wedge 1\text{-}4$ " $=166\ 6$

109



Prisms longitudinally striated. Cleavage: I perfect. H.=2—2·5. G.=6—6·4; 6·194, Hausmann; 6·23, fr. Przibram, v. Payr. Lustre metallic. Color and streak light steel-gray, inclining to silver-white, also blackish lead-gray. Yields easily to the knife, and is rather brittle. Fracture subconchoidal—uneven.

Comp.—5 (Pb, Ag) S + 2 $Sb^2 S^3$ (fr. v. Payr's anal.)=, if Ag : Pb=3 : 4, Sulphur 18·6, antimony 25·9, lead 31·2, silver 24·3=100. Analyses: 1, 2, Wöhler (Pogg., xlvi. 146); 3, Escosura (Rev. Minera, vi. 358, Ann. d. M., V. viii. 495); 4, v. Payr (Jahrb. Min. 1860, 579):

	S	Sb	Pb	Ag	Fe	Cu
1.	18·77	27·72	30·00	22·18	0·11	1·62=100 W.
2.	18·72	27·05	30·08	23·78	——=99·60 W.	
3. Spain	17·60	26·83	31·90	22·45	——=98·78 Escosura.	
4. Przibram	18·41	27·11	30·77	23·08	0·63=100 Payr.	

Pisani refers here the massive dark *weissgültigerz* analyzed by Klaproth, who obtained (l. c.) S 22·00, Sb 21·50, Pb 41·00, Ag 9·25, Fe 1·75, Äl 1·00, Si 0·75=97·25, considering part of the silver as here replaced by lead.

Pyr.—In the open tube gives sulphurous and antimonial fumes, the latter condensing as a white sublimate. B.B. on charcoal fuses easily, giving a coating, on the outer edge white, from antimonous acid, and near the assay yellow, from oxyd of lead; continued blowing leaves a globule of silver.

Obs.—With argentite, siderite, and galenite, in the Himmelsfürst mine, at Freiberg in Saxony, and Kapnik in Transylvania; at Ratieborzitz, the ore of which locality contains bismuth, according to Zincken; at Przibram in crystals, often twins, and 2 to 6 lines long; at Felsobanya; at Hiendelencina in Spain, with argentite, red silver, siderite, galenite, etc.

The crystals from Himmelsfürst are *triclinic*, according to Breithaupt (B. H. Ztg., xxv. 189). Chapman took his name *donacargyrite* from the British Museum, knowing nothing of its origin. Such a name ought not to displace *freieslebenite*.

115. **PYROSTILPNITE.** Feuerblende *Breith.*, Char., 285, 333, 1832. Fireblende *Dana*, Min., 543, 1850. Pyrostilpnite, *Dana*.

Monoclinic. In delicate crystals grouped like stilbite. Observed planes, I, $i\text{-}\grave{i}$, $1\text{-}2$, $1\text{-}\grave{i}$, $2\text{-}\grave{i}$, B. & M.

I ∧ *I*=139° 12′. 2-ì ∧ 2-ì, top,=74°. *i*-ì ∧ 1-ì=123° 34′.
1-ì ∧ 1-ì, top,=112 52. *i*-ì ∧ 2-ì=148 42. 1-ì ∧ 1-ì, top,=62 36.

Cleavage: *i*-ì, and crystals flattened in this direction. Faces *i*-ì striated parallel to the clinodiagonal. Twins: plane of composition *i*-*i* (orthodiagonal).

H.=2. G.=4·2—4·25. Lustre pearly-adamantine. Color hyacinth-red. Translucent. Sectile and somewhat flexible.

Comp.—Contains 62·3 per cent. of silver, along with sulphur and antimony (Plattner, l. c., 333).
Pyr.—Like pyrargyrite.
Obs.—From the Kurprinz mine near Freiberg; Andreasberg; Przibram.
Named from πῦρ, *fire*, and στιλπνός, *shining*, in allusion to its fire-like color.

116. RITTINGERITE. Rittingerit *Zippe*, Ber. Ak. Wien, ix. 2, 345, 1852.

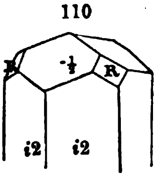
Monoclinic; *C*=88° 26′. In small rhombic tables with replaced basal edges. Observed planes: *O*, $\frac{1}{2}$, *I*, ±6, ±1. Observed angles: *O* ∧ *I*=91° 24′, *I* ∧ *I*=126° 18′, *O* ∧ 1=132° 24′, *O* ∧ -1=130° 50′, 1 ∧ -1=96° 20′, *O* ∧ -6=98° 30′, *O* ∧ $\frac{1}{2}$=150°, -1 ∧ -1=140° 1′. Cleavage: *O* imperfect.

H.=1·5—3. Lustre submetallic-adamantine. Plane *O* blackish-brown in the larger crystals, less dark in the more minute; other parts iron-black. Translucent and dull honey-yellow to hyacinth-red in the direction of the axis. Streak orange-yellow. Brittle.

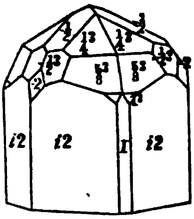
Comp.—Probably a compound of sulphid of silver and antimony.
Pyr.—B.B. same as with pyrargyrite; fuses very easily, gives an arsenical odor, and finally a globule of pure silver.
Obs.—From Joachimsthal, in small crystals.

117. PYRARGYRITE. Argentum rude rubrum pt., *Germ.* Rothgolderz, *Agric.*, 362, Interpr., 462, 1546. Argentum rubri coloris pt., Gemein Rothguldenerz, *Gesner.*, Foss., 62, 1565. Rothgylden pt., Argentum arsenico pauco sulphure et ferro mineralisatum pt., Minera argenti rubra var. opaca, var. nigrescens, *Wall.*, 310, 1747. Mine d'argent rouge *Fr. Trl.* Wall., 1753. Ruby Silver Ore pt., Red Silver Ore pt., *Hill*, Foss., 1771. Dunkles Rothgültigerz, Lichtes id. pt., *Wern.*, 1789. Dark Red Silver Ore; Antimonial Red Silver. Argent antimonié sulfuré pt. *H.*, Tr., 1801. Argent rouge antimoniale *Proust.*, J. de Phys., lix. 407, 1804. Ærosit *Selb*, Denks. Nat. Schwab., i. 311, Tasch. Min., 401, 1817. Rubinblende pt. *Mohs.* Antimonsilberblende. Pyrargyrit *Glock.*, Handb., 388, 1831. Argyrythrose *Beud.*, Tr., ii. 430, 1832.

110



11

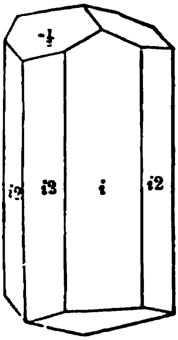


Rhombohedral. Opposite extremities of crystals often unlike. *R* ∧ *R*=108° 42′, B. & M., *O* ∧ *R*=137 42′; *a*=0·788. Observed planes in this and the following species: basal and prismatic, *O*, *I*, *i*-2, *i*-$\frac{3}{2}$, *i*-$\frac{5}{4}$, *i*-$\frac{26}{25}$; rhombohedral, $\frac{1}{4}$, $\frac{1}{2}$, $\frac{7}{10}$, $\frac{5}{8}$, *R* (or 1), $\frac{5}{2}$, 4, —14, —5, —$\frac{7}{2}$, —2, —$\frac{3}{2}$, —1, —$\frac{1}{2}$, —$\frac{1}{5}$, —$\frac{1}{8}$; pyramidal, $\frac{2}{3}$-2, $\frac{4}{3}$-2,; scalenohedral, $\frac{1}{7}^{5}$, $\frac{1}{5}^{5}$, $\frac{1}{5}^{\frac{17}{3}}$, $\frac{1}{4}^{3}$, $\frac{1}{4}^{4}$, $\frac{1}{4}^{7}$, $\frac{6}{14}^{\frac{5}{3}}$, $\frac{1}{8}^{3}$, $\frac{1}{8}^{\frac{17}{3}}$, $\frac{4}{13}^{\frac{5}{2}}$, $\frac{2}{5}^{2}$, $\frac{2}{5}^{3}$, $\frac{2}{5}^{4}$, $\frac{1}{2}^{3}$, $\frac{1}{2}^{\frac{11}{3}}$, $\frac{5}{8}^{\frac{5}{3}}$, $\frac{5}{8}^{\frac{11}{5}}$, $\frac{5}{8}^{3}$, $\frac{2}{3}^{3}$, $\frac{2}{3}^{\frac{5}{3}}$, $1^{\frac{4}{3}}$, $1^{\frac{5}{2}}$, 1^{3}, $1^{\frac{7}{2}}$, 1^{4}, 1^{5}, $1^{\frac{17}{3}}$, 1^{6}, 1^{7}, $\frac{11}{8}^{\frac{17}{11}}$, 2^{3}, $\frac{11}{5}^{\frac{21}{11}}$, $\frac{5}{2}^{\frac{9}{5}}$, $\frac{8}{3}^{3}$, $10^{\frac{6}{5}}$, $-8^{\frac{5}{4}}$, $-5^{\frac{7}{5}}$, $-5^{\frac{31}{20}}$, $-5^{\frac{11}{5}}$, $-5^{\frac{13}{5}}$, $-4^{\frac{3}{2}}$, $-\frac{7}{2}^{\frac{11}{7}}$, $-\frac{2}{7}^{4}$, $-\frac{11}{4}^{\frac{17}{11}}$, $-\frac{5}{2}^{\frac{9}{5}}$, -2^{2}, -2^{3}, $-2^{\frac{7}{3}}$, $-\frac{5}{4}^{\frac{13}{5}}$, $-1^{\frac{7}{3}}$, $-\frac{4}{5}^{3}$, $-\frac{2}{7}^{3}-\frac{1}{3}^{\frac{11}{3}}$, $-\frac{1}{2}^{3}$, $-\frac{1}{2}^{3}$, $-\frac{1}{2}^{\frac{11}{5}}$, $-\frac{1}{8}^{3}$, $\frac{1}{5}^{3}$, $\frac{1}{5}^{9}$, $\frac{1}{20}^{13}$, Q. Sella.

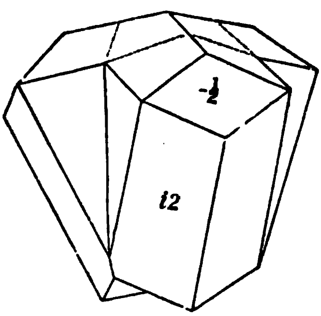
$O \wedge \frac{1}{2} = 155° \; 32'$ $\quad \frac{1}{2} \wedge \frac{1}{2} = 137° \; 58'$ $\quad R \wedge \frac{1}{2} = 144° \; 21'$
$O \wedge 1^3 = 112 \; 33'$ $\quad i\text{-}2 \wedge R = 125 \; 39$ $\quad R \wedge \frac{1}{4}^3 = 164 \quad 5$
$O \wedge 1^7 = 100 \; 14$ $\quad i\text{-}2 \wedge 1^3 = 155 \quad 4$ $\quad i\text{-}2 \wedge i\text{-}2 = 120.$

Cleavage: *R* rather imperfect. Twins: composition-face $-\frac{1}{2}$, as in f. 113, which consists of four individuals; *O* or basal plane, as in f. 114; also *R* and *I*. Also massive, structure granular, sometimes impalpable.

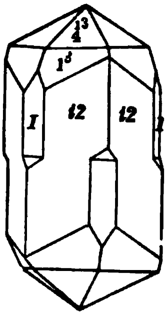
112



113



114



H.=2—2·5. G.=5·7—5·9. Lustre metallic-adamantine. Color black, sometimes approaching cochineal-red. Streak cochineal-red. Translucent —opaque. Fracture conchoidal.

Comp.—3 Ag S + $Sb^2 S^3$ = Sulphur 17·7, antimony 22·5, silver 59·8 = 100. **Analyses**: 1, Bonsdorff (Ak. H. Stockh., 1821, 338); 2, Wöhler (Ann. d. Pharm., xxvii. 157); 3, Böttger (Ramm. Handw., ii. 106); 4, F. Field (Q. J. Ch. Soc., xii. 12):

	S	Sb	Ag
1. Andreasberg	16·61	22·85	58·95, gangue 0·30=98·70 Bonsdorff.
2. Mexico	18·0	21·8	60·2=100 Wöhler.
3. Zacatecas, Mex.	17·76	24·59	57·45=99·80 Böttger.
4. Chili	17·45	23·16	59·01=99·62 Field.

Henckel found arsenic in ruby silver (Pyritol., 169, 1725), and both light and red silver ores were afterwards considered arsenical, until Klaproth's analysis, detecting antimony alone, in 1794 (Beitr., i. 141); after this both were supposed to be antimonial, until Proust, in 1804 (J. de Phys., lix. 403) showed that there were two species, an antimonial and an arsenical.

Pyr., etc.—In the closed tube fuses and gives a reddish sublimate of sulphid of antimony; in the open tube sulphurous fumes and a white sublimate of oxyd of antimony. B.B. on charcoal fuses with spirting to a globule, gives off sulphid of antimony, coats the coal white, and the assay is converted into sulphid of silver, which, treated in O.F., or with soda in R.F., gives a globule of fine silver. In case arsenic is present it may be detected by fusing the pulverized mineral with soda on charcoal in R.F.

Decomposed by nitric acid with separation of sulphur and antimonous acid.

Obs.—The *dark-red silver ore* occurs principally with calcite, native arsenic, and galenite, at Andreasberg in the Harz; also in Saxony, Hungary, Norway, at Gaudalcanal in Spain, and in Cornwall. In Mexico it is worked extensively as an ore of silver. In Chili it is found in crystals at mine Dolores and Chañarcillo near Copiapo. In Nevada, at Washoe in Daney Mine; in Ophir mine, rare; abundant about Austin, Reese river, but no good crystals; at Poorman lode, Idaho, in masses sometimes of several hundred weight, along with cerargyrite.

A *light-red* ore from Andreasberg, according to Zincken, contains no arsenic. A *gray* ore from the same locality, contains both arsenic and antimony, and may be miargyrite. On cryst. of pyrargyrite, see Q. Sella, Acad. Sci. Torino, 8vo, 1856.

Alt.—Occurs like proustite, changed to argentite (Ag S); to pyrite; so-called argentopyrite silver.

118. PROUSTITE. Argentum rude rubrum translucidum carbunculis simile, *Germ.* Durcl sichtig Rodtguldenerz, *Agric.*, 362, Interpr., 462, 1546. Argentum rubri coloris pellucidur Schön Rubin Rothguldenerz, *Gesner*, Foss., 62, 1565. Minera argenti rubra pellucida *Wall.*, 31 1747. Ruby Silver Ore pt. *Hill.* Argent rouge arsenicale *Proust*, J. de Phys., lix. 404, 180 Lichtes Rothgültigerz pt., Arsenikalisches id., Arseniksilberblende, *Germ.* Rubinblende p Arsenical Silver Ore; Light Red Silver Ore. Proustite *Beud.*, Tr., ii. 445, 1832.

Rhombohedral. $R \wedge R=107° \ 48'$, $O \wedge R=137° \ 9'$; $a=0·78506$. Als granular massive.

H.=2—2·5. G.=5·422—5·56. Lustre adamantine. Color cochinea red. Streak cochineal-red, sometimes inclined to aurora-red. Subtransp rent—subtranslucent. Fracture conchoidal—uneven.

Comp.—$3\,\text{Ag}\,\text{S}+\text{As}^2\,\text{S}^3$=Sulphur 19·4, arsenic 15·2, silver 65·4=100. **Analyses:** 1, H. Ro (Pogg., xv. 472); 2, F. Field (Q. J. Chem. Soc., xii. 12):

1. Joachimsthal	S 19·51	As 15·09	Ag 64·67	Sb 0·69=99·96 Rose.
2. Chili	19·81	15·12	64·88=99·81 Field.	

Pyr., etc.—In the closed tube fuses easily, and gives a faint sublimate of sulphid of arseni in the open tube sulphurous fumes and a white crystalline sublimate of arsenous acid. B.B. charcoal fuses and emits odors of sulphur and arsenic; by prolonged heating in O.F., or with so in R.F., gives a globule of pure silver. Some varieties contain antimony.

Decomposed by nitric acid, with separation of sulphur and arsenous acid.

Obs.—Occurs at Freiberg, Johanngeorgenstadt, Marienberg, and Annaberg; at Joachimsth in Bohemia; Wolfach in Baden; Markirchen in Alsace; Chalanches in Dauphiné; Guadalcan in Spain; in Mexico; Peru; Chili, near Copiapo, at Chanarçillo, some crystals 3 in. long (Forbes.) In Nevada, in the Daney mine, and in Comstock lode, but rare; in veins about Austi Lander Co; in microscopic crystals in Cabarrus Co., N. C., at the McMakin mine; in Idaho, the Poorman lode, with pyrargyrite, native silver and gold, and cerargyrite.

Named after the French chemist, J. L. Proust.

Alt.—Occurs altered to pyrrhotite, Breith.

119. BOURNONITE. Ore of Antimony (fr. Endellion) *P. Rashleigh*, Spec. Brit. Min., i. 3 pl. xix., 1797. Triple Sulphuret of Lead, Antimony, and Copper *Bournon* (with figs.), Ph Trans., 30, 1804; *Ch. Hatchett* (anal.), ib., 63. Bournonite, Antimonial Lead Ore, *Jamese* Syst., ii. 579, 1805, iii. 372, 1816. Spiessglanzblei *Karst.*, in Klapr. Beitr., iv. 82, 1807, a Tab., 68, 1808. Plomb sulfuré antimonifère *H.*, Tabl., 1809. Endellione *Bourn.*, Cat. Mi 409, 1813. Schwarz Spiesglanzerz *Wern.* Antimoine sulfuré plumbo-cuprifère *H.*, Tr., i 1822. Rädelerz [=Wheel Ore] *Kapnik miners.* Endellionite *Zippe*, Char. Min., 213, 1859.

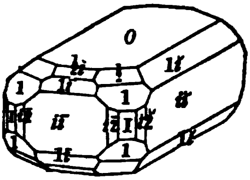
Prismatischer Spiesglas-Glanz *Mohs*, Char., 1820; Prismatoidischer Kupfer-Glanz *Mo* Grundr., ii. 559, 1824. Antimonkupfer-Glanz *Breith.* Wölchit *Haid.*, Handb., 564, 184 Wölchite.

Orthorhombic. $I \wedge I=93° \ 40'$, $O \wedge 1\text{-}\bar{\imath}=136° \ 17'$, $a:b:c=0·95618$ $1:1·0662$. Observed planes: O; vertical, $i\text{-}\breve{\imath}$, $i\text{-}\bar{\imath}$, $i\text{-}\frac{4}{3}$, $i\text{-}\frac{3}{2}$, $i\text{-}\breve{2}$, $i\text{-}\breve{3}$, $i\text{-}\breve{}$, i- $i\text{-}\frac{5}{3}$, $i\text{-}\frac{5}{4}$; domes, $\frac{3}{2}\text{-}\breve{\imath}$, $\frac{4}{3}\text{-}\breve{\imath}$, $1\text{-}\breve{\imath}$, $8\text{-}\breve{\imath}$; $\frac{1}{4}\text{-}\bar{\imath}$, $\frac{2}{7}\text{-}\bar{\imath}$, $\frac{1}{2}\text{-}\bar{\imath}$, $\frac{3}{4}\text{-}\bar{\imath}$, $\frac{2}{3}\text{-}\bar{\imath}$, $1\text{-}\bar{\imath}$, $\frac{5}{4}\text{-}\bar{\imath}$, $\frac{7}{5}\text{-}i$, $2\text{-}\bar{\imath}$, $3\text{-}\bar{\imath}$ octahedral, $\frac{1}{3}$, $\frac{1}{2}$, $\frac{2}{3}$, $\frac{3}{4}$, 1, 2, $1\text{-}\breve{2}$, $2\text{-}\breve{2}$, $3\text{-}\breve{3}$, $\frac{3}{4}\text{-}\breve{3}$, $1\text{-}\breve{\imath}$, $\frac{2}{3}\text{-}\frac{4}{3}$, $1\text{-}2$, $2\text{-}2$.

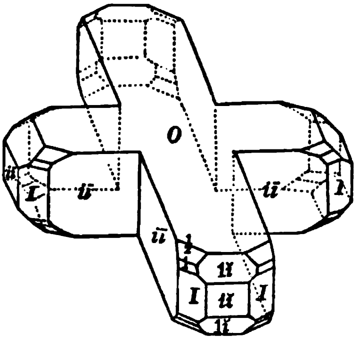
$O \wedge \frac{1}{2}\text{-}\bar{\imath}=154° \ 27'$.	$O \wedge \frac{1}{2}=146° \ 45'$.	$1 \wedge 1$, mac.,$=114° \ 6'$.
$O \wedge \frac{2}{3}\text{-}\bar{\imath}=147 \ 29$.	$O \wedge 1=127 \ 20$.	$1 \wedge 1$, brach,$=109 \ 6$.
$O \wedge 1\text{-}\breve{2}=133 \ 26$.	$O \wedge \frac{3}{4}\text{-}\breve{3}=144 \ 29$.	$i\text{-}\breve{2} \wedge i\text{-}\breve{2}$, ov. $i\text{-}\bar{\imath}$,$=129 \ 44$.
$O \wedge 2\text{-}\breve{2}=115 \ 20$.	$O \wedge 1\text{-}\breve{\imath}=138 \ 6$.	$i\text{-}\breve{2} \wedge i\text{-}\breve{2}$, ov. $i\text{-}\breve{\imath}$,$=123 \ 52$.

Cleavage: *i-ĭ* imperfect; *i-ī* and *O* less distinct. Twins: composition-face *I*; crystals often cruciform (f. 116), crossing at angles of 93° 40′ and 86° 20′; hence, also, cog-wheel shaped. Also massive: granular, compact.

115



116



Nagyag.

H.=2·5–3. G.=5·7–5·9. Lustre metallic. Color and streak steel-gray, inclining to blackish lead-gray or iron-black. Opaque. Fracture conchoidal or uneven. Brittle.

Comp., Var.—$3\,(\text{Ꞓu, Pb})\,\text{S}+\text{Sb}^2\,\text{S}^3$, or $(3\,\text{Ꞓu}\,\text{S}+\text{Sb}^2\,\text{S}^3)+2\,(3\,\text{Pb}\,\text{S}+\text{Sb}^2\,\text{S}^3)$ Ramm.=Sulphur 19·7, antimony 25·0, lead 42·4, copper 12·9=100. Analyses: 1, H. Rose (Pogg., xv. 573); 2, Sinding (Ramm. Handw., 123); 3–5, Rammelsberg (Pogg., lxxvii. 253); 6, C. Kuhlemann (ZS. Nat. Ver. Halle, viii. 500); 7, F. Field (Q. J. Ch. Soc., xiv. 158); 8, 9, Dufrénoy (Ann. d. M., III. x. 371):

	S	Sb	Pb	Cu
1. Neudorf	20·31	26·28	40·84	12·65=100·08 Rose.
2. "	19·63	25·68	41·38	12·68=99·37 Sinding.
3. Meiseberg	19·49	24·60	40·42	13·06=97·57 Ramm.
4. "	18·99	24·82	40·04	15·16=99·01 Ramm.
5. Wolfsberg	19·76	24·34	42·88	13·06=100·04 Ramm.
6. Clausthal	(½) 18·81	23·79	40·24	12·99, Fe 2·29, Mn 0·17, Ši 2·60=100 K.
7. Cornwall	20·30	26·30	40·80	12·70=100·10 Field.
8. Alais	19·4	29·4	38·9	12·3=100 Dufrénoy.
9. Mexico	17·8	28·3	40·2	13·3=99·6 Dufrénoy.
10. Huasco	20·45	26·21	40·76	12·52=99·94 Field. G.=5·80.

The Meiseberg mineral (No. 4) is light-gray, and occurs in tabular crystals, with an uneven conchoidal fracture, and submetallic lustre. G.=5·703, Zincken; 5·726 and 5·792, Bromeis; 5·779, Rammelsberg.

Another variety (No. 3) is iron-black, with the faces of a rhombic octahedron largely developed. Fracture conchoidal. Lustre metallic. G.=5·822 and 5·847, Bromeis; 5·844, Zincken; 5·863, Rammelsberg.

The Wolfsberg ore (No. 5) is iron-black. The crystals are rectangular prismatic. Fracture conchoidal. Lustre metallic. G.=5·726, Rammelsberg; 5·796, Zincken; 5·801 and 5·855, Bromeis.

For Zirkel on cryst. and history, see Ber. Ak. Wien, xlv. 431, 1862. Zirkel makes the macrodiagonal of the crystal above the vertical axis; and in this we have not followed him, because the above is strictly the *normal* position for the vertical axis, or that which homology with the cube requires, since *O* ∧ 1-ĭ and *O* ∧ 1-ī are near 135°. The faces *i*-ī and *i*-ĭ are homologous with the cubic faces, and *I*, *I* with the dodecahedral, the angle between which, either side of *i*-ĭ, is near 90°.

Pyr., etc.—In the closed tube decrepitates, and gives a dark-red sublimate. In the open tube gives sulphurous acid, and a white sublimate of oxyd of antimony. B.B. on charcoal fuses easily, and at first coats the coal white, from antimonous acid; continued blowing gives a yellow coating of oxyd of lead; the residue, treated with soda in R.F., gives a globule of copper.

Decomposed by nitric acid, affording a blue solution, and leaving a residue of sulphur, and white powder containing antimony and lead.

Obs.—Occurs in the mines of Neudorf in the Harz (which include the Meiseberg localities where the crystals occasionally exceed an inch in diameter; also at Wolfsberg, Clausthal, an Andreasberg in the Harz; with quartz, tetrahedrite, and phosphorescent blende, at Kapnik i Transylvania, in flattened crystals; at Servoz in Piedmont, associated with pearl spar an quartz. Other localities are the parish of Bräunsdorf and Gersdorf in Saxony, Olsa in Carinthi etc.; Endellion at Wheal Boys in Cornwall, where it was first found, and hence called *endellion* by Count Bournon, after whom it was afterward named; in Mexico; at Huasco-Alto in Chili at Machacamarca in Bolivia; in Peru.

Alt.—Occurs altered to cerussite, malachite, azurite, and also (as Rammelsberg has shown) t the mineral called *wölchite*, which occurs in similar crystals, with the same hardness and sam sp. gr. (5·88—5·94 Ramm.). It was originally from Wölch in Carinthia, but occurs also at Ols with true bournonite.

Schrötter, in his analysis of wölchite from Wölch, obtained (Baumgartn. ZS., viii. 284) S 28·6 Sb 16·65, As 6·04, Pb 29·90, Cu 17·35, Fe 1·40=99·94. Rammelsberg found, as the mean of analyses (Min. Chem., 80), S 16·81, Sb 24·41, Pb 15·59, Cu 42·83, Fe 0·36=100, excluding th percentage of mixed carbonate, sulphate, and antimonial salts of lead and copper, and some wate

120. STYLOTYPITE. Stylotyp *v. Kobell*, Ber. Ak. München, 1865, i. 163, 1865. Cañutill *Chilian miners.*

Orthorhombic. $I \wedge I$ about 92½°, near that of Bournonite. Twins cruciform, angle of intersection near 90°. Cleavage: none distinct.

H.=3. G.=4·79. Lustre metallic. Color iron-black; streak black Fracture imperfectly conchoidal, uneven.

Comp.—3 (Ꞓu, Ag, Fe) S + $Sb^2 S^3$, the species being an iron-silver-copper bournonite (ratio Ꞓ +Ag : Fe=2 : 1, and Ꞓu : Ag=6 : 1)=Sulphur 24·9, antimony 31·6, copper 28·2, silver 8·0, iro 7·3=100. Analysis: v. Kobell (l. c.):

S	Sb	Cu	Fe	Ag
24·30	30·53	28·00	7·00	8·30, Pb, Zn *tr.*=98·13

Pyr., etc.—B.B. decrepitates, and fuses very easily. On charcoal a steel-gray globule, whic is magnetic; fumes of antimony, and some lead coating the coal.

Obs.—From Copiapo in Chili.

Named from στῦλος, *column*, and τύπος, *form*, in allusion to the columnar form, in which it differ from tetrahedrite, although approaching it in composition.

121. WITTICHENITE. Kupferwismutherz *Selb.*, Denks. d'Aerzte u. Nat. Schwab., i. 419 *Klapr.*, Beitr., iv. 91, 1807. Bismuth sulfuré cuprifère *Fr.* Cupreous Bismuth; Cupriferous Sul phuret of Bismuth. Wismuth-Kupfererz *Leonh.*, 1826. Wittichit *v. Kob.*, Taf., 13, 1853. Witti chenit *Kenng.*, Uebers. 1853, 118, 1855.

Orthorhombic. Observed planes O, i-$\breve{i}$, i-$\bar{i}$, 1-$\breve{i}$, 1-$\bar{i}$, I, and isomorphou with bournonite, Breith.; prismatic angle of 110° 50′, Sandberger. Mas sive and disseminated; also coarse columnar, or an aggregate of imperfec prisms. Cleavage in one vertical direction.

H.=3·5. G.=5; 4·3, fr. Gallenbach, Hilger. Color steel-gray, tin white, tarnishing pale lead-gray. Streak black.

Comp.—3 Ꞓu S + $Bi^2 S^3$ (from Schneider's analyses)=Sulphur 19·44, bismuth 42·11, coppe 38·45=100; 3 (Ꞓu, Fe) S + $Bi^2 S^3$, from Hilger's.

Analyses: 1, Klaproth (l. c.); 2, Schenck (Ann. Ch. Pharm., xci. 232); 3, Tobler (ib., xcvi. 207) 4–7, Schneider (Pogg., xciii. 305, 472, xcvii. 476, cxxvii. 302); 8, Hilger (ib., cxxv. 144):

	S	Bi	Cu	Fe
1. Wittichen	12·58	47·24	34·66	——=94·48 Klaproth.
2. "	17·79	48·13	31·14	2·54=99·60 Schenck.

		S	Bi	Cu	Fe
3.	Wittichen	17·26	49·65	31·56	2·91=101·38 Tobler.
4.	"	16·15	51·83	31·31	——=99·29 Schneider.
5.	"	15·87	50·62	33·19	——=99·68 Schneider.
6.	"	([illegible]) 17·10	47·44	34·09	0·20, Co 0·36=99·19 Schneider
7.	"	([illegible]) 18·69	51·40	28·82	0·91=99·82 Schneider.
8	"	18·21	41·53	36·91	3·13=99·78 Hilger.

Pyr.—In the open tube gives sulphurous fumes and a white sublimate of sulphate of bismuth. B.B. on charcoal fuses easily, at first throws out sparks, and coats the coal with oxyd of bismuth; the residue with soda in R.F. gives a globule of metallic copper. Soluble in muriatic acid, with evolution of sulphuretted hydrogen; decomposed by nitric acid, with separation of sulphur.

Obs.—From cobalt mines with barite, near Wittichen in Gallenbach, Baden; analyses 4–6 are of specimens from the Neuglück mine, and 7, 8, from the Daniel mine; also at Zell, near Wolfach; at Christophsaue near Freudenstadt.

Alt.—Undergoes easy alteration, becoming yellowish-brown, then red and blue externally, forming apparently covellite; also changing to a greenish earthy mineral, which is a mixture of malachite, oxyd of bismuth, and hydrated oxyd of iron; also to an earthy yellow bismutite and bismuth-ochre. (Sandberger, Jahrb. Min., 1865, 274.)

122. BOULANGERITE. Plomb antimonié sulfuré *Boulanger*, Ann. d. M., III. vii. 575, 1835. Schwefelantimonblei *Germ.* Sulphuret of Antimony and Lead. Boulangerit *Thaulow*, Pogg., xli. 216, 1837; *Hausm.*, ib., xlvi. 281. Embrithite, Plumbostib, *Breith.*, J. pr. Ch., x. 442, 1837.

In plumose masses, exhibiting in the fracture a crystalline structure; also granular and compact.

H.=2·5–3. G.=5·75–6·0. Lustre metallic. Color bluish lead-gray; often covered with yellow spots from oxydation.

Comp.—$3\ PbS + Sb^2S^3$=Sulphur 18·2, antimony 23·1, lead 58·7=100. Analyses: 1, Boulanger (Ann. d. M., III. vii. 575); 2, Thaulow (Pogg., xli. 216); 3, Bromeis (Pogg., xlvi. 281); 4, Brüel (ib.); 5, Abendroth (Pogg., xlvii. 493); 6, Rammelsberg (3d Suppl., 28); 7, 8, E. Bechi (Am. J. Sci., II. xiv. 60); 9, Genth (private contrib.):

		S	Sb	Pb
1.	Molières	18·5	25·5	53·9, Fe 1·2, Cu 0·9=100 Boulanger.
2.	Nasafjeld,	18·86	24·60	55·57=99·03 Thaulow.
3.	Nertschinsk	18·21	25·04	56·29=99·54 Bromeis.
4.	"	19·11	23·66	53·87, Fe 1·78, Ag 0·05=98·47 Brüel.
5.	Ober-Lahr	19·05	25·40	55·60=100·07 Abendroth.
6.	Wolfsberg	18·91	25·94	55·15=100 Rammelsberg. G.=5·96.
7.	Tuscany, *mass.*	17·99	26·08	53·15, Cu 1·24, Zn 1·41, Fe 0·35=100·23 Bechi.
8.	" *acic.*	17·32	26·74	55·39 " 1·25 " 0·09 " 0·23=101·52 Bechi.
9.	Union Co., Nev.	17·91	26·85	54·82, Fe 0·42, Ag *tr.*=100 Genth.

Pyr.—Same as for zinkenite.

Obs.—Quite abundant at Molières, department of Gard, in France; also found at Nasafjeld in Lapland; at Nertschinsk; Ober-Lahr in Sayn-Altenkirchen; Wolfsberg in the Harz; near Bottino in Tuscany, both massive, acicular, and fibrous.

Embrithite is from the locality of boulangerite at Nertschinsk, and is probably the same species. It is granular in texture, of a lead-gray color, has G.=6·29—6·311; and contains, according to Plattner (l. c.), lead 53·3, copper 0·8, silver 0·04, along with antimony and copper. Named from ἐμβριθής, *heavy*.

Plumbostib is also from Nertschinsk. It consists, according to Plattner, of antimony, arsenic, sulphur, a little iron, with 58·8 p. c. of lead; and appears to be boulangerite. Named from *plumbum* and *stibium*.

123. KOBELLITE. Kobellit *Sätterberg*, Ak. H. Stockh., 188, 1839; Jahresb., xx. 215.

Resembles gray antimony, but brighter in lustre; structure radiated.

G.=6·29–6·32, Sätterberg; 6·145, Ramm. Soft. Color blackish lead-gray to steel-gray. Streak black.

Comp.—$(3\ PbS + Bi^2S^3) + (3\ PbS + Sb^2S^3)$ Ramm.=$3\ PbS + (Bi, Sb)^2S^3$=Sulphur 16·8, bismuth 18·2, antimony 10·6, lead 54·4=100.

Analyses: 1, Sätterberg (loc. cit.); 2, Rammelsberg (J. pr. Ch., lxxxvi. 340):

	S	Sb	Bi	Pb	Fe	Cu
1.	17·86	9·24	27·05	40·12	2·96	0·80, gangue 1·45=99·48 S.
2.	17·47	10·43	20·52	48·78	1·55	——=98·75 R.

Rammelsberg's analysis represents the composition of pure kobellite after excluding 5 61 p. cobaltiferous pyrites, and 3·67 p. c. chalcopyrite, present as mechanical impurities in the spe men analyzed.

Pyr., etc.—B.B. in the closed tube fuses and gives a faint sublimate of sulphur. In the op tube, sulphurous fumes and a sublimate of oxyd of antimony. On charcoal fuses and forms coating, the outer edge of which is white from antimonous acid, etc., and near the assay da yellow. Soluble in concentrated muriatic acid, with evolution of sulphuretted hydrogen.

Obs.—From the cobalt mine of Hvena in Sweden, associated with actinolite, chalcopyrite, a small reddish-white crystals of a cobaltiferous mispickel (Kobaltarsenikkies). Named after v Kobell.

124. AIKINITE. Nadelerz *Mohs*, Null's Kab., iii. 726, 1804. Bismuth sulfuré plumbo-cup fère *H.*, Tabl, 105, 1809. Needle Ore; Acicular Bismuth; Cupreous Bismuth. Aikinite *Ch man*, Min., 127, 1843. Patrinite *Haid.*, Handb., 568, 1845. Belonit *Glock.*, Syn., 27, 18 Aciculite *Nicol*, Min., 487, 1849.

Orthorhombic. $I \wedge I=110°$ nearly, Hörnes. Crystals long, imbedde acicular, longitudinally striated. Also massive.

H. = 2–2·5. G.=6·1–6·8; 6·757, Frick. Lustre, metallic. Col blackish lead-gray, with a pale copper-red tarnish. Opaque. Fractu uneven.

Comp.—(3 Ꞓu S+Bi^2 S^3)+2 (3 Pb S+Bi^2 S^3)=3 (Ꞓu, Pb) S+Bi^2 S^3=Sulphur 16·7, bismu 36·2, lead 36·1, copper 11·0=100. Supposed to be isomorphous with bournonite.

Analyses: 1, 2, Frick (Pogg., xxxi. 529); 3, Chapman (Phil. Mag., III. xxxi. 541); 4, Herma (J. pr. Ch., lxxv. 452):

	S	Bi	Pb	Cu	Ni
1. Beresof	16·05	34·62	35·69	11·79	——=98·15 Frick; G.=6·757.
2. "	16·61	36·45	36·05	10·59	——=99·70 Frick.
3. "	18·78	27·93	40·10	12·53	——=99·64 Chapman; G.=6·1.
4. "	16·50	34·87	36·31	10·97	0·36, Au 0·09=100 Herm.

Pyr., etc.—In the open tube gives sulphurous fumes, and also a white sublimate, which m be fused into clear drops that are white on cooling; the assay becomes surrounded with a bla fused oxyd, which on cooling is transparent and greenish-yellow. B.B. on charcoal fuses a gives a white coating, yellow on the edge nearest the assay; with the fluxes, reactions for co per, and after long blowing a globule of metallic copper.

Decomposed by nitric acid, with separation of sulphur and sulphate of lead.

Obs.—Occurs at Beresof near Katharinenburg, Urals, with gold, malachite, and galenite, white quartz. In the United States, in the gold region of Georgia (?) in slender crystals, so of which have a centre of gold, and others are altered to bismuth-ochre or cupreous carbonate bismuth (Genth, Am. J. Sci., II. xxxiii. 190); probably at Gold Hill, Rowan Co., N. Carolina.

Alt.—Occurs, as just stated, altered to bismuth-ochre and native gold.

RETZBANYITE *Hermann* (J. pr. Ch., lxxv. 450, 1859). A lead-gray ore of bismuth, occurri mixed with the product of its alteration, at Retzbanya in Hungary It is without trace of cr tallization; H.=2·5; G.=6·21. Afforded Hermann, S 11·93, O 7·14, Bi 38·38, Pb 36·01, 1·93, Cu 4·22=99·61.

125. TETRAHEDRITE. Argentum arsenico cupro et ferro mineralisatum, Falerts, Grauer Minera argenti grisea, *Wall.*, 313, 1747. Falerz, Argentum cupro et antimonio sulph. miner isatum, *Cronst.*, 157, 1758; Pyrites cupri griseus, Fahlkupfererz, *Cronst.*, 175, 1758. Argent cinereum crystallis pyramidatis trigonis *v. Born*, Lithoph., i. 82, 1772. Cuprum cinereum cry trigonis, etc., *v. Born*, ib., 108. Fahlerz, Kupferfahlerz, Schwarzerz pt., Antimonfahlerz, *Ge*

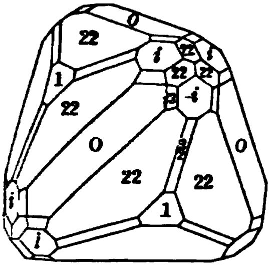
Mine de cuivre grise *de Lisle*, Crist., iii. 315 (with figs. cryst.), 1783. Cuivre gris *Fr.* Gray Copper Ore. Panabase *Beud.*, Tr., ii. 438, 1832. Tetraëdrit *Haid.*, Handb., 563, 1845. Clinoëdrit pt., Fahlit, *Breith.*, B. H. Ztg., xxv. 181.

Argentif.: Argentum rude album pt. *Agric.*, Foss., 362, 1546. Weisgylden, Minera argenti alba pt., *Wall.*, 312, 1747; Cronstedt, 156, 1758. Weissgultigerz pt., Silberfahlerz, Graugiltigerz pt., Schwarzgiltigerz pt., *Germ.* Freibergit *Kenng.*, Min., 117, 1853. Polytelit *v. Kob.*, Taf., 10, 1853 [not of *Glock.*, Syn., 31, 1847].

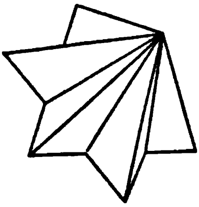
Mercurial: Schwarzerz pt. *Wern.* Quecksilberfahlerz. Graugiltigerz pt. *Hausm.* Spaniolith *v. Kob.*, Min. Namen, 98, 1853. Schwatzit *Kenng.*, Min., l. c., 1853. Hermesit *Breith.*, B. H. Ztg., xxv. 182.

Isometric; tetrahedral. Observed planes: those of f. 117, with also 4-4, 5-5?, $\frac{8}{5}$-$\frac{8}{5}$, $\frac{12}{5}$-$\frac{12}{7}$; on one crystal from Kahl, 1, 2-2, $\frac{8}{5}$-$\frac{8}{5}$, $\frac{12}{5}$-$\frac{12}{7}$, —1, —2-2, —4-4. —5-5?, with *O* and *i*, Hessenberg. Twins, composition face octahedral, producing, when the composition is repeated, the form in f. 119, the simpler condition of which is shown in f. 118, a solid seemingly made of two interpenetrating tetrahedrons; also forms similar to f. 62, 63, p. 21, in which the tetrahedrons are united in a reversed position. Also massive; granular, coarse, or fine; compact or crypto-crystalline.

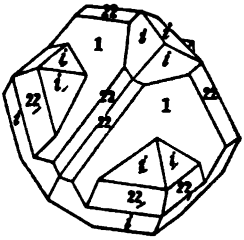
117



118



119



H.=3—4·5. G.=4·5—5·11. Lustre metallic. Color between light flint-gray and iron-black. Streak generally same as the color; sometimes inclined to brown and cherry-red. Opaque; sometimes subtranslucent in very thin splinters, transmitted color cherry-red. Fracture subconchoidal—uneven. Rather brittle.

Comp., Var.—4 Cu S + Sb^2S^3, with part of the copper often replaced by iron, zinc, silver, or quicksilver, and rarely cobalt, and part of the antimony by arsenic, and rarely bismuth; whence the general formula 4 (Ȼu, Fe, Zn, Ag, Hg) + $(Sb, As, Bi)^2 S^3$. Ratio Ag + Ȼu : Zn + Fe generally =1 : 1. There are thus:

A. An antimonial series;
B. An arsenio-antimonial series;
C. A bismuthic arsonio-antimonial;

besides an *arsenical*, in which arsenic replaces all the antimony, and which is made into a distinct species named *tennantite*. In the analyses below the largest amount of arsenic given is about 20 p. c. (anal. 20.)

Var. 1. *Ordinary*. Containing little or no silver (Cupreous tetrahedrite; Kupferfahlerz, Lichtes Fahlerz, Graugiltigerz pt., *Germ.*). Color steel-gray to dark gray. G.=5—5·8.

2. *Argentiferous*; *Freibergite* (Syn. above). Light steel-gray, sometimes iron-black. G.=4·8—5. or less.

3. *Mercuriferous*; *Schwatzite* (Syn. above). Color gray to iron-black. G.=5—5·6. Breithaupt designates the ore of Schwatz alone *schwatzite*, having G.=5·107; that of Kotterbach and others;

having G.=5·2—5·28, *spaniolite;* that of Moschellandsberg, having G.=5 5—5·566, *hermesite* (from the Greek for Mercurius), it affording Hg 24·10, Ag 5·62. But another ore from Moschellandsberg contains Hg 17·32 p. c., and no silver, a fact which shows the futility of attempts to divide up tetrahedrite into distinct groups or species.

4. *Platiniferous.* An ore from Guadalcanal, Spain, contains, according to Vauquelin, 1—10 p. c of platinum.

In distinguishing these varieties, color, as above seen, is a poor criterion, it depending largely on the amount of iron present. The argentiferous ores are commonly the lighter gray, but not always so.

Analyses: *Ordinary.* 1. Kerl (B. H. Ztg., 1853, No. 2); 2, Bromeis (Pogg., lv. 117); 3, Amelung (Ramm., 3d Suppl., 51); 4, Klaproth (Beitr., iv. 61); 5, H. Rose (Pogg., xv. 576); 6, C Kuhlemann (ZS. nat. Ver. Halle, viii. 500, Jahresb., 1856, 834); 7, J. L. Smith (Am. J. Sci., II xliii. 67); 8, Sandmann (Ann. Ch. Pharm., lxxxix. 364); 9, H. Rose (l. c.); 10, Wandesleben (Jahrb. Pharm. ii. 105, Jahresb., 1854, 814); 11, A. Löwe (Rose's Reis. Ural, i. 197); 12, Wittstein (Viert. pr. Pharm., iv. 72); 13, Sandmann (l. c.); 14, Sandberger (Jahrb. Min., 1865, 584); 15, H Rose (l. c.); 16, Ebelmen (Ann. d. M., IV. xi. 47); 17, H. Rose (l. c.); 18, Hilger (Jahrb. Min., 1865, 591); 19, 20, v. Bibra (J. pr. Ch., xcvi. 204).

Argentiferous. 21, Svanberg (Œfv. Ak. Stockh., iv. 85); 22, C. Kuhlemann (l. c.); 23, J. L Smith (Gilliss's Exp., ii. 91); 24, H. Rose (l. c.); 25 J. L. Smith (Am J. Sci., II. xliii. 67); 26 Sander (Ramm., 1st Suppl., 52); 27–29, Rammelsberg (Pogg., lxxvii. 251); 30, Paykull (Œfv. Ak Stockh., 1866, 85, J. pr. Ch., c. 62); 31, F. A. Genth (Am. J. Sci., II. xvi. 83); 32, Klaproth (Beitr. iv. 73); 33, 34, H. Rose (l. c.).

Mercurial. 35–37, v. Hauer (Jahrb. g. Reichs., 1852, 98, J. pr. Ch., lx. 55); 38, Klaproth (Beitr. iv. 65); 39, v. Hauer (l. c.); 40, 41, Kersten (Pogg., lix. 131, lxvii. 428); 42, C. Bechi (Am. J. Sci. II. xiv. 60); 43, Scheidhauer (Pogg., lviii. 161); 44, v. Hauer (l. c.); 45, H. Weidenbusch (Pogg. lxxvi. 86); 46, G. v. Rath (Pogg., xcvi. 322); 47, Œllacher (Jahrb. Min., 1865, 594):

1. *Containing little or no Silver.*

		S	Sb	As	Cu	Fe	Zn	Ag
1.	Rammelsberg, *mas.*	25·82	28·78	——	37·95	2·24	2·52	0·67=97·98 Kerl.
2.	Durango	23·76	25·97	——	37·11	4·42	5·02	1·09, Pb 0·54, *und.* 0·47=98·38 Bromeis
3.	Kamsdorf	23·73	28·87	*tr.*	38·78	5·03	3·59	——=100 Amelung.
4.	Kapnik	28·00	22·00	——	37·75	3·25	5·00	0·25=96·25 Klaproth.
5.	"	25·77	23·94	2·88	37·98	0·86	7·29	0·62=99·34 Rose.
6.	Andreasberg	25 22	27·38	0·67	37·18	3·94	5·00	1·58=100·97 Kuhlemann.
7.	Arkansas	26·71	26·50	1·02	36·40	1·89	4·20	2·30=99·02 Smith.
8.	Mornshausen	(§) 24·61	25·65	1·65	38·17	1·59	6·28	0·62, Ni *tr.*=98·57 Sandm.
9.	Dillenburg	25·03	25·27	2·26	38·42	1·52	6·85	0·83=100·18 Rose.
10.	Freiberg	27·27	17·40	2·40	42·02	8·41	1·89	0·06=99·45 Wandesleben.
11.	Beresof	26·10	21·47	2·42	40·57	2·92	5·07	[0·56]=99·11 Löwe.
12.	Cornwall	25·64	23·66	4·40	39·18	6·99	——	——=99·87 Wittstein.
13.	Stahlberg	(§) 25·52	19·71	4·98	38·41	2·29	6·50	0·69, Ni *tr.*, S̈i 0·36=98·4 Sandmann.
14.	Schwarzwald	26·40	14·72	6·98	33·83	6·40	——	1·37, Co 4·21, Ni *tr.*, Bi 4·5 =98·46 Sandberger
15.	Gersdorf	26·33	16·52	7·21	38·63	4·89	2·76	2·37=98·71 Rose.
16.	Algeria	27·25	14·77	9·12	41·57	4·66	2·24	——=99·61 Ebelmen.
17.	Elsace	26·83	12·46	10·19	40·60	4·66	3·69	0·60, quartz 0·41=99·44 R.
18.	Kahl, in Zechstein	28·34	15·05	10·19	32·04	4·85	3·84	0·22, Co 2·95, Pb 0·43, Bi 1·88=99·74 Hilger.
19.	Algodon, Bolivia	19·66	18·00	19·30	36·35	4·29	——	0·58, Hg *tr.*=98·18 Bibra.
20.	" "	21·14	11·64	20·05	38·72	6·33	——	0·45, Pb, Hg *tr.*=98·33 B.

2. *Containing Silver: Freibergite.*

		S	Sb	As	Cu	Fe	Zn	Ag
21.	*Aphthonite*	30·05	24·77	*tr.*	32·91	1·31	6·40	3·09, Pb 0·04, Co 0·49, gangue 1·29=100·37 Svanberg.
22.	Clausthal	25·54	27·64	——	34·59	6·23	3·43	3·18=100·61 Kuhlemann.
23.	Chili	26·83	23·21	3·05	36·02	2·36	4·52	3·41=99·40 Smith.
24.	Clausthal	24·73	28·24	——	34·48	2·27	5·55	4·97=100·24 Rose.
25.	Arkansas	25·32	27·01	0·61	33·20	0·82	6·10	4·97=98·03 Smith.
26.	Clausthal	24·10	26·80	——	35·70	4·50	——	8·90, Pb 0·90=100·90 Sand.

	S	Sb	As	Cu	Fe	Zn	Ag	
27. Meiseberg, *massive*	24·22	26·44	——	31·53	4·36	3·25	7·27=97·07 Ramm.	
28. " "	24·69	25·74	——	32·46	4·19	3·00	7·55=97·63 Ramm.	
29. " *cryst.*	24·80	26·56	——	30·47	3·52	3·39	10·48, Pb 0·78=100 Ramm	
30. Longbon	23·32	[28·76]	——	30·04	1·86	6·02	10·00=100 Paykull.	
31. Cabarrus, N. C.	25·48	17·76	11·55	30·73	1·42	2·53	10·53=100 Genth.	
32. Wolfach	25·50	27·00	——	25·50	7·00	——	13·25=98·25 Klaproth	
33. "	23·52	26·68	——	25·23	3·72	3·10	17·71=99·91 Rose.	
34. Freiberg	21·17	24·68	——	14·81	5·98	0·99	31·29=98·87 Rose.	
3. *Containing Mercury: Spaniolite.*								Hg
35. Poratsch, Hungary	22·00	31·56	——	39·04	7·38	——	0·12	0·52=100·62 Hauer
36. " "	19·38	33·33	——	34·23	9·46	——	0·10	3·57=100·07 Hauer
37. " "	24·89	30·18	——	32·80	5·85	——	0·07	5·57=99·36 Hauer.
38. " "	26·00	19·50	——	39·00	7·50	——	——	6·25=98·25 Klap.
39. " "	24·37	25·48	*tr.*	30·58	1·46	——	0·09	16·69=98·67 Hauer.
40. V. di Castello	24·17	27·47	——	35·80	1·89	6·05	0·32	2·70=98·41 Kersten.
41. Angina, Tuscany	23·40	27·47	——	35·90	1·93	6·24	0·33	2·70=97·97 Kersten.
42. " "	24·14	26·52	——	37·72	1·64	6·23	0·45	3·03=99·73 Bechi.
43. Iglo, Hungary	(⅔) 24·74	19·34	4·23	37·54	5·21	1·07	*tr.*	7·87=100 Scheidh.
44. Zavatka "	25·90	26·70	*tr.*	36·59	7·11	——	0·11	3·07=90·48 Hauer.
45. Schwatz, Tyrol	22·96	21·35	——	34·57	2·24	1·34	——	15·57, gangue 0·80=98·83 Weidenbusch.
46. Kotterbach	(⅓) 22·53	19·34	2·94	35·34	0·87	0·69	——	17·27, Pb 0·21, Bi 0·81 =100 Rath.
47. Moschellandsberg	21·90	23·45	0·31	32·19	1·41	0·10	0·10	17·32, Co 0·23, Bi 1·57, gangue 1·39=99·87 O.

G. in anal. 12, 4·73; 13, 4·58; 21, 4·87; 27, 4·89—4·946; 28, 4·526; 29, 4·852; 35, 4·582; 36, 4·762; 37, 4·733; 39, 5·107; 41, 4·84; 44, 4·605; 45, 5·107; 46, 5·356.

Cobalt occurs in the ore of Schwarzwald, Moschellandsberg, Schottenhöfen near Zell, Clara near Schapbach, and others.

Pyr., etc.—Differ in the different varieties. In the closed tube all fuse and give a dark-red sublimate of sulphid of antimony; when containing mercury, a faint dark-gray sublimate appears at a low red heat; and if much arsenic, a sublimate of sulphid of arsenic first forms. In the open tube fuses, gives sulphurous fumes and a white sublimate of antimony; if arsenic is present, a crystalline volatile sublimate condenses with the antimony; if the ore contains mercury it condenses in the tube in minute metallic globules. B.B. on charcoal fuses, gives a coating of antimonous acid and sometimes arsenous acid, oxyd of zinc, and oxyd of lead; the arsenic may be detected by the odor when the coating is treated in R.F.; the oxyd of zinc assumes a green color when heated with cobalt solution. The roasted mineral gives with the fluxes reactions for iron and copper; with soda yields a globule of metallic copper. To determine the presence of a trace of arsenic by the odor, it is best to fuse the mineral on charcoal with soda. The presence of mercury is best ascertained by fusing the pulverized ore in a closed tube with about three times its weight of dry soda, the metal subliming and condensing in minute globules. The silver is determined by cupellation.

Decomposed by nitric acid, with separation of sulphur and antimonous and arsenous acids.

Obs.—The Cornish mines, near St. Aust., have afforded large tetrahedral crystals, with rough and dull surfaces. More brilliant crystallizations occur at the Levant mine near St. Just, at Condurrow mine and other places in Cornwall; at Andreasberg and Clausthal in the Harz; Kremnitz in Hungary; Freiberg in Saxony; Przibram in Bohemia; Kahl in Spessart; Kapnik in Transylvania; Dillenburg in Nassau; and other localities mentioned above.

The ore containing mercury occurs in Schmölnitz, Hungary; at Poratsch, Zavatka, and Kotterbach near Iglo; at Schwatz in the Tyrol; and in the valleys of Angina and Castello in Tuscany.

Tetrahedrite is found in America; in Mexico, at Durango, etc.; at various mines in Chili; in Bolivia; at the Kellogg mines, 10 m. N. of Little Rock, Arkansas, with galenite. In California in Mariposa Co., in the Pine Tree gold vein and others; in Shasta Co., Chicago claim. In Nevada, abundant at the Sheba and De Soto mines, Humboldt Co., massive and rich in silver (the De Soto containing 16·4 p. c. of silver, Allen); near Austin in Lander Co.; in Arizona at the Heintzelman mine, containing 1½ p. c. of silver; at the Santa Rita mine.

Alt.—Chalcopyrite, malachite, azurite, amalgam, bournonite, erythrite, cinnabar, covellite, occur as pseudomorphs after tetrahedrite. Also a red pulverulent mineral, consisting of an acid of antimony, oxyd of copper or oxyd of mercury, etc. (See *Ammiolite.*)

Annivite of Brauns (Mitth. nat. Ges. Bern, 1854, Kenngott's Ueb., 1855), from the Anniver valley in the Valais, is probably, according to Kenngott, only tetrahedrite. Brauns obtained 23·75, Sb 8·80, As 10·96, Bi 4·94, Cu 35·57, Fe 3·85, Zn 2·01, quartz 9·40=100·28. Excluding th quartz, the composition corresponds nearly to 4 R S+($As^2 S^3$, $Sb^2 S^3$, $Bi^2 S^3$). It occurs onl massive, and is mixed with chalcopyrite.

Studerite of Fellenberg (Mitth. nat. Ges., Bern, 1864, 178) is a similar compound (Kenng Min. d. Schweiz, 402). It is from Ausserberg in the Upper Valais, Switzerland. Fellenber obtained, S 24·70, Sb 15·43, As 11·38, Bi 0·57, Cu 37·89, Fe 2·73, Zn 5·06, Pb 0·38, Ag 0·9 gangue 1·81. G.=4·657.

A. FIELDITE.—An ore from mine Altar, 30 leagues from Coquimbo, afforded F. Field (Q. J. Cl Soc., iv. 332), S 30·35, As 3·91, Sb 20·28, Cu 36·72, Zn 7·26, Fe 1·23, Ag 0·075, Au 0·003. It i soft, of greasy appearance, greenish-gray, slightly reddish, with powder bright-red. Domeyk considers it impure with blende, pyrite, and galenite. Ettling observes (ib., vi. 140) that the co stitution is analogous rather to enargite than tetrahedrite, corresponding to the formula 4 (Ꞓ Zn, Fe, Ag) S+(Sb, As^2) S^5. Kenngott has named it *Fieldite*.

B. APHTHONITE (or Aftonite) Svanberg.—A steel-gray ore, resembling tetrahedrite, if not ide tical with it; H.=3; G.=4·87; and it contains, according to Svanberg (Berz. Jahresb., xxvi 236), S 30·05, Sb (with *tr.* of As) 24·77, Cu 32·91, Ag 3·09, Zn 6·40, Fe 1·31, Co 0·49, Pb 0·0 gangue 1·29=100·35. Ratio of sulphid of antimony to that of the other metals, 3 : 6·4. Fro Wermland in Sweden.

126. POLYTELITE *Glock.*, Syn., 31, 1847. (Weissgültigerz pt.) An ore consisting mainly o lead, silver, antimony, and sulphur. Glocker cites Rammelsberg's analysis (Pogg., lxviii. 51 Min. Ch., 99) of an ore from Hoffnung Gottes mine near Freiberg, a fine-granular ore, having =5·438—5·465, apparently homogeneous but somewhat mixed with blende and pyrite. Klaprot analyzed a related *weissgültigerz* from the Himmelsfürst mine near Freiberg (Beitr. i. 166).

	S	Sb	Cu	Fe	Zn	Pb	Ag
1. Himmelsfürst, *light*	13·21	8·50	——	2·42	——	51·81	22·00=97·94
2. " *dark*	22·39	21·88	——	1·79	——	41·73	9·41=97·20
3. Hoff. G.	22·53	22·39	0·32	3·83	6·79	38·36	5·78=100 R.

Rammelsberg makes the mineral, from his analysis, a silver-lead tetrahedrite, with the formul 4 (Pb, Ag, Fe, Zn) S+$Sb^2 S^3$, in which the ratio Fe : Zn : Pb+Ag=2 : 3 : 6, and Pb : Ag=7 :

127. TENNANTITE. Gray Sulphuret of Copper in dodecahedral crystals *Sowerby*, Brit. Min 1817. Tennantite *Wm. & R. Phillips*, Q. J. Sci., vii. 95, 100, 1819. Arsenikalfahlerz *Gern* Kupferblende *Breith.*, Char., 131, 251, 1823, Pogg., ix. 613, 1827. Sandbergerit *Breith.*, B. Ztg., xxv. 187, 1866.

Isometric; holohedral, Phillips. Observed planes O, I, 1, 2-2, Figs. 55, 57, 58, and 18 with planes of 55. Cleavage: dodecahedral im perfect. Twins as in tetrahedrite. Massive forms unknown.

H.=3·5—4. G.=4·37—4·53; 4·37—4·49, Cornwall; 4·53, Skutterud Lustre metallic. Color blackish lead-gray to iron-black. Streak dar reddish-gray. Fracture uneven.

Comp.—4 (Ꞓu, Fe) S+$As^2 S^3$, agreeing in crystalline form and general formula with tetrah drite. Analyses: 1, Phillips (l. c.); 2, Kudernatsch (Pogg., xxxviii. 397); 3, Wackernag (Ramm, Min. Ch., 88); 4, Rammelsberg (Min. Ch., 88); 5, Fearnley (Scheerer in Pogg., lxv. 298) 6, Plattner (Pogg., lxvii. 422); 7, Merbach (B. H. Ztg., xxv. 187):

	S	As	Cu	Fe	Zn
1. Trevisane, Cornw.	30·25	12·46	47·70	9·75	——=100·16 Phillips.
2. " "	27·76	19·10	48·94	3·57	—— Ag *tr.*, S̈i 0·08=99·45 Kud.
3. " "	26·88	20·53	48·68	3·09	——=99·18 Wack.
4. " "	26·61	19·03	51·62	1·95	——=99·21 Ramm.
5. Skutterud, G.=4·53	29·18	19·01ᵃ	42·60	9·21	——=100 Fearnley.
6. *Kupferblende*	28·11	18·88	41·07	2·22	8·89, Ag, Sb, *tr.*, Pb 0·34=99·51 Pl.
7. *Sandbergerite*	25·12	14·75	41·08	2·38	7·19, Sb 7·19, Pb 2·77=100·48 Merbach.

The Kupferblende *Breith.* (or *zincfahlerz*), from near Freiberg (anal. 6), has part of the ir replaced by zinc. Its streak is brownish or dirty cherry-red; G.=4·2—4·4. The *sandberger* (anal. 7), from L. Morococha in Peru, is stated to have cubic cleavage, an iron-black color, and G. =4·369; it is in tetrahedral crystals, having also the planes *i*, 2-2.

Pyr.—In the closed tube gives a sublimate of sulphid of arsenic. In the open tube gives sulphurous fumes, and a sublimate of arsenous acid. B.B. on charcoal fuses with intumescence and emission of arsenic and sulphur fumes to a dark-gray magnetic globule. The roasted mineral gives reactions for copper and iron with the fluxes; with soda on charcoal gives metallic copper, with iron.

Obs.—Formerly found in the Cornish mines, particularly at Wheal Jewel in Gwennap, and Wheal Unity in Gwinear, usually in splendent crystals investing other copper ores; but latterly not met with unless at East Relistian mine. Also at Skutterud in Norway, and in Algeria.

Named after the chemist, Smithson Tennant.

128. MENEGHINITE. *Bechi*, Am. J. Sci., II. xiv. 60, 1852.

Monoclinic, v. Rath. Observed planes: vertical, *i*-*ì*, *i*-*i*, *I*, *i*-$\frac{5}{3}$, *i*-2̀, *i*-$\frac{7}{3}$, *i*-$\frac{4}{3}$, *i*-3̀; hemidomes 1-*i*, 2-*i*, −1-*i*, −2-*i*; hemioctahedral, 2-2, and four others. *I* ∧ *I*=140° 16′, *i*-2̀ ∧ *i*-2̀, front, 108° 17′, *i*-3̀ ∧ *i*-3̀, front, 85° 23′, *i*-*i* ∧ −1-*i* =110° 0′, *i*-*i* ∧ −2-*i*=124° 30′, *i*-*i* ∧ 1-*i*=107° 54′, *i*-*i* ∧ 2-*i*=124° 29′. Crystals slender prismatic. Twins: composition-face *i*-*i*; 1-*i* ∧ −1-*i*=177° 54′, the two faces 1-*i*, −1-*i* being nearly in the same plane. Also compact fibrous.

H.=2·5. G.=6·339. Lustre metallic, very bright. Resembles boulangerite.

Comp.—$4\,Pb\,S+Sb^2\,S^3$. analogous to tetrahedrite. Analysis: 1, E. Bechi (l. c.); 2, v. Rath (Pogg., cxxxii. 1867):

	S	Sb	Pb	Cu	Fe
1. Bottino	17·52	19·28	59·21	3·54	0·35=99·90 Bechi.
2. "	16·97	18·37	61·47	0·39	0·28, *undec.* 0·82=98·25 Rath.

Obs.—Occurs at Bottino, near Serravezza, in Tuscany, along with galenite, boulangerite, jamesonite, etc., and also crystals of albite; also in the neighboring valley of Castello. First observed by Prof. Meneghini, of Pisa. The crystallization has been determined as above given, and crystals, both simple and compound, figured by v. Rath (l. c.). Q. Sella made it orthorhombic (Gazz. uffic. d'Ital., 1862).

129. GEOCRONITE. Geokronit *Svanberg*, Jahresb., xx. 203, 1839. Kilbrickenite *Apjohn*, Trans. R. Irish Ac., 1840. Schulzit *Hausm.*, Handb., 166, 1847.

Orthorhomic. *I* ∧ *I*=119° 44′, Kerndt. Observed planes: *I*, *i*-*ĭ*, 1-2̆. 1-2̆ ∧ 1-2̆, pyram., about 153° and 64° 45′, bas., 122°. Cleavage: *I*. Usually massive. Also granular or earthy.

H.=2—3. G.=6·4—6·6. Lustre metallic. Color and streak light lead-gray—grayish blue. Fracture uneven.

Comp.—$5\,Pb\,S+(Sb,\,As)^2\,S^3$=Sulphur 16·5, antimony 16·7, lead 66·8=100. Analyses: 1, Svanberg (Jahresb., xx. 203); 2, Sauvage (Ann. de M., III. xvii. 525); 3, Kerndt (Pogg., lxv. 302); 4, Apjohn (l. c.); 5, Svanberg (Œfv. Ak. Stockh., 1848, 64):

		S	Sb	As	Pb	Cu	Fe
1. Sala, Sweden	G.=6·54	16·26	9·58	4·69	65·45	1·51	0·42, Zn 0·11=99·03 Sv.
2. Merido, *Schulzite*	G.=6·43	16·90	16·00	——	64·89	1·60	——=99·39 Sauvage.
3. Tuscany,	G.=6·45—6·47	17·32	9·69	4·72	66·55	1·15	1·73=100·95 Kerndt.
4. *Kilbrickenite*	G.=6·407	16·36	14·39	——	68·87	——	0·38=100 Apjohn.
5. Fahlun	G.=6·434	15·16	5·66	4·62	64·17	4·17	0·08, Ag 0·24, Zn 0·59, Cu 4·17, Äl 1·9=98·35 Svanberg.

Svanberg deduces for the last the formula $6\,Pb\,S+(Sb,\,As)^2\,S^3$.

Pyr.—Same as for zinkenite.

Obs.—From the silver mines of Sala in Sweden; also from Gallicia, Merido in Spain, in nodules in galena; it crumbles easily and soils the fingers; the valley di Castello near Pietro Santo, in Tuscany.

The *killbrickenite* is from Kilbricken, Clare Co., Ireland.

The name geocronite is derived from γῆ, *earth*, and Κρόνος, *Saturn*, the alchemistic name for lead.

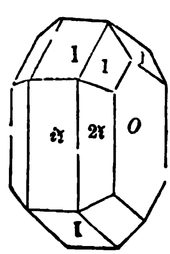
A mineral found at Tinder's gold mine, Louisa Co., Va., may be this species. It contains, according to Genth (Am. J. Sci., II. xix. 19) S 16, Pb 60, Ag 0·25, with antimony and arsenic.

An antimonial ore from between La Paz and Yungas, in Bolivia, is referred here by D. Forbes (Phil. Mag., IV. xxix. 9).

130. STEPHANITE. Argentum rude nigrum?, *Germ.* Schwarzerz, pt., *Agric.*, Interpr., 462, 1456. Svartgyldon, Schvartsertz, pt. Minera argenti nigra spongiosa (fr. Freiberg) *Wall.*, 313, 1747. Argentum mineralisatum nigrum fragile (fr. Schemnitz, etc.), Röschgewächs (of Hung. miners) *Born.*, Lithoph., i. 81, 1772. Sprödglaserz *Wern.*, 1789. Sprödglanzerz. Brittle Silver Ore, or Glance. Brittle Sulphuret of Silver. Argent noir pt. *H.*, Tr., 1801. Argent sulfuré fragile *Fr.* Schwarzgültigerz *Leonh.*, Handb., 638, 1826. Psaturose *Beud.*, Tr., ii. 432, 1832. Stephanit *Haid.*, Handb., 570, 1845.

Orthorhombic. $I \wedge I = 115° \ 39'$, $O \wedge 1\text{-}\bar{\imath} = 132° \ 32\frac{1}{2}'$; $a : b : c = 1·0897 : 1 : 1·5844$. Observed planes: O; vertical, $i\text{-}\breve{\imath}$, $i\text{-}\bar{\imath}$, $i\text{-}\breve{11}$, $i\text{-}\breve{9}$, $i\text{-}\bar{3}$, $i\text{-}\breve{3}$; domes $\frac{2}{3}\text{-}\breve{\imath}$, $1\text{-}\breve{\imath}$, $2\text{-}\breve{\imath}$, $4\text{-}\breve{\imath}$, $\frac{15}{2}\text{-}\breve{\imath}$, $7\text{-}\breve{\imath}$, $8\text{-}\breve{\imath}$, $1\text{-}\bar{\imath}$; octahedral, $\frac{1}{4}$, $\frac{1}{3}$, $\frac{1}{2}$, $\frac{2}{3}$, 1, 2, $\frac{22}{7}\text{-}\breve{11}$, $3\text{-}\breve{}$, $\frac{7}{2}\text{-}\breve{7}$, $1\text{-}\breve{5}$, $\frac{5}{3}\text{-}\breve{5}$, $15\text{-}\breve{5}$, $8\text{-}\breve{4}$, $\frac{3}{4}\text{-}\bar{3}$, $1\text{-}\bar{3}$, $\frac{2}{3}\text{-}\bar{3}$, $3\text{-}\bar{3}$, $\frac{4}{3}\text{-}\bar{2}$, $4\text{-}\bar{2}$, $\frac{13}{3}\text{-}\breve{\frac{13}{7}}$, $5\text{-}\breve{\frac{5}{3}}$, $\frac{5}{2}\text{-}\breve{\frac{5}{3}}$, $6\text{-}\breve{\frac{3}{2}}$; $\frac{3}{2}\text{-}\bar{3}$, $3\text{-}\bar{3}$.

120



$O \wedge \frac{1}{2} = 147° \ 14'$.
$O \wedge 1 = 127 \ 51$.
$O \wedge 2 = 111 \ 14$.
$O \wedge 1\text{-}\breve{\imath} = 145 \ 34$.
$O \wedge 2\text{-}\breve{\imath} = 126 \ 6$.

$1\text{-}\breve{\imath} \wedge 1\text{-}\breve{\imath}$, ov. $i\text{-}\breve{\imath}$, $= 68° \ 52'$.
$2\text{-}\breve{\imath} \wedge 2\text{-}\breve{\imath}$, ov. $i\text{-}\bar{\imath}$, $= 107 \ 48$.
$1 \wedge 1$, mac., $= 131 \ 16$.
$1 \wedge 1$, brach., $= 96 \ 8$.

Cleavage: $2\text{-}\breve{\imath}$ and $i\text{-}\breve{\imath}$ imperfect. Twins: composition-face I; forms like those of aragonite frequent. Also massive, compact, and disseminated.

H.$=2-2·5$. G.$=6·269$, Przibram. Lustre metallic. Color and streak iron-black. Fracture uneven.

Comp.—5 Ag S + Sb^2S^3 = Sulphur 16·2, antimony 15·3, silver 68·5 = 100. Analyses: 1, H. Rose (Pogg., xv. 474); Kerl (B. H. Ztg., 1853, No. 2):

	S	Sb	Ag	Fe	Cu
1. Schemnitz	16·42	14·68	68·54	—	0·64=100·28 Rose.
2. Andreasberg	16·51	15·79	68·38	0·14	——=100·82 Kerl.

Considered an arsenical mineral until Klaproth's analysis in 1793 (Beitr., i. 162).

Pyr.—In the closed tube decrepitates, fuses, and after long heating gives a faint sublimate of sulphid of antimony. In the open tube fuses, giving off antimonial fumes and sulphurous acid. B.B. on charcoal fuses with projection of small particles, coats the coal with antimonous acid, which after long blowing is colored red from oxydized silver, and a globule of metallic silver is obtained.

Soluble in dilute heated nitric acid, sulphur and oxyd of antimony being deposited.

Obs.—In veins, with other silver ores, at Freiberg, Schneeberg, and Johanngeorgenstadt in Saxony; at Przibram and Ratieborzitz in Bohemia; at Schemnitz and Kremnitz in Hungary; at Andreasberg in the Harz; at Zacatecas in Mexico; and in Peru.

In Nevada, an abundant silver ore in the Comstock lode; at Ophir and Mexican mines in fine crystals; in the Reese river and Humboldt and other regions. In Idaho, at the silver mines

Named after the Archduke Stephan, Mining Director of Austria. A valuable ore of silver.

The species is homœomorphous with aragonite. See on cryst., F. H. Schroeder, Pogg., xcv. 257.

Alt.—Crystals occur altered to silver, and also to argentopyrite (p. 39).

131. **POLYBASITE.** Sprödglaserz pt. *Wern.* Polybasit *H. Rose*, Pogg., xv. 573, 1829. Eugenglanz *Breith.*, Char., 266, 1832.

Orthorhombic, Descl. *I* ∧ *I* nearly 120°, *O* ∧ 1=121° 30′. Observed planes *O*, *I*, 1. 1 ∧ 1, pyr.,=129° 32′, 1 ∧ 1, bas.,=117°. Crystals usually short tabular prisms, with the bases triangularly striated parallel to alternate edges. Cleavage: basal imperfect. Also massive and disseminated.

H.=2–3. G.=6·214. Lustre metallic. Color iron-black; in thin crystals cherry-red by transmitted light. Streak iron-black. Opaque except when quite thin. Fracture uneven.

Comp.—9 (Ag, Ȼu) S+(Sb, As)^2 S^3=, if containing silver without copper or arsenic, Sulphur 14·8, antimony 9·7, silver 75·5=100. More probably 10 (Ag, Ȼu) S+(Sb, As)^2 S^3, in which the second member is *half* what it is in the preceding species, and the at. ratio (Ag, Ȼu) and (S. Sb, As) is 2 : 3. **Analyses**: 1–3, H. Rose (l. c.); 4, C. A. Joy (Inaug. Diss., 24); 5, Tonner (Lotos, 1859, 85, Jahrb. Min., 1860, 716):

	S	Sb	As	Ag	Cu	Fe	Zn	
1. Durango, Mexico	17·04	5·09	3·74	64 29	9·93	0·06	——	=100·15 Rose.
2. Schemnitz	16 83	0·25	6·23	72·43	3·04	0·33	0·59	=99·70 Rose.
3 Freiberg	16·35	8·39	1·17	69·99	4·11	0·29	——	=100·30 Rose.
4. Cornwall	15·87	5·46	3·41	72·01	3·36	0·34	——	=100·45 Joy.
5. Przibram, G.=6·03	15·55	11·53	——	68·55	3·36	0·14	——	=99·13 Tonner.

D. Forbes found in crystallized specimens from Tres Puntos, Chili, 67·47 and 66·94 p. c. of silver. and in a massive ore from Romero, S. of Copiapo, 66·14 p. c. (Private communication.)

Pyr., etc.—In the open tube fuses, gives sulphurous acid and antimonial fumes, the latter forming a white sublimate, sometimes mixed with crystalline arsenous acid. B.B. fuses with spirting to a globule, gives off sulphur (sometimes arsenic). and coats the coal with antimonous acid; with long-continued blowing some varieties give a faint yellowish-white coating of oxyd of zinc, and a metallic globule, which with salt of phosphorus reacts for copper, and cupelled with lead gives pure silver.

Decomposed by nitric acid.

Obs.—Occurs in the mines of Guanaxuato and Gaudalupe y Calvo in Mexico; also at Guarisames in Durango, with chalcopyrite and calcite; at Tres Puntos, desert of Atacama, Chili: at Freiberg and Przibram. In Nevada, at the Reese mines; in Idaho, at the silver mines of the Owhyhee district.

Named from πολύς, *many*, and βάσις, *base*, in allusion to the many metallic bases present.

Alt.—Stephanite and pyrite occur as pseudomorphs after polybasite.

132. **ENARGITE.** Enargit *Breith.*, Pogg., lxxx. 383, 1850. Guayacanite *Field*, Am. J. Sci., II. xxvii. 52, 1859.

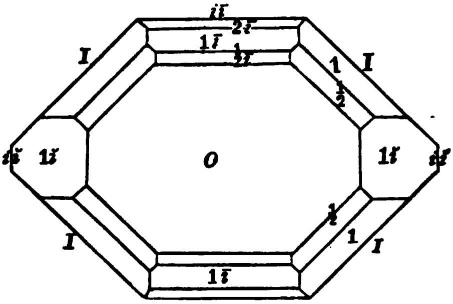
Orthorhombic. *I* ∧ *I*=97° 53′, *O* ∧ 1-ī=136° 37′, Dauber; *a* : *b* : *c*= 0·94510 : 1 : 1·1480. Observed planes: *O*; vertical, *I*; *i*-ī, *i*-ĭ; domes, ½-ī, 1-ī, 2-ī, 1-ĭ; octahedral, ½, 1.

O ∧ ½-ī=154° 43′
O ∧ 2-ī=117 53
O ∧ 1-ĭ=140 20
O ∧ 1=128 35

Cleavage: *I* perfect; *i*-ī, *i*-ĭ distinct; *O* indistinct. Also massive, granular or columnar.

H.=3. G.=4·43–4·45; 4·362, Kenngott. Lustre metallic. Color grayish to iron-black; streak grayish-black, powder having a metallic lustre. Brittle. Fracture uneven.

121



Peru.

Comp.—At. ratio for Cu. As, S=3 : 1 : 4; whence 3 Ȼu S + $As^2 S^5$=Sulphur 32·5, arsenic 19·1, copper 48·4=100. Analyses: 1, Plattner (Pogg., lxxx. 383); 2, F. Field (l. c.); 3, v. Kobel (Ber. Ak. Münch., i. 161, 1865): 4, W. J. Taylor (Proc. Ac. Philad., 168, 1857); 5, Genth (Am. J. Sci., II. xxiii. 420); 6, 7, Luthe & Rammelsberg (ZS. G., xviii. 241); 8, B. S. Burton (private contrib.):

	S	As	Sb	Cu	Fe	Ag
1. Peru	32·22	17·60	1·61	47·20	0·57	0·02, Zn 0·23=99·45 Plattner.
2. Chili, *Guay.*	31·82	19·14	——	48·50	*tr.*	*tr.*=99·46 Field.
3. Coquimbo	32·11	18·10	——	48·89	0·47	—— Te 0·05, Zn, Se *tr.*=99·62 Kobell.
4. N. Grenada	34·50	16·31	1·29	46·62	0·27	——=98·99 Taylor.
5. Chesterfield	33·78	15·63	——	50·59	——	——=100 Genth.
6. Cosihuirachi	31·86	17·17	——	50·08	0·09	——=99·20 Luthe.
7. "	32·45	15·88	——	49·21	1·58	——=99·12 Ramm.
8. Colorado (⅔)	30·95	17·46	1·35	46·64	1·02	—— insol. 1·98=99·40 Burton.

Genth's analysis was made on "too small a quantity for a complete examination."

Pyr.—In the closed tube decrepitates, and gives a sublimate of sulphur; at a higher temperature fuses, and gives a sublimate of sulphid of arsenic. In the open tube, heated gently, the powdered mineral gives off sulphurous and arsenous acids, the latter condensing to a sublimate containing some antimonous acid. B.B. on charcoal fuses, and gives a faint coating of arsenous acid, antimonous acid, and oxyd of zinc; the roasted mineral with the fluxes gives a globule of metallic copper.

Soluble in nitro-muriatic acid.

Obs.—From Morococha, Cordilleras of Peru, at a height of 15,000 feet, in large masses, occasionally with small druses of crystals, along with tennantite, imbedded in crystalline limestone (anal. 1); Cordilleras of Chili (*guayacanite*, anal. 2); same, mine of Hediondas, Prov. Coquimbo (anal. 3); mines of Santa Anna, N. Grenada, in cavities in quartz (anal. 4); at Cosihuirachi in Mexico; Brewster's gold mine, Chesterfield district, S. Carolina (anal. 5); in Colorado (anal. 8); at Willis's Gulch, near Black Hawk.

For Dauber on cryst., see Pogg., xcii. 237. Breithaupt (ib., lxxx. 383) made $I \wedge I$=98° 11′, and Rammelsberg (ZS. G., xviii. 242) 98° 10′.

133. XANTHOCONITE. Xanthokon *Breith.*, J. pr. Ch., xx. 67, 1840.

Rhombohedral; $R \wedge R$=71° 34′; $O \wedge R$=110° 30′, a=2·3163. Observed planes R, –2, O. $O \wedge 2$=100° 35′. Cleavage: R, and O. Usually in reniform masses, with the interior consisting of minute crystals.

H.=2. G.=5·0—5·2. Color dull-red to clove-brown; crystals orange-yellow on the edges by transmitted light. Streak-powder yellow. Brittle.

Comp.—(3 Ag S + $As^2 S^5$) + 2 (3 Ag S + $As^2 S^3$)=Sulphur 21·1, arsenic 14·9, silver 64·0=100. **Analyses:** Plattner (Pogg., lxiv. 275):

	S	As	Ag	Fe
1.	21·36	[13·49]	64·18	0·97=100
2.	21·80	[14·32]	63·88	——=100

Pyr.—In the closed tube, at a gentle heat, the yellow color is changed to dark-red, but on cooling it regains its original color; at a higher temperature fuses, and gives a faint sublimate of sulphid of arsenic. In the open tube, and on charcoal, behaves like proustite.

Obs.—Occurs with stephanite at the Himmelsfürst mine near Freiberg.

Named in allusion to its yellow powder, from ξανθος, *yellow*, and κονις, *powder*.

APPENDIX TO SULPHIDS, ETC.

134. CLAYITE *W. J. Taylor*, Proc. Ac. Philad., Nov. 1859.

Isometric, tetrahedral. Occurring form the tetrahedron, with planes of the dodecahedron Crystals small. Also massive, incrusting.

H.=2·5. Lustre metallic. Color and streak blackish lead-gray. Opaque. Sectile.

Analyses by W. J. Taylor (l. c.):

	S	As	Sb	Pb	Cu	Ag
1.	8·22	9·78	6·54	68·51	7·67	*trace.*
2.	8·14	*undet.*	*undet.*	67·40	5·62	——

From Peru. Probably a result of alteration. Requires further investigation.

135. BOLIVIANITE. Bolivian *Breith.*, B. H. Ztg., xxv. 188.

Orthorhombic. In acicular rhombic prisms, tufts, and fine columnar. Resembles stibnite. H.=2½. G.=4·820—4·828. Cleavage: *i-ī* distinct. Lustre submetallic. Color lead-gray, a little darker than in stibnite.

According to T. Richter, an antimonial sulphid of silver, containing 8·5 p. c. of silver. From Bolivia.

65B. SULPHOSELENID OF ZINC AND MERCURY. *A. del Castillo*, in priv. comm., dated Mexico, Feb. 27, 1865, to Prof. Henry, and from him to the author.

In crystals (rhombohedrons?); cleavage not observed. H.=3. G.=6·67—7·165. Color dark lead-gray. Streak grayish-black.

Comp.—According to Castillo's trials, a compound of sulphur, selenium, zinc, and mercury, of undetermined proportions.

Pyr., etc.—In the closed tube gives a grayish-black sublimate, and above this a ring of metallic mercury; in the open tube affords the odor of selenium, a blackish zone of selenium, and above this a grayish-red oxyd, and still higher a sublimate of mercury. B.B. the selenium and mercury are volatilized, leaving a residue of oxyd of zinc, yellow while hot and white on cooling. On charcoal burns with a bluish flame, giving first the odor of sulphur and then of selenium; the assay turns yellow, then red, and finally yields a yellow skeleton of oxyd of zinc. Insoluble in nitric acid; soluble in nitro-muriatic acid.

Obs.—Occurs at the quicksilver mines of Guadalcazar, along with cinnabar, and in cavities in barite, fluorite, and gypsum. Appears to be near *onofrite*, No. 65A, p. 56.

III. COMPOUNDS OF CHLORINE, BROMINE, IODINE.

---

1. ANHYDROUS CHLORIDS, ETC.

1. Composition R^2 (Cl, Br, I).

1. CALOMEL GROUP. Tetragonal.

136. **Calomel**, Hg^2 Cl.

2. Composition R (Cl, Br, I).

1. HALITE GROUP. Isometric.

137. **Sylvite**, K Cl.
138. **Halite**, Na Cl.
139. **Sal Ammoniac**, NH^4 Cl.
140. **Cerargyrite**, Ag Cl.
141. **Embolite**, Ag (Cl, Br).
142. **Bromyrite**, Ag Br.

2. IODYRITE GROUP. Hexagonal.

143. **Iodyrite**, Ag I.
144. **Coccinite**, Hg I.

3. COTUNNITE GROUP. Orthorhombic.

145 **Cotunnite**, Pb Cl.

3. Composition R^2 Cl^3.

MOLYSITE GROUP.

146. **Molysite**, Fe^2 Cl^3.

2. HYDROUS CHLORIDS.

147. **Carnallite**, (K Mg) Cl + 4 $\dot{H}$.
148. **Tachhydrite**, (Cu, Mg) Cl + 4 $\dot{H}$.
149. **Kremersite**, 2 (K, Am) Cl + Fe^2 Cl^3 + 3 $\dot{H}$.

3. OXYCHLORIDS.

150. **Matlockite**, Pb Cl + Pb O.
151. **Mendipite**, Pb Cl + 2 Pb O.
152. **Schwartzembergite**, Pb I + 2 Pb O.
153. **Atacamite**. 3 $\dot{Cu}$ $\dot{H}$ + (Cu Cl) $\dot{H}$
153A. **Tallingite**, 4 $\dot{Cu}$ $\dot{H}$ + (Cu Cl) $\dot{H}$ + 3 aq.
154. **Percylite**.

Appendix.—155. **Chlorid of Magnesium.** 156. **Chlorid of Manganese.** 157. **Iodid of Zinc**
158. **Bromid of Zinc.**

1. ANHYDROUS CHLORIDS, ETC.

136. CALOMEL. Horn Mercury (fr. Deux Ponts) *Woulfe*, Phil. Trans., 618, 1776. Mine de mercure cornée *de Lisle*, Crist., iii. 161, 1783. Quecksilber-Hornerz *Wern.*, Bergm. J., 381, 1789. Horn Quicksilver; Dichlorid of Mercury. Kalomel, Chlorquecksilber, Chlormercur, *Germ.* Mercure chloruré *Fr.*

Tetragonal. $O \wedge 1\text{-}i = 129° \; 4'$; $a = 1·232$. Observed planes: vertical, I, $i\text{-}\bar{i}$, $i\text{-}\frac{4}{3}$; octahedral, $\frac{1}{4}$, $\frac{1}{3}$, 1; $\frac{2}{3}\text{-}i$, $2\text{-}i$; zirconoid, 2-2, $2\text{-}\frac{2}{3}$, $\frac{4}{3}\text{-}2$.

$O \wedge 2\text{-}i = 112° \; 5'$ $O \wedge 1 = 119° \; 51'$ $2\text{-}i \wedge 2\text{-}i$, pyr., $= 98° \; 8'$
$O \wedge \frac{2}{3}\text{-}i = 140 \; 36$ $O \wedge \frac{1}{3} = 149 \; 51$ $1 \wedge 1$, pyr., $= 104 \; 20$

Pyramid $2\text{-}i$ when alone gives a very acute termination to the prism. Cleavage: I, indistinct. Twins compounded so as to have the vertical axis in one line, but the edges of the pyramid of one in the same plane with the faces of the pyramid of the other.

H.=1—2. G.=6·482, Haidinger. Lustre adamantine. Color white, yellowish-gray, or ash-gray, also grayish, and yellowish-white, brown. Streak pale yellowish-white. Translucent—subtranslucent. Fracture conchoidal. Sectile.

Comp.—$Hg^2 \, Cl$=Chlorine 15·1, mercury 84·9=100.

Pyr., etc.—In the closed tube volatilizes without fusion, condensing in the cold part of the tube as a white sublimate; with soda gives a sublimate of metallic mercury. B.B. on charcoal volatilizes, coating the coal white. Insoluble in water, but dissolved by nitro-muriatic acid; blackens when treated with alkalies.

Obs.—At Moschellandsberg in the Palatinate, coating the cavities of a ferruginous gangue, associated with cinnabar—crystals often large and well-defined; also at the quicksilver mines of Idria in Carniola; Almaden in Spain; Horzowitz in Bohemia.

According to Hessenberg, crystals from Moschellandsberg afford $O \wedge 1\text{-}i = 129° \; 40'$, $O \wedge 2\text{-}i = 112° \; 35'$.

Named from καλός, *beautiful*, and μέλι, *honey*, the taste being sweet, and the compound the *Mercurius dulcis* of early chemistry.

137. SYLVITE. Muriate of Potash (fr. Vesuvius) *Smithson*, Ann. Phil., II. vi. 258, 1823. Chlorid of Potassium. Kali Salzsaures, Chlorkalium, *Germ.* Sylvine *Beud.*, Tr., ii. 511, 1832. Hoevelit *H. Girard*, Jahrb. Min. 1863, 568. Leopoldit *E. Reichardt*, Jahrb. Min. 1866, 331. Schätzellit and Hövellit (fr. Stassfurt), B. H. Ztg., xxiv. 276, Ann. Ch. Phys., IV. v. 318, 324.

Isometric. Figs 1, 6, 2. Cleavage cubic. Also compact.

H.=2. G.=1·9—2. White or colorless. Vitreous. Soluble; taste like that of common salt.

Comp.—K Cl=Potassium 52·5, chlorine 47·5=100. That of Vesuvius, according to A. Müller (Verh. Ges. Basel, 1854, 113), is pure, affording no trace of lime, magnesia, or alumina, and only a trace of soda. The sylvite of the Anhalt salt mine, Leopoldshall, afforded Reichardt (l. c.) K 52·4, Cl 47·4.

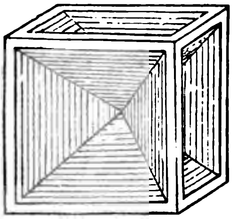
Pyr., etc.—B.B. in the platinum loop fuses, and gives a violet color to the outer flame. Added to a salt of phosphorus bead, which has been previously saturated with oxyd of copper, colors the O.F. deep azure. Water completely dissolves it, 100 parts taking up 34·5 at 18·75° C. Heated with sulphuric acid gives off muriatic acid gas.

Obs.—Occurs at Vesuvius, about the fumaroles of the volcano. Also at Stassfurt, in the carnallite beds of the salt formation; at Leopoldshall (*leopoldite*).

The compound is the *Sal digestivus Sylvii* of early chemistry, whence Beudant's name for the species. There is no reason for changing it in the fact that the earlier known mineral was of volcanic origin.

138. HALITE. COMMON SALT. Rock Salt, Muriate of Soda, Chlorid of Sodium. Kochsal Steinsalz, Bergsalz, *Germ.* Soude muriatée, Chlorure de sodium, Sal gemme, *Fr.* Salmai *Beud.*, Tr., 1832. Halites *Glock.*, Syn., 290, 1847.

122



Isometric. Observed planes, *O*, 1, *I*, *i*-2. Figs. 1 2, 6, 16, and 6+16; usually in cubes; rarely in oct hedrons; faces of crystals sometimes cavernous, as i f. 122. Cleavage: cubic, perfect. Massive and gran lar, rarely columnar.

H.=2·5. G.=2·1–2·257; of pure crystals, 2·13 Hunt. Lustre vitreous. Streak white. Color whit also sometimes yellowish, reddish, bluish, purplish often colorless. Transparent—translucent. Fractur conchoidal. Rather brittle. Soluble; taste purely saline.

Comp.—Na Cl=Chlorine 60·7, sodium 39·3=100. Commonly mixed with some sulphate c lime, chlorid of calcium, and chlorid of magnesium, and sometimes sulphate of magnesia, whic render it liable to deliquesce. Analyses: 1–8, Berthier (Ann. d M., x. 259); 9, Fournet (ib., I ix. 55!); 10, Rammelsberg (Min. Ch., 1014); 11, 12, C. A. Goessmann (Rep. on Petit Anse Sa Mine, Bureau of Mines, New York, 1867, 17):

		NaCl	MgCl	$\dot{\mathrm{Ca}}\overline{\overline{\mathrm{S}}}$	$\dot{\mathrm{Na}}\overline{\overline{\mathrm{S}}}$	$\dot{\mathrm{Mg}}\overline{\overline{\mathrm{S}}}$	
1.	Vic, *white*	99·3	——	0·5	——	——	Clay 0·2=100 B.
2.	" *grayish*	97·8	——	0·3	——	——	1·9=100 B.
3.	" *gray*	90·3	——	5·0	2·0	— –	2·0 $\dot{\mathrm{H}}$ 0·7=100 B.
4.	" *red*	99·8	——	——	——	——	— $\dot{\mathrm{H}}$ 0·2=100 B.
5.	Marennes, *whitish*	97·2	0·4	1·2	——	0·5	0·7=100 B.
6.	" *yellow*	96·70	0·23	1·21	——	0·66	1·20=100 B.
7.	" *red*	96·78	0·68	1·09	——	0·60	0·85=100 B.
8.	" *green*	96·27	0·27	1·09	——	0·80	1·57=100 B.
9.	Algiers	97·8	1·1	——	——	——	$\overline{\overline{\mathrm{Si}}}$ 1·5, $\dot{\mathrm{H}}$ 0·6=100 F.
10.	Stassfurt	97·35	——	1·01	0·43	0·23,	$\dot{\mathrm{H}}$ 0·30=99·32 Ramm.
11.	Petit Anse, *white*	98·88	*tr.*	0·79	——	——	CaCl *tr.*, $\dot{\mathrm{H}}$ 0·33=100 Goessmann.
12.	St. Domingo	98·33	0·04	1·48	——	0·06,	$\dot{\mathrm{H}}$ 0·07, insol. 0·01=99·99 Goessman

Other analyses: Salt from Stassfurt, by Heintz, ZS. nat. Ver. Halle, xi. 345; from Algier by de Marigny and Simon, Ann. d. M., xii. 674; from Wieliczka, Berchtesgaden, Hall in the Tyr Hallstadt, Schwabisch-Hall, by G. Bischof, Geol., ii. 1669, 1675; from Erfurt and Cardona, Söchting, ZS. nat. Ver. Halle, vii. 404; from Vesuvius, 1822, by Laugier, Pogg., iii. 79; fro Vesuvius, 1850, by Bischof; from Vesuvius, 1850, by Scacchi, Ann. d. M., IV. xvii. 323; fro Vesuvius, 1855, by Deville, Bull. G. Fr. II. xiii. 620.

Dissolves in three parts of water. Some varieties attract moisture, but are unchanged in a d atmosphere.

The *martinsite* of Karsten (J. pr. Ch., xxxvi. 127) contains 9·02 per cent. of sulphate of magnesi which is equivalent to 10 parts of common salt to 1 of sulphate of magnesia. It is from Stas furt. In Rammelsberg's analysis the water was hygroscopic, and the specimen contained 0· of mixed karstenite. In a dirty reddish salt from Abingdon, Washington Co., Va., E. Stier found (Jahresb., 1862, 766) NaCl 90·55, gypsum 0·45, clay and carb. lime 9·00=100.

The bluish and indigo-colored salt of Stassfurt, etc., possibly owes its color, according to Pr S. W. Johnson, to the presence of subchlorid of sodium.

Pyr., etc.—In the closed tube fuses, often with decrepitation; when fused on the platinu loop colors the flame deep yellow. Other reactions like those given under sylvite.

Obs.—Common salt occurs in extensive but irregular beds in rocks of various ages, asso ated with gypsum, polyhalite, clay, sandstone, and calcite; also dissolved, and forming s springs.

In Europe and England it occurs in the Triassic, associated with red marl or sandstone, but it not confined to these rocks. At Durham, Northumberland, and Leicestershire, England, salt sprin rise from the Carboniferous series; in the Alps, some salt works are supplied from Oolitic rock the famous mines of Cardona and Wieliczka are referred, the former to the Green Sand formatio and the latter to Tertiary rocks. Salt springs also occur in volcanic regions. In the United States the brines of New York come from Upper Silurian strata; those of Ohio, Pennsylvania, and Virginia, mostly from Devonian and Subcarboniferous beds; those of Michigan, mainly from the Subcarboniferous and Carboniferous; while in Louisiana, at Petit Anse, there is a thick bed of pure salt in the Post-tertiary or more recent deposits of the coast; recent explorations there have proved that it underlies 144 acres, and it has been penetrated to a depth of 38 feet without showing any change in its structure or purity. Salt also occurs as efflorescences over the dry prairies and shallow ponds or lakes of the Rocky Mountains, California, Atacama; and in most desert or semi-desert regions there are numerous salt lakes.

The principal mines of Europe are at Wieliczka, in Poland; at Hall, in the Tyrol; Stassfurt, in Prussian Saxony; and along the range through Reichenthal in Bavaria, Hallein in Salzburg, Hallstadt, Ischl, and Ebensee, in Upper Austria, and Aussee in Styria; in Hungary, at Marmoros and elsewhere; in Transylvania; Wallachia, Gallicia, and Upper Silesia; Vic and Dieuze in France; Valley of Cardona and elsewhere in Spain, forming hills 300 to 400 feet high; Bex in Switzerland; and Northwich in Cheshire, England. At Cheshire it occurs in a basin-shaped deposit, and is arranged in spheroidal masses, from 5 to 8 feet in diameter, which are composed of concentric coats, and present polygonal figures It is but little contaminated with impurities, and is prepared for use by merely crushing it between iron rollers. At the Austrian mines, where it contains much clay, the salt is dissolved in large chambers, and the clay thus precipitated. After a time the water, fully saturated with the salt, is conveyed by aqueducts to evaporating houses, and the chambers, after being cleared out, are again filled; at Berchtesgaden, the water is saturated in a month, at Hall it takes nearly a year.

It also occurs, forming hills and covering extended plains, near Lake Oroomiah, the Caspian Lake, etc. In Algeria; in Abyssinia; in India in the province of Lahore, and in the valley of Cashmere; in China and Asiatic Russia; in South America, in Peru, and at Zipaquera and Nemocon, the former a large mine long explored in the Cordilleras of Granada. Occasionally formed at the eruptions of Vesuvius, as in 1855, when it was found in cubes, incrustations, and stalactites.

In the United States, salt has been found forming beds with gypsum, in Virginia, Washington Co., 18 m. from Abingdon; in the Salmon River Mts. of Oregon; in Louisiana, as already mentioned. Brine springs are very numerous in the Middle and Western States. These springs are worked at Salina and Syracuse, N. Y.; in the Kanawha Valley, Va.; Muskingum, Ohio; Michigan, at Saginaw and elsewhere; and in Kentucky. The salt water is obtained by boring, and raised by means of machinery, and thence conveyed by troughs to the boilers, where it is evaporated by artificial heat; or to basins for evaporation by exposure to the heat of the sun.

The following table by Prof. Beck (Mineralogy of New York, p. 112), gives the amount of brine required for a bushel of salt at the principal salt springs in the United States:

	Galls.		Galls.
Boone's Lick, Missouri	450	Kanawha, Va.	75
Conemaugh, Penn.	300	Grand River, Ark.	80
Shawneetown, Ill.	280	Illinois River, Ark.	80
Jackson, Ohio	213	Montezuma, N. Y.	70
Lockhart's, Miss.	180	Grand Rapids, Mich.	50–60
St. Catherines, Upper Canada	120	Muskingum, Ohio	50
Zanesville, Ohio	95	Salina—Old wells	40–45
		New wells	30–35

Sea water at Nantucket gives a bushel of salt for every 350 gallons.

Composition of Syracuse brines, according to analyses by Dr. C. A. Goessmann (private communication):

	I.	II.	III.	IV.
Chlorid of sodium	16·7503	15·5317	18·2465	13·3767
Sulphate of lime	0·5673	0·5772	0·5117	0·5234
Chlorid of calcium	0·1594	0·1533	0·1984	0·1037
Chlorid of magnesium	0·1464	0·1444	0·1784	0·1338
Bromid of magnesium	0·0022.	0·0024	0·0025	0·0017
Chlorid of potassium	0·0110	0·0109	0·0119	0·0086
Carbonate of protoxyd of iron	0·0034	0·0044	0·0036	0·0015
Water	82·3600	83·5757	80·8470	85·8508
	100	100	100	100

No. I. has G. = 1·1300 at 16° Baumé, and 20° C. No. II. has G. = 1·1225 at 15° Baumé, and 21° C. The Saginaw brines, Michigan, afford about 19·250 of salt.

Vast lakes of salt water exist in many parts of the world. Lake Timpanogos in the Rock mountains, 4,200 feet above the level of the sea, now called the Great Salt Lake, is 2,000 squa miles in area. L. Gale found in this water 20·196 per cent. of chlorid of sodium (Stansb. Expe cited in Am. J. Sci., II. xvii. 129). The Dead and Caspian Seas are salt, and the waters of th former contain 20 to 26 parts of solid matter in 100 parts. Prof. Gmelin, who analyzed a portio of these waters of specific gravity 1·212, found them to contain chlorid of calcium 3·336, chlor of magnesium 12·167, chlorid of sodium 7·039, sulphate of lime 0·052, bromid of magnesium 0·44 chlorid of potassium 1·086, chlorid of aluminum 0·144, chlorid of ammonium 0·007, chlorid manganese 0·161=24·435, with 75·565 water=100·000. This result is given as corrected Marchand.

Alt.—Anhydrite, gypsum, polyhalite, occur as pseudomorphs after this species; also celestin dolomite, quartz, hematite, pyrite; the removal of the salt cubes by their solution, leaves a cavi which any mineral may then occupy. The hopper-shaped crystals often leave an impression their form on clays.

139. SAL AMMONIAC. Naturliches Salmiak (fr. Bucharia) *J. G. Model*, Versuch über e nat. Salmiak, Leipzig, 1758. Muriate of Ammonia; Chlorid of Ammonium. Salmiak *Gern* Ammoniaque muriatée *Fr.* Salmiac *Beud.*, Tr., 1832.

Isometric. Observed planes, *O*, 1, *I*, 2-2. Figs. 1, 2, 3, 6, 10, 1 Cleavage octahedral. Also stalactitic, and in globular masses; in crust or as an efflorescence.

H.=1·5—2. G.=1·528. Lustre vitreous. Color white; often yellow ish or grayish. Streak white. Translucent—opaque. Fracture conchoida Soluble; taste saline and pungent; not deliquescent.

Comp.—NH^4Cl=Am Cl=Ammonium 33·7, chlorine 66·3=100. Klaproth obtained (Beitr., i 89):

	Vesuvius.	Bucharia.
Chlorid of ammonium	99·5	97·50
Sulphate of ammonia	0·5	2·50

B. Silliman, Jr., obtained (Dana's G. Rep. Expl. Exp., 202) for a specimen from Kilauea, Hawa Chlorid of ammonium 65·53, chlorid of iron 12·14, sesquioxyd of iron 8·10, chlorid of aluminu 13·00, insoluble matter and loss 1·23=100. For an analysis of an impure Stromboli specime see C. Schmidt, in ZS. G., ix. 403.

Pyr., etc.—Sublimes in the closed tube without fusion. Pulverized with hydrate of lime, heated with a solution of caustic alkali, gives off pungent ammoniacal vapors. Soluble in thr times its weight of water.

Obs.—Occurs about volcanoes, as at Etna, the island of Vulcano, Vesuvius, Stromboli, San wich Islands, and near Hecla after the eruption of 1845, as observed by Bunsen. Observed aft the eruption of Vesuvius in 1855, in rhombic dodecahedrons with cavernous faces; and as usu it occurred where the lavas had spread over soil and vegetation. Also found in small quantiti in the vicinity of ignited coal seams, as at St. Etienne in France, and also at Newcastle, and Scotland; crystallized near Duttweiler in Prussia, where a coal seam has been burning for mo than a hundred years. It occurs also in Bucharia; at Kilauea in Hawaii, a variety which co tains largely of iron (see above), and becomes rusty yellow on exposure; in guano from the Chi cha Islands.

The ἅλς ἀμμωνιακός, sal-ammoniac of Dioscorides, Celsius, and Pliny, is proved by Beckmann (Hi of Inventions, iv. 360) to be common rock salt, dug in Egypt, near the oracle of Ammon. T name was afterward transferred to the muriate of ammonia, when subsequently manufactured Egypt. Sal-ammoniac is supposed to have been included by the ancients, with one or two oth species, under the name of *nitrum*, which, according to Pliny, gave the test of ammonia wh mingled with quicklime.

140. CERARGYRITE. Argentum cornu pellucido simile (fr Marienberg), *Germ.* Hornfar Silber, *Gesner*, Foss., 63, 1565. Argentum rude jecoris colore, lucem corneam habens (fr. Fr berg, etc.) *G. Fabricius*, De Rebus Met., 1566. Glaserz, dursichtig wie ein Horn in einer La tern, *Matthesius*, Sarept., 1585. Horn-Silfver, Minera argenti cornea, A. sulphure et arsen mineralisatum, *Wall.*, 310, 1747. Argento acido salis mineralisatum, Hornerz, *Cronst.*, 159, 17

Silberhornerz, Silberkerat, Hornsilber, Chlor-Silber, *Germ.* Horn Silver; Corneous Silver. Argent muriaté, Argent corné, Chlorure d'argent *Fr.* Buttermilcherz (first mentioned early in 17th century). Kerargyre *Beud.*, Tr., ii. 501, 1832. Kerat *Haid.*, Handb., 506, 1845. Argyroceratite *Glock.*, Syn., 249, 1847. Plata cornea blanca *Domeyko*, Min., 200, 1845. Kerargyrite.

Isometric. Observed forms, *O*, *I*, 1, 2, 2-2; f. 1, 2, 3, 5, 6, 7; also 5 with planes 1, 2, 2-2. Cleavage none. Twins: composition-face octahedral. Usually massive and looking like wax; sometimes columnar, or bent columnar; often in crusts.

H.=1–1·5. G.=5·552; 5·31–5·43, Domeyko. Lustre resinous, passing into adamantine. Color pearl-gray, grayish-green, whitish, rarely violet-blue, colorless sometimes when perfectly pure; brown or violet-brown on exposure. Streak shining. Transparent—feebly subtranslucent. Fracture somewhat conchoidal. Sectile.

Comp.—Ag Cl=Chlorine 24·7, silver 75·3=100. This constitution corresponds with Klaproth's analyses (Beitr., i. 134, and iv. 10); also F. Field's of a specimen from Chañarcillo, Chili (Q. J. Ch. Soc., x. 239).

Pyr., etc.—In the closed tube fuses without decomposition. B.B. on charcoal gives a globule of metallic silver. Added to a bead of salt of phosphorus, previously saturated with oxyd of copper, and heated in O.F., imparts an intense azure-blue to the flame. A fragment placed on a strip of zinc, and moistened with a drop of water, swells up, turns black, and finally is entirely reduced to metallic silver, which shows the metallic lustre on being pressed with the point of a knife. Insoluble in nitric acid, but soluble in ammonia.

Obs.—Occurs in veins of clay slate, accompanying other ores of silver, and usually only in the higher parts of these veins. It has also been observed with ochreous varieties of brown iron ore; also with several copper ores, calcite, barite, etc.

The largest masses, and particularly those of a green color, are brought from Peru, Chili, and Mexico, where it occurs with native silver. In Chili, at some mines, it is a much less common ore than the chlorobromid; often contains, intimately mixed with it, native silver in very minute grains; it occurs at Tres Puntos, Atacama, Chañarcillo near Copiapo, and elsewhere in Chili. Also in Nicaragua near Ocotal; in Dept. of Gracias, Honduras. It was formerly obtained in the Saxon mining districts of Johanngeorgenstadt and Freiberg, but is now rare; a mass weighing six and three-quarter pounds, from this region, is in the Zwinger collection at Dresden. It also occurs in the Altai, at the mines of Smeinogorsk and Krukovskoi; at Konigsberg in Norway; in Alsace; rarely in Cornwall, and at Huelgoet in Brittany. In Nevada, about Austin, Lander Co., abundant; at mines of Comstock lode. In Arizona, in the Willow Springs dist., veins of El Dorado cañon, and San Francisco dist. In Idaho, at the Poorman mine, in crystals some half an inch across, mostly cubes and cubo-octahedrons, but occasionally with other planes, and in twins consisting of two interpenetrating cubes, the angles of one projecting from the faces of the other.

At Andreasberg in the Harz, an earthy variety is met with, called by the Germans Buttermilk ore (*Buttermilcherz*, *Thonige Hornsilber*), which, according to Klaproth (Beitr., i. 187), contains silver 24·64, chlorine 8·28, alumina 67·08. Funckens describes it as "weiss und dünn wie eine Buttermilch" (Lenz Min., ii. 101, 1794).

Named from κέρας, *horn*, and ἄργυρος, *silver*—*Ceratargyrite*, the proper derivative, being contracted to *Cerargyrite*. The Greek *k* becomes *c*, as in other cases.

141. EMBOLITE. Chlorobromure d'argent *Domeyko*, Ann. d. M., IV. vi. 153, 1844; Berthier, ib., IV. ii. 540, 1842. Plata cornea verde *Domeyko*, Min., 202, 1845. Embolit *Breith.*, Pogg., lxxvii. 134, 1849. Chlorobromid of Silver. Chlorbromsilber. Megabromite, Microbromit, *Breith.*, B. H. Ztg., xviii. 449, 1859.

Isometric. Figs. 1, 4, 6, 7, 6 + 7, 11. Also massive; sometimes stalactitic or concretionary at surface.

H.=1–1·5. G.=5·31–5·43, Domeyko: 5·53, Yorke; 5·79–5·81, Breith. Lustre resinous and somewhat adamantine. Color grayish-green and asparagus-green to pistachio or yellowish-green, and yellow, often dark; becoming darker externally on exposure.

Comp.—Ag (Cl, Br). the ratio of the chlorine to the bromine varying indefinitely, the yellowis varieties and those of deeper green colors containing the largest proportion of bromine. Analyses 1, 2, Domeyko (Min., 1845, 203, and 1860, 212); 3, Müller (B. H. Ztg., xviii. 449); 4, 5, Domeyk (l. c.); 6, 7, F. Field (Q. J. Ch. Soc., x. 239); 8, Yorke (Q. J. Ch. Soc., iv. 149); 9, Plattner (Pogg lxxvii. 134); 10, 11, Domeyko (l. c.); 12, Richter (B. H. Ztg., xviii. 449); 13, F. Field (l. c.); a ranged in the order of the proportion of bromid to chlorid (mentioned in column Br : Cl), commen ing with those having the least of the bromid:

	Ag	Br	Cl	Br : Cl	
1. Chañarcillo, *pearly green*	71·94	7·92	20·14	1 : 5·67	Domeyko.
2. " " "	70·44	11·53	18·03	1 : 3·5	"
3. Copiapo, *microbromite*	69·84	12·39	17·77	1 : 3	Müller.
4. Quillota, *pearly green*	69·28	14·30	16·42	1 : 2·75	Domeyko
5. Chañarcillo " "	69·14	14·63	16·23	1 : 2·5	"
6. " *light geeen*	68·22	16·84	14·92	1 : 2	Field.
7. " *embolite*	66·94	19·82	13·18	1 : 1·5	"
8. Chili, *Greenish yellow*	66·95	19·90	13·15	1 : 1·5	Yorke.
9. Chañarcillo, *embolite*	66·86	20·08	13·05	———	Plattner.
10. " "	66·84	20.09	13·07	1 : 1·5	Domeyko.
11. " *yellow*	66·53	20·85	12·62	1 : 1·33	"
12. *Megabromite*	64·19	26·49	9·32	1 : 0·8	Richter.
13. Chañarcillo, *dark green.*	61·07	33·32	5·00	1 : 0·33	Field.

The *megabromite* and *microbromite* of Breithaupt are only varieties of embolite based on the pr portion of bromid to chlorid, and are even indistinct as varieties, these extremes being connect by indefinite shadings. The above numbers for Domeyko's and Yorke's analyses are calculat from their statements of the proportion of chlorid and bromid, which they give as follows:

	1	2	4	5	8	10	11
Chlorid of silver	81·4	72·9	66·4	65·6	53·2	52·8	51·0
Bromid of silver	18·6 D.	27·1 D.	33·6 D.	34·4 D.	46·8 Y.	47·2 D.	49 0

Obs.—Abundant in Chili, constituting the principal silver ore of the mines of Chañarcillo, a found also at Agua-Amarga, Tres-Puntas, Rosilla, and at all the new openings in the province Copiapo; found also at Eulalia in Chihuahua, Mexico; at the mine of Coloal in Gracias, Hondur Named from ἐμβόλιον, *an intermediate*, because between the chlorid and bromid of silver.

142. BROMYRITE. Bromure d'Argent, Plata Verde *Mex.*, (fr. Mexico and Huelgoet), *Bert* Ann. d. M., III. xix. 734, 742, 1841, IV. ii. 526. Bromid of Silver; Bromic Silver. Bromsilb *Germ.* Bromit *Haid.*, Handb., 506, 1845. Bromyrite *Dana*, Min., 93, 1854. Bromargy *Ramm.*, Min. Ch., 196, 1860. Plata cornea amarilla melada *Domeyko*, Min., 214, 1860.

Isometric. Figs. 1, 2, 4, 6. Occurs usually in small concretions; rare in crystals.

H.=2–3. G.=5·8–6. Lustre splendent. Color when pure brig yellow to amber-colored, slightly greenish; often grass-green or olive-gre externally. Little altered in color on exposure. Sectile.

Comp.—Ag Br=Bromine 42·6, silver 57·4=100. Analyses: 1, Berthier (Ann. d. M., IV. 526); 2, F. Field (Q. J. Ch. Soc., x. 241):

1. Mexico Bromine 42·44 Silver 57·56=100 Berthier.
2. Chañarcillo 42·57 57·43=100 Field.

In the Chilian ore Domeyko found 57·1 of silver.

Pyr., etc.—In the closed tube and with metallic zinc reacts like cerargyrite. B.B. on charc emits pungent bromine vapors and yields a globule of metallic silver. Fused with bi-sulphate potash in a matrass gives off yellowish-brown vapors of bromine. Insoluble in nitric acid. Di cultly soluble in ammonia.

Obs.—With other silver ores in the district of Plateros, Mexico, and at the mine of San Onof seventeen leagues from Zacatecas, associated with chlorid of silver and carbonate of lead; als crystals at Chañarcillo, Chili, with chlorid of silver, sometimes imbedded in calcite; also at Hu goet in Brittany, with cerargyrite.

143. IODYRITE. Iodure d'Argent *Vauquelin*, Ann. Ch. Phys., xxix. 99, 1825; *Domeyko*, Ann. d. M., IV. vi. 158, 1844. Plata cornea amarilla *Domeyko*, Min., 205, 1845. Iodic Silver. Iodsilber *Germ.* Iodit *Haid.*, Handb., 506, 1845. Iodyrite *Dana*, Min., 95, 1854. Iodargyrit *Ramm.*, Min. Ch., 197, 1860.

Hexagonal. $O \wedge 1 = 138° 46'$; $a = 0·81438$. Observed planes: O, I, 4, 2, ½. Angles:

$O \wedge 2 = 118°$	$O \wedge \frac{1}{2}$ $= 154° 49'$	$1 \wedge 2$, pyr., $= 127° 36'$
$O \wedge 4 = 104\ \ 53'$	$\frac{1}{2} \wedge \frac{1}{2}$, pyr., $= 155\ \ 26$	$4 \wedge 4$ " $= 122\ \ 12$

Cleavage: basal perfect. Also massive, and in thin plates with a lamellar structure.

Soft. G.=5·5—5·71; 5·707, Damour; 5·504, Domeyko; 5·64—5·67, Breith. Lustre resinous to adamantine. Color citron and sulphur-yellow to yellowish-green, sometimes brownish. Streak yellow. Translucent. Plates flexible, sectile.

Comp.—Ag I=Iodine 54, silver 46=100. Analyses: 1, Domeyko (l. c.); 5, Damour (Ann. d. M., V. iv. 329); 3, 4, J. L. Smith (Am. J. Sci., II. xviii. 374); 5, F. Field (J. Ch. Soc., x. 241):

		Ag	I
1.	Algodones	46·25	[53·75]=100 Domeyko.
2.	"	(⅔) 45·72	54·03=99·75 Damour.
3.	"	46·52	52·93=99·45[a] Smith.
4.	"	46·38	53·11=99·49[a] Smith.
5.	Chañarcillo	45·98	54·02=100 Field.

[a] With traces of chlorine and copper.

Pyr., etc.—In the closed tube fuses and assumes a deep orange color, but resumes its yellow color on cooling. B.B. on charcoal gives fumes of iodine and a globule of metallic silver. With zinc reacts like cerargyrite and bromyrite. Fused with bisulphate of potash in a matrass, yields violet vapors of iodine.

Obs.—Occurs in thin veins or seams in hornstone at Albarradon, near Mazapil; in Mexico; at Algodones, 12 leagues from Coquimbo; less abundantly at Delirio mines of Chañarcillo, Chili, where the crystals are sometimes half an inch broad (Breith., B. H. Ztg., xviii. 450); also at Guadalajara in Spain. In Arizona at Cerro Colorado mine. Descloizeaux has pointed out its homœomorphism with greenockite (Ann. Ch. Phys., III. xl.).

144. COCCINITE. Iodure de Mercure *Del Rio*; *Beud.*, Tr., ii. 515, 1832. Coccinit *Haid.*, Handb., 572, 1845. Mercure ioduré *Fr.* Iodquecksilber *Germ.*

In particles of a reddish-brown color on selenid of mercury, adamantine in lustre, at Casas Viejas, Mexico; and supposed by Del Rio to be an iodid of mercury. But Castillo says (Colegio de Min. Mexico, 1865) that specimens labelled by Del Rio contain no iodine, and appear to be largely chlorine and mercury, yet are not calomel. Castillo describes it from Zimapan and Culebras, both massive and in acute, acicular, rhombic pyramids, 2–6 mm. long; color fine red to yellow, and sometimes yellowish-green, changing to greenish-gray and dark green on exposure; transparent to translucent. In a closed tube affords a sublimate, white when cold, of $Hg^2 Cl$, and leaves a residuum which is dull red while hot, orange-yellow when cold, and which B.B. turns aurora-red, and is dissipated with an odor like that of selenium.

145. COTUNNITE. Cotunnia *Mont. & Cov.*, Prodr. Oritt. Vesuv. Cotunnite. Chlorid of Lead.

Orthorhombic. $I \wedge I = 99° 46'$, $O \wedge 1\text{-}\bar{i} = 149° 14'$; $a : b : c = 0·5953 : 1 : 1·1868$. Observed planes: I, $i\text{-}\bar{i}$, $i\text{-}\breve{i}$, $i\text{-}\breve{2}$, $1\text{-}\breve{i}$. $O \wedge 1 = 142° 6'$, $O \wedge 1\text{-}\breve{i} = 153° 22'$, $1 \wedge 1$, mac., $= 133° 22'$, brach., $123° 58'$, $i\text{-}\breve{2} \wedge i\text{-}\breve{2}$, ov. $i\text{-}\breve{i}$, $= 118° 38'$. In acicular crystals.

May be scratched by the nail. G.=5·238. Lustre adamantine; inclining to silky or pearly. Color white. Streak white.

Comp.—Pb Cl=Chlorine 25·5, lead 74·5=100.

Pyr., etc.—B.B. on charcoal fuses readily, spreading out on the coal and volatilizing, gives a white coating, the inner edge of which is tinged yellow from oxyd of lead; the coating in R.F. disappears, tinging the flame azure; with soda gives metallic lead. Added to a salt of phosphorus bead, previously saturated with oxyd of copper, gives the reaction for chlorine (see cerargyrite). Soluble in about 22 parts of hot water.

Obs.—Found by Monticelli and Covelli, in the crater of Vesuvius, after the eruption of 1822, accompanied by chlorid of sodium, and chlorid and sulphate of copper; also by Scacchi and Guiscardi on the lava of 1855.

Named after Dr. Cotugno of Naples. Angles very near those of haidingerite.

---

146. MOLYSITE. Eisenchlorid *Hausm.*, 1819, Handb., 1463, 1847. Chlorid of Iron. Molysite *Dana.*

Incrusting. Color brownish-red, light or dark, and yellow.

Comp.—$Fe^2\ Cl^3$=Chlorine 65·5, iron 34·5=100.

Obs.—Noticed by Hausmann at Vesuvius in 1819, forming a brownish-red incrustation on lavas; and by Scacchi in the same region, as a result of recent eruptions (Eruz. Vesuv., 1850–55), who attributes the yellow color of the lavas about the fumaroles or steam-holes partly to this species.

The existence of a *protochlorid of iron* (Fe Cl) at Vesuvius was announced by Monticelli and Covelli; but this is not confirmed by Scacchi.

Named from *μόλυνσις*, *stain*, in allusion to its staining the lavas.

---

2. HYDROUS CHLORIDS.

147. CARNALLITE. Carnallit *H. Rose*, Pogg., xcviii. 161, 1856.

Massive, granular; flat planes developed by action of water, but no distinct traces of cleavage; lines of striæ sometimes distinguished, which indicate twin-composition.

Lustre shining, greasy. Color milk-white, but often reddish from mixture of oxyd of iron. Fracture conchoidal. Soluble. Strongly phosphorescent.

Comp.—$K\ Cl+2\ Mg\ Cl+12\ H=(\frac{1}{3}\ K+\frac{2}{3}\ Mg)\ Cl+4\ H$=Chlorid of magnesium 34·20, chlorid of potassium 26·88, water 38·92=100. Under a more general formula $(K, Mg)\ Cl+4\ \dot{H}$. Analyses: 1, 2, Oesten (Pogg., xcviii., 161); 3, Siewert (Jahresb., 1858. 739); 4, A. Goebel (J.pr. Ch. xcvii. 6):

	Mg Cl	K Cl	Na Cl	Ca Cl	$\dot{C}a\dddot{S}$	$\bar{F}e$	$\dot{H}$
1. Stassfurt, *reddish*	31·46	24·27	5·10	2·62	0·84	0·14	[35·57]=100 Oesten.
2. " "	30·51	[24·27]	4·55	3·01	1·26	[0·14]	[36·26]=100 Oesten.
3. " *white*	36·03	27·41	0·23	——	1·14	——	— —, $\dot{H}$ 36·33—38·01 Siewert.
4. Maman, Persia	34·65	25·62	——	——	——	——	39·67, gangue 0·06=100 Goebel.

The impure carnallite of the mine contains Mg Cl 29·53, K Cl 21·80, Na Cl 7·95, sulphate of potash 10·20, silicate of magnesia and alumina, sand, and boracic acid 1·20, water and loss 29·32. The brown and red color of much of the mineral is due partly to oxyd of iron, which is in hexagonal tables and partly to organic matters (water-plants, infusoria, sponges, etc.). In anal

4, there was some organic substance present with the water; and the carnelian to blood-red color is shown to be due to it.

Pyr., etc.—B.B. fuses easily. Soluble in water, 100 parts of water at 18·75°C. taking up 64·5 parts.

Obs.—Occurs at Stassfurt, where it forms beds in the upper part of the salt formation, alternating with thinner beds of common salt and kieserite, and also mixed with the common salt. Its beds consist of subordinate beds of different colors, reddish, bluish, brown, deep red, sometimes colorless. Sylvine occurs in the carnallite. Also found with salt at Maman in Persia. Its richness in potassium makes it valuable for exploration.

Named after von Carnall of the Prussian mines.

Artif.—Occurs artificially formed in the salt pans at Halle.

148. TACHHYDRITE. Tachhydrit *Ramm.*, Pogg., xcviii. 261, 1856.

Massive; in roundish masses. Two distinct cleavages.

Color yellowish. Transparent to translucent. Very deliquescent on exposure.

Comp.—(Ca Cl+2 Mg Cl)+12 $\dot{H}$=(⅓ Ca+⅔ Mg) Cl+4 $\dot{H}$=Chlorine 41·17, calcium 7·76, magnesium 9·30, water 41·77=100; or under a more general formula, (Ca, Mg) Cl+4 $\dot{H}$. Analysis by Rammelsberg (l. c.):

Cl 40·34 Ca 7·46 Mg 9·51 $\dot{H}$ [42·69]=100

Pyr., etc.—Fuses easily. Very soluble; 100 parts of water at 18·75°C. dissolving 160·3 of the salt.

Obs.—From the salt mines of Stassfurt, in thin seams with carnallite and kieserite, in anhydrite.

Named in allusion to its ready deliquescence, from ταχύς, *quick*, and ὕδωρ, *water*.

149. KREMERSITE. Eisenchlorid mit den Chloralkalien *Kremers*, Pogg., lxxxiv. 79, 1851. Kremersit *Kenng.*, Min., 9, 1853.

Isometric. In octahedrons.

Color ruby-red. Easily soluble.

Comp.—K Cl+Am Cl+$Fe^2 Cl^3$+3 $\dot{H}$=2 (½ K+½ Am) Cl+$Fe^2 Cl^3$+3 $\dot{H}$=Chlorine 55·86, potassium 12·32, ammonium 5·67, iron 17·65, water 8·50=100. Analysis by Kremers (Pogg., lxxxiv. 79):

Cl	K	Am	Na	Fe	$\dot{H}$
55·15	12·07	6·17	0·16	16·89	[9·56]=100.

It is identical with an artificial salt obtained by Fritzsche.

Obs.—From fumaroles at Vesuvius, as a product of sublimation.

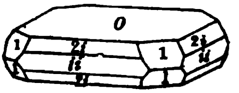
---

3. OXYCHLORIDS.

150. MATLOCKITE. *R. P. Greg*, Phil. Mag., IV. ii. 120, 1851.

Tetragonal. $O \wedge 1\text{-}i=128°\ 42'$; $a=1·2482$. Observed planes, O, I, 1, 2-i. $O \wedge I=90°$, $O \wedge 2\text{-}i=111°\ 50\tfrac{1}{2}'$, $O \wedge 1=119°\ 34'$, 2-$i \wedge$ 2-i, pyram.,=97° 58′, basal,=136° 19′, $1 \wedge 1$, pyram.,=104° 6′, basal, 120° 52′. Cleavage: basal imperfect. Crystals generally tabular.

123



H. = 2·5—3. G. = 7·21. Lustre adamantine, occasionally pearly Color clear yellowish, sometimes a little greenish. Transparent to translucent.

Comp.—$PbCl + PbO$ = Chlorid of lead 55·5, oxyd of lead 44·5 = 100. Analysis by Dr. R. A Smith (l. c.):

Pb Cl 55·18	Pb O 44·30	Moisture 0·07 = 99·55.

Rammelsberg found (Pogg. lxxxv. 141), Pb Cl 52·45, Pb O 46·42.

Pyr., etc.—Reacts like mendipite.

Obs.—From an old mine near Cromford in Derbyshire, with phosgenite. Crystals seldom large but one measures two inches across; according to Keungott (Min. Not., No. 11), $1 \wedge 1$, basal = 121° 2′, and $2\text{-}i \wedge 2\text{-}i$, basal edge = 136° 17′; also, as a sublimation product at Vesuvius afte the eruption of 1858 (R. Cappa, J. pr Ch., lxxx. 381).

151. MENDIPITE. Saltsyradt Bly (Salzsaures Blei) *Berz.*, Ak. H. Stockh, 184, 1823; Ed. Sci., i. 379, 1824. New ore of lead from Mendip, Peritomous Lead-baryte, *Haid.*, Mohs's Min ii. 151, 1825. Muriate of Lead, Chlorid of Lead. Plomb chloruré, pt., *Fr.* Kerasine pt. [re phosgenite] *Beud.* Tr., ii. 502, 1832. Chlor-Spath *Breith.*, Char., 61, 1832. Berzelite *Le* Min. Heul., ii. 448, 1837. Mendipit *Glock.*, Grundr., 604, 1839.

Orthorhombic; $I \wedge I = 102° 36'$. Observed planes, O, I, $i\text{-}\bar{\imath}$, $i\text{-}\breve{\imath}$. Occur in fibrous or columnar masses, often radiated. Cleavage: I highly perfect diagonal less perfect.

H. = 2·5—3. G. = 7—7·1. Lustre pearly and somewhat adamantin upon cleavage faces. Color white, with a tinge of yellow, red, or blue Streak white. Feebly translucent—opaque.

Comp.—$PbCl + 2PbO$ = Chlorid of lead 38·4, oxyd of lead 61·6 = 100. Analyses: 1, Berzeli (Ak. H. Stockh., 1823, Pogg., i. 272, and Ramm. 1st Suppl., 24); 2, Schnabel (ib., 3d Suppl., 78 3, Rhodius (Ann. Ch. Pharm., lxii. 373):

1. Mendip Hills	Pb Cl 39·82	Pb O 60·18 = 100	Berzelius.
2. Westphalia	38·70	61·25 = 99·95	Schnabel.
3. "	32·55	67·78 = 100·33	Rhodius.

Pyr., etc.—In the closed tube decrepitates and becomes more yellow. B.B. on charcoal fuse easily, and is reduced to metallic lead with elimination of acid vapors, giving the coal a whi coating of chlorid of lead, the inner edge of which is yellow from oxyd of lead. With salt c phosphorus bead, previously saturated with oxyd of copper, colors the O.F. azure-blue. Solub in nitric acid.

Obs.—This rare mineral was formerly found at the Mendip Hills, in Somersetshire, in sma radiated crystalline masses on earthy black manganese; it has been met with at Tarnowit Silesia, in clay in opaque prismatic crystals; at mine Kunibert near Brillon in Westphalia.

152. SCHWARTZEMBERGITE. Oxychloroiodure de plomb (fr. Atacama) *Domeyko*, An d. M., VI. v. 453, 1864. Schwartzembergite *Dana.*

Rhombohedral. In druses of small crystals. Also in thin amorphou crusts, compact, passing into earthy.

H. = 2—2·5. G. = 5·7, Schwartzemb.; 6·2—6·3, Liebe. Lustre adamantin Color honey-yellow, when purest; also straw-yellow, inclining to lemo yellow, sometimes a little reddish. Streak straw-yellow. Brittle.

Comp.—$PbI + 2PbO$, Liebe. More probably, as the analysis so gives, $Pb(I, Cl) + 2PbO$, wi $I : Cl = 3 : 2$. Analysis: K. T. Liebe (Jahrb. Min., 1867, 159):

Pb Cl	Pb I	Pb O	$\bar{P}b\dddot{S}$	$\bar{P}b\ddot{C}$	$\dddot{S}b$
11·40	30·89	48·92	5·51	1·88	0·91 = 99·51

Liebe regards all the ingredients as impurities except the iodid and oxyd of lead. Domeyko in an imperfect analysis (l. c.) obtained Pb Cl 22·8, Pb I 18·7, Pb O 47·1, $\dddot{\mathrm{S}}$ 2·5, $\dot{\mathrm{Ca}}$ 1·7, gangue 5·3 =98·1.

Pyr., etc.—Very fusible, like cerargyrite; in fusing loses its color. On charcoal metallic globules. In a matrass abundant violet vapors of iodine. No effervescence with nitric acid, but loses color, becoming first brownish and then white, and, if some water be added, it dissolves completely on heating.

Obs.—Forms crusts in galenite at a mine 10 leagues foom the port of Paposo in the desert of Atacama, where it was discovered by Mr. Schwartzemberg.

153. ATACAMITE. Sable vert cuivreux du Perou, Chaux cuivreuse unie à un peu d'acide muriatique et d'eau, *Rochefoucauld, Baumé & Fourcroy*, Mem. Ac. Paris, 1786 (pub'd in 1788); *Berthollet*, ib., 474 (note added in 1788). Kupfersand, Salzsaures Kupfer, *Karst.*, Tab, 46, 76, 1800. Cuivre muriaté *H.*, Tr., 1801. Muriate of Copper. Atacamit, Salzkupfererz, *Blumenbach*, Handb. Nat., 1805. Kupferhornerz, Atacamit, *Ludwig*. Min., ii. 178, 1804. Smaragdochalcit *Hausm.*, Handb., 1039, 1813. Halochalzit *Breith.*, Handb., 165. 1841. Remolinite *B. & M.*, Min., 618, 1852. Marcylite *Shep.*, Marcy's Expl. Red River, 135, 800. Washington, 1854, Am. J. Sci., II, xxi. 206; Dana, ib., xxiv. 122. Botallackite *A. H. Church*, J. Ch. Soc., II. iii. 212, 1865.

Orthorhombic. $I \wedge I=112^\circ\ 20'$, $O \wedge 1\text{-}\bar{\imath}=131^\circ\ 29'$; $a:b:c=1{\cdot}131:1:1{\cdot}492$. Observed planes: vertical, I, $i\text{-}\bar{\imath}$, $i\text{-}\breve{\imath}$, $i\text{-}\breve{2}$, $i\text{-}\breve{4}$; domes, $1\text{-}\breve{\imath}$, $1\text{-}\bar{\imath}$; octahedral, $i\text{-}\breve{2} \wedge i\text{-}\breve{2}$, ov. $i\text{-}\breve{\imath}$,$=106^\circ\ 34'$, $i\text{-}\breve{4} \wedge i\text{-}\breve{4}$, ib.,$=139^\circ\ 4'$, $1\text{-}\breve{\imath} \wedge 1\text{-}\breve{\imath}$, top$=105^\circ\ 40'$, $I \wedge 1=143^\circ\ 42'$, $1 \wedge 1$, mac.,$=126^\circ\ 40'$. Usual in modified rectangular prisms, and rectangular octahedrons. Twins: composition-face I; consisting of three individuals. Cleavage: $i\text{-}\breve{\imath}$ perfect, $1\text{-}\bar{\imath}$ imperfect. Occurs also massive lamellar.

H.=3—3·5. G.=4—4·3; 3·7, Breith. Lustre adamantine—vitreous. Color various shades of bright green, rather darker than emerald, sometimes blackish-green. Streak apple-green. Translucent—subtranslucent.

Comp.—$3\ \dot{\mathrm{Cu}}\ \dot{\mathrm{H}}+\mathrm{Cu\ Cl}\ \dot{\mathrm{H}}=(\tfrac{3}{4}\ \dot{\mathrm{Cu}}+\tfrac{1}{4}\ \mathrm{Cu\ Cl})\ \dot{\mathrm{H}}$=Oxyd of copper 53·6, chlorid of copper 30·2, (chlorine 16·0, copper 14·3), water 16·2=100. The ore of Cobija (anal. 1) and *botallackite* (anal. 8) contain half more of water, giving the formula $3\ \dot{\mathrm{Cu}}\ \dot{\mathrm{H}}+\mathrm{Cu\ Cl}\ \dot{\mathrm{H}}+2$ aq.. Analyses: 1, Berthier (Ann. d. M., III. vii. 542); 2, 3, Bibra (J. pr. Ch., xcvi. 203); 4, 5, F. Field (J. Ch. Soc., vii. 193); 6, Mallet (Ramm., 5th Suppl., 57); 7, 8, Church (J. Ch. Soc., II. iii. 81, 213):

	Cl	$\dot{\mathrm{Cu}}$	Cu	$\dot{\mathrm{H}}$
1. Bolivia, Cobija	14·92	50·00	13·33	21·75=100 Berthier.
2. " Algodon	14·96	52·54	13·33	19·17=100 Bibra.
3. " "	15·07	52·40	14·00	18·53=100 Bibra.
4. Copiapo	14·94	——	56·46	17·79 Field.
5. "	15·01	——	56·24	18·00 Field.
6. Chili	16·33	55·94	14·54	12·96, quartz 0·08=99·85 **Mallet.**
7. Cornwall	15·20	54·32	13·57	16·91=100 Church.
8. *Botallackite*	14·51	66·25	——	22·60=103·36 Church.

Anal. 4 corresponds to Cu Cl 28·22, $\dot{\mathrm{Cu}}$ 53·99, $\dot{\mathrm{H}}$ 17·79; and 5 to Cu Cl 28·35, $\dot{\mathrm{Cu}}$ 53·62, $\dot{\mathrm{H}}$ 18·00 For other analyses see Ulex, Ann. Ch. Pharm, lxix. 361.

Pyr., etc.—In the closed tube gives off much water, and forms a gray sublimate. B.B. on charcoal fuses, coloring the O.F. azure-blue, with a green edge, and giving two coatings, one brownish and the other grayish-white; continued blowing yields a globule of metallic copper; the coatings touched with the R.F. volatilize, coloring the flame azure-blue. In acids easily soluble.

Obs. This species was originally found in the state of sand in the Atacama province, northern part of Chili. It occurs in different parts of Chili, especially at Los Remolinos; also in veins in the district of Tarapaca, Bolivia; at Tocopilla, 16 leagues north of Cobija, an imporant locality, in Bolivia; with malachite in South Australia; at the extraordinary malachite locality in the Serra do Bembe, near Ambriz, on the west coast of Africa; at the Estrella mine in southern Spain; at St. Just in Cornwall, in crusts and stalactitic tubes. Botallackite occurs at the Botallack mine, Cornwall, in thin crusts of minute interlacing crystals, closely investing killas; Schwarzenberg in Saxony; also supposed to invest some of the lavas of Vesuvius, but questioned by Scacchi, the mineral so called being a basic sulphate (Mem. Incend. Vesuv., 1855).

It is sometimes ground up in Chili, and sold under the name of *Arsenillo* as sand for letters.

Marcylite of Shepard, as originally described, was an impure atacamite of a black color; a tri afforded Shepard copper 54·30, O and Cl 39·20, $\dot{H}$ 9·50. G.=4—4·1. From the south part of th Red River, near the Wachita Mts. (See further under Melaconite, p. 137.)

153A. TALLINGITE. *A. H. Church*, J. Ch. Soc., II. iii. 213, 1865.

In thin crusts, consisting of irregular aggregations of minute globules appearing botryoidal under the microscope. Subcrystalline.

H.=3. G.=3·5 (approximate). Color bright-blue, inclining to green Streak white. Subtranslucent. Fragile. Hygroscopic.

Comp.—$4\,\dot{Cu}\,\dot{H} + Cu\,Cl\,\dot{H} + 3aq$ = Chlorid of copper 22·55, oxyd of copper 53·29, water 24·16= 100; or chlorine 11·91, oxyd of copper 66·60, water 24·16=102·67. Church (J. Ch. Soc, II. ii 77) obtained $\dot{Cu}$ 66·24, Cl 11·33, which corresponds to

Cl 11·33 $\dot{Cu}$ 53·57 Cu 10·11 $\dot{H}$ 24·99=100.

In another blue Cornwall mineral Church found (ib., 213) Oxyd of copper 67·25, chlorine 8·7 water 26·56=102·54; which gives the formula $6\,\dot{Cu}\,\dot{H} + Cu\,Cl\,\dot{H} + 5\,aq$ = Oxyd of copper 67·2 chlorine 8·58, water 26·13=101·96. Church says the less hydrated copper sulphates and chlorid are green, the more hydrated blue.

Pyr., etc.—In vacuo loses hygroscopic water, remaining blue. At 100° C. rapidly become green, losing considerable water. Insoluble in water, but easily soluble in dilute acids and i ammonia.

Obs.—Occurs at the Botallack mine, Cornwall. Named after R. Talling, of Lostwithiel, b whom the mineral was collected.

Artif.—A similar compound has been formed by Kane, and by Graham, by the action of wate on $N\,H^3\,Cu\,Cl$; its formula is $4\,\dot{Cu}\,\dot{H} + Cu\,Cl^4 + aq$.

154. PERCYLITE. *H. J. Brooke*, Phil. Mag., III. xxxvi. 131, 1850.

Isometric. In minute cubes. Observed planes: *O*, 1, *I*, *i*-2.

H.=2·5. Color sky-blue. Streak similar to the color.

Comp.—According to Percy, contains, besides some water, lead, chlorine, copper, and probab oxygen, with Pb : Cl : Cu=2·66 : 0·84 : 0·77; whence Percy suggests the formula (Pb Cl + Pb (+(Cu Cl + Cu O) + aq.

Pyr.—In the closed tube yields water and odorless fumes. B.B. tinges the flame green wi blue on the edges. With borax reacts for copper.

Obs.—Found with gold, and supposed to be from Sonora, Mexico.

APPENDIX TO CHLORIDS, BROMIDS, AND IODIDS.

155. CHLORID OF MAGNESIUM. 156. CHLORID OF MANGANESE.

Chlorid of magnesium and chlorid of manganese, according to Scacchi (Mem. Incend. Vesu 1855), probably occur in the saline incrustations formed at the eruption of Vesuvius in 1855. Tl supposed existence of the manganesian chlorid was ascertained by treating the crust with distill water and testing with ferrocyanid of potassium, when a white precipitate was thrown dow which acquired after a while a pale rose tint; and also in other ways.

157, 158. IODID OF ZINC.—BROMID OF ZINC.—Iodine and bromine are stated by Mentzel to occ along with a cadmiferous zinc in Silesia, and hence it is inferred that iodid and bromid of zinc exi in nature, though not yet distinguished.

Besides the preceding species, the following also contain chlorine: Sodalite and Pyrosmalit and some Nephelite, Nosite, and Mica among silicates; some Apatite among phosphate Boracite among borates; Phosgenite among carbonates.

IV. FLUORINE COMPOUNDS.

---

1. ANHYDROUS.

1. FLUORITE GROUP.

159.	FLUORITE	Ca F	161. FLUOCERITE	Ce F
160	YTTROCERITE	(Ca, Ce, Y) F	162. FLUOCERINE	

2. FLUELLITE GROUP. Contain Aluminum.

163. FLUELLITE

3. CRYOLITE GROUP. Contain Aluminum and Sodium or Calcium.

164.	CRYOLITE	$3\ Na\ F + Al^3\ F^3$	166. CHIOLITE	$3\ Na\ F + 2\ Al^3\ F^3$
165.	ARKSUTITE	$(Ca,\ Na)^2\ F + Al^3\ F^3$	167. CHODNEFFITE	$2\ Na\ F + Al^3\ F^3$

2. HYDROUS.

168.	PACHNOLITE	$3\ (Ca,\ Na)\ F + Al^2\ F^3 + 2\ \dot{H}$	170. GEARKSUTITE	$Ca^2\ F + Al^2\ F^3 + 4\ \dot{H}$
169.	THOMSENOLITE	$2\ (Ca,\ Na)\ F + Al^2\ F^3 + 2\ \dot{H}$	171. PROSOPITE	

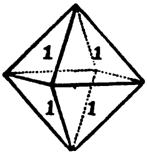
159. FLUORITE or FLUOR. Fluores lapides gemmarum similes sed minus duri—qui ignis calore liquescunt [whence he derives the name]—Colores varii, jucundi, (1) rubri, (2) purpurei (vulgo amethysti), (3) candidi, (4) lutei, (5) cineracei, (6) subnigri, etc. [with mention also of its use as a flux in smelting], *Agric.*, Berm., 458, 1529; *Germ.* Flusse *id.*, Interpr., 464, 1546. Fluor mineralis Stolbergicus, Lithophosphorus Suhlensis, *Woodward*, Cat., 1728. Glas-Spat, Spatum vitreum, *Wall.*, 64, 1747. Fluss, Flussspat, Glasspat, *Cronst.*, 93, 1758. Flussaures Kalk *Scheele*, Ak. H. Stockh., 1771. Calx fluorata *Bergm.*, Sciagr., 1782. Spath fusible, Spath vitreux, *de Lisle*, Crist., 1772, 1783. Fluorite *Napione*, Min., 373, 1797. Fluor Spar, Fluate of Lime, Fluorid of Calcium; *Vulg.* Derbyshire Spar, Blue-john. Chaux fluatée *Fr.* Fluorine *Beud.*, Tr., ii. 517, 1832. Liparit *Glock.*, Syn. 282, 1847.

Var.—Chlorophane (fr. Nertschinsk) *Th. De Grotthaus*; Delameth., J. de Phys., xlv. 398, 1794. Ratofkit *Fischer*, John Ch. Unters., vi. 232, 1812.

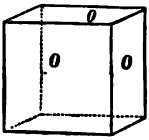
Isometric. Observed planes: *O*; *I*; 1, 2, 3; i-2, i-3, i-$\frac{5}{3}$, i-$\frac{3}{2}$; 2-2, 3-3, $\frac{7}{5}$-$\frac{7}{2}$; 4-2, $\frac{10}{3}$-$\frac{5}{2}$, $\frac{11}{3}$-$\frac{11}{5}$, 7-$\frac{7}{3}$, $\frac{25}{2}$-$\frac{25}{6}$. Figs. 1 (common), 2 to 8, 10, 11, 16, 18, similar to 24 (planes 1, and 3-3), 26. Cleavage: octahedral, perfect. Twins: composition-face, 1, f. 50; also f. 129, in which the composition is parallel to each octahedral face. Massive. Rarely columnar; usually granular, coarse or fine. Crystals often having the surfaces made up of small cubes, or cavernous with rectangular cavities.

H.=4. G.=3·01—3·25; 3·1800—3·1889, Kenngott, from 43 specimens the mean 3·183. Lustre vitreous; sometimes splendent; usually glimmering in the massive varieties. Color white, yellow, green, rose and crimson red, violet-blue, sky-blue, and brown: wine-yellow, greenish and viole blue, most common; red, rare. Streak white. Transparent—subtranslu cent. Brittle. Fracture of fine massive varieties flat-conchoidal an splintery. Sometimes presenting a bluish fluorescence. Phosphoresce when heated.

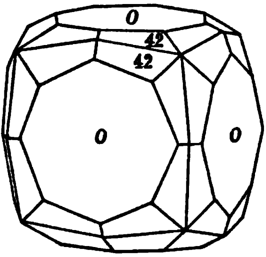
124



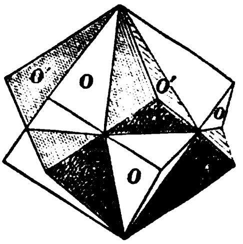
125



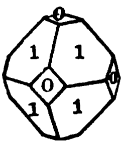
128



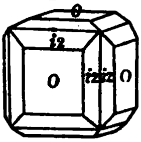
129



126



127



Comp., Var.—Fluorid of calcium, Ca F=Fluorine 48·7, calcium 51·3=100. Berzelius four 0·5 of phosphate of lime in the spar of Derbyshire. The presence of chlorine (or muriatic acid old chemistry) was detected early by Scheele. Kersten found it in fluor from Marienberg a Freiberg. The bright colors, as shown by Kenngott, are lost on heating the mineral; they a attributed mainly to different hydrocarbon compounds by Wyrouboff (Bull. Soc. Ch., II. v. 33 1866), the crystallization having taken place from aqueous solution.

Var. 1. *Ordinary; (a)* cleavable or crystallized, very various in colors; (*b*) coarse to fi *granular; (c)* earthy, dull, and sometimes very soft. A soft earthy variety from Ratofka, Russi of a lavender-blue color, is the *ratofkite.*

The finely-colored fluors have been called, according to their colors, *false* ruby, topaz, emeral amethyst, etc. The colors of the phosphorescent light are various, and are independent of t actual color; and the kind affording a green color is (*d*) the *chlorophane* (fr. χλωρός, *green,* a φαίνω, *I appear*) or *pyro-emerald.*

Breithaupt obtained for fluor G.=3·017, fr. Alston Moor, Cumberland, white; 3·170, Eu blue; 3·176, ib., white; 3·171, fr. Siberia, blue; 3·183, ib., white; 3·166, fr. near Marienbe green; 3·172, ib., blue; 3·169, fr. Bösenbrunn in Voigtland, green; 3·186 ib., blue; 3·188, i white; 3·185, fr. Cornwall, fluorescent; 3·188, fr. Switzerland, rose-red; 3·193, fr. near Freibe green; 3·255, fr. Mexico, emerald-green transparent oct.; 3·324—3·357, fr. Siberia, violet-blue.

2. *Antozonite* of Schönbein. The dark violet-blue fluor of Wölsendorf, Bavaria, afforded Schr ter 0·02 p. c. of ozone, which Schönbein (J. pr. Ch., lxxxiii. 95, lxxxix. 7) showed to be *antozo* whence his name for this variety. Its strong antozone odor is said often to produce headac and vomiting in the miners. Schafhäutl states (Ann. Ch. Pharm., xlvi. 344) that this fluor co tains, Nitrogen 0·02073, hydrogen 0·00584, carbon 0·0365, chlorous acid 0·08692. But Wyroub discredits, in part, his results; he himself obtained Carbon 0·0170, hydrogen 0·0038, with 0·0180, Fe 0·0032, Fe 0·0025, Cl 0·0071. Wyrouboff attributes the various colors to compoun of carbon and hydrogen, derived from a slight infusion of organic matters in the solvent water he found (Bull. Soc. Ch., II. v. 334, 1866) that the blue and violet colors changed to purple heating, and supposes that two C H substances, a blue and a red, were present, the former mo volatile, and therefore leaving the color reddish after partial heating.

Pyr., etc.—In the closed tube decrepitates and phosphoresces. B.B. in the forceps and charcoal fuses, coloring the flame red, to an enamel which reacts alkaline to test paper. Wi soda on platinum foil or charcoal fuses to a clear bead, becoming opaque on cooling; with excess of soda on charcoal yields a residue of a difficultly fusible enamel, while most of the so sinks into the coal; with gypsum fuses to a transparent bead, becoming opaque on cooli Fused in an open tube with fused salt of phosphorus gives the reaction for fluorine. Treat with sulphuric acid gives fumes of hydrofluoric acid which etch glass.

Phosphorescence is obtained from the coarsely powdered spar below a red heat. At a high temperature it ceases, but is partially restored by an electric discharge.

Obs.—Sometimes in beds, but generally in veins, in gneiss, mica slate, clay slate, and also in limestones, both crystalline and uncrystalline, and sandstones. Often occurs as the gangue of metallic ores. In the North of England, it is the gangue of the lead veins, which intersect the coal formation in Northumberland, Cumberland, Durham, and Yorkshire; the Cumberland fluor often contains drops of fluid within, especially the green variety (Greg and Lettsom). In Derbyshire it is abundant, and also in Cornwall, where the veins intersect metamorphic rocks. Common in the mining district of Saxony; fine near Kongsberg in Norway. In the dolomites of St. Gothard it occurs in pink octahedrons; at Münsterthal in Baden in flesh-red hexoctahedrons. It has been detected in cannel coal by Prof. Rogers.

In *Maine*, on Long Island, Blue Hill Bay, in veins. In *N. Hampshire*, at N. village of Westmoreland, 2 m. S. of meeting-house, white, green, purple, constituting a vein in quartz; at the Notch in the White Mts., green oct. in quartz, rare. In *Vermont*, at Putney, in green cubes. In *Massachusetts*, at the Southampton lead mine. In *Connecticut*, at Trumbull, the *chlorophane* var., with topaz, in two veins, each 18 in. wide, in gneiss; at Plymouth, in octahedral and dodecahedral crystals; at Willimantic, purple, in a vein in gneiss, and also sparingly at the topaz vein; at the Middletown lead mine. In *New York*, in Jefferson Co., at Muscolonge lake, formerly abundant, in gigantic cubes, sometimes modified (fig. 128), of grass-green and pale-green shades, in granular limestone; in St. Lawrence Co., at Rossie and Johnsburgh, rarely in fine crystals; at Lockport, occasionally in cubes, with selenite and celestine in limestone; also similarly near Rochester and Manlius; Amity, in thin seams, with spinel and tourmaline. In *New Jersey*, near the Franklin Furnace. In *Virginia*, near Woodstock, in limestone; on the Potomac, at Shepardstown, in white limestone. In *Illinois*, Gallatin Co., for 30 m. along the Ohio, 10 to 15 m. below Shawneetown, and at other places, dark purple, often in large crystals, in carboniferous limestone, with galenite, and through the soil. In *California*, at Mt. Diablo, rare in white cubes. In *Arizona*, in Castle Dome dist., white, pink, green, purple. In *Nova Scotia*, at Mabou harbor, green. Near Lake Superior, a few miles from the N.E. corner of Thunder bay, in large violet cubes on amethyst, affording magnificent specimens.

Alt.—Fluor spar is slightly soluble in waters containing bicarbonate of lime in solution. The alkaline carbonates decompose it, producing carbonate of lime or *calcite*, and a subsequent change of the calcite may produce other forms of pseudomorphs. Fluor spar occurs changed to quartz, by substitution, and also to limonite, hematite, lithomarge, psilomelane, calamine, smithsonite, cerusite, kaolinite.

160. YTTROCERITE. Yttrocerit *Gahn & Berzelius*, Afh., iv. 1814. Yttrocererit *Leonh.*, Handb., 573, 1826. Yttria fluatée *Fr.* Fluate of Cerium and Yttria. Ytterflussspath, Flussyttrocalcit, *Germ.* Yttrocalcit *Glock.*, Syn., 283, 1847.

Massive; crystalline-granular and earthy. Cleavage: in two directions inclined to one another 108° 30′.

H.=4–5. G.=3·447, Berzelius. Lustre glistening; vitreous—pearly. Color violet-blue, inclining to gray and white, often white; sometimes reddish-brown. Fracture uneven.

Comp.—Contains CaF, CeF, and YF, in different proportions. Analyses by Gahn and Berzelius (Afhandl., iv. 151, and Schw. J., xvi, 241):

$\dot{\mathrm{C}}\mathrm{a}$	$\ddot{\bar{\mathrm{C}}}\mathrm{e}$	Y	FH
47·63	18·21	9·11	25·05
50·00	16·45	8·10	25·45

Pyr., etc.—In the closed tube gives water. B.B. on charcoal alone infusible; with gypsum the yttrocerite of Finbo fuses to a bead, not transparent, and that of Broddbo is infusible. With the three fluxes the Finbo mineral behaves like fluor spar; the glass is, however, yellow in the oxydizing flame as long as hot, and becomes opaque sooner than the glass given by fluor spar. In a pulverized state it dissolves completely in heated muriatic acid, forming a yellow solution.

Obs.—Occurs sparingly at Finbo and Broddbo, near Fahlun in Sweden, imbedded in quartz, and associated with albite and topaz. Also at Amity, Orange Co., N. Y.; in Mass., probably Worcester Co.; at Mt. Mica, in Paris, Maine. The Amity mineral has been examined by J. E. Teschemacher. The Massachusetts mineral afforded Dr. C. T. Jackson (Proc. Nat. H., Bost., 1844, 166) lime, yttria, oxyd of cerium, with some $\ddot{\bar{\mathrm{A}}}\mathrm{l}$, $\ddot{\bar{\mathrm{F}}}\mathrm{e}$, and $\ddot{\mathrm{S}}\mathrm{i}$, and a loss of 19·4. The mineral is mixed with fluorite in the vein, and probably the specimen analyzed was not pure from it.

Yttrocerite has been considered a fluor spar in which part of the lime is replaced by oxyds cerium and yttrium. The angle of cleavage reported, 108° 30′, differs but a degree from t angle between faces of a regular octahedron.

161. FLUOCERITE. Neutralt flussspatssyradt Cerium *Berz.*, Afh., vi. 56, 1818. Neutral flussaures Cerer, Flusscerium ceriumfluat, *Germ.* Neutral Fluate of Cerium. Cerium fluat *Fr.* Flucérine *Beud.*, Tr., ii. 519, 1832. Fluocerit *Haid.*, Handb., 500, 1845.

Hexagonal. In hexagonal prisms and plates. Cleavage: basal mo distinct. Also massive.

H.=4–5. G.=4·7. Lustre weak. Color dark tile-red or almost ye low; deeper when the mineral is wet. Streak white, or slightly yellowis Subtranslucent—opaque.

Comp.—$Ce\,F + Ce^2\,F^3$, Berzelius, who obtained in an analysis (l. c.) $\ddot{Ce}$ 82·64, $\dot{Y}$ 1·12.

Pyr., **etc.**—In the closed tube yields water, and at a high temperature corrodes the glass; t water contains fluorine, and tinges Brazil-wood paper yellow; the assay changes from yellow white by heat. B.B. on charcoal infusible, but darkens in color. With soda it is not dissolv but divides and swells up; the soda is absorbed by the charcoal, and leaves a gray mass on t surface.

Obs.—Occurs at Finbo and Broddbo near Fahlun, in Sweden, imbedded in quartz and albi accompanying pyrophysalite and orthite.

162. FLUOCERINE.—(Basisk flussspatssyradt Cerium *Berz.*, Afh. vi. 64. Basisches Fluorceriu Basic flucorine. Basicerine *Beud.* Fluocerine *Hausm.*, 1847.) Isometric? Supposed to sho traces of the rhombic dodecahedron; usually massive. H.=4·5–5. Lustre vitreous or resi ous. Color a fine yellow, with some red, and when impure, brownish-yellow. Streak yello brownish. Subtranslucent to opaque.

Formula, $Ce^2\,F^3 + 3\,(C^2\,O^3 + \ddot{H})$=Cerium 17·6, fluorine 10·9, sesquioxyd of cerium 66·4, wat 5·1=100. Berzelius obtained in his analysis (l. c.) $\ddot{Ce}$ 84·20, and $\dot{H}$ 4·95, and deduced as composition $Ce\,F + 3\,\dot{Ce}\,\dot{H}$.

B.B. on charcoal infusible, at a low red heat appears almost black; on cooling it becomes da brown, clear red, and finally yellow. With the fluxes behaves like fluocerite.

From Finbo, with fluocerite.

A mineral from Bastnäs afforded Hisinger (Ak. H. Stockh., 1838, 189), Sesquioxyd of Ce (a La) 36·43, fluorid ibid. 50·15, water 13·41, which corresponds to the formula $Ce^2\,F^3 + Ce^2\,O^3 + 4$ Named *Bastnæsite* by Huot, Min., i. 296, 1841.

163. FLUELLITE. Fluellite *Levy*, Ann. Phil., II. viii. 242, 1824. Fluate of Alumine, Fluo of Aluminum.

Orthorhombic; in acute rhombic octahedrons with truncated ape $1 \wedge 1$, pyram.,=109° 6′, 82° 12′, and, basal, 144°; $I \wedge I$=105° nearly.

H.=3. Lustre vitreous. Color white. Transparent.

Comp.—Fluorine and aluminum, according to Wollaston.

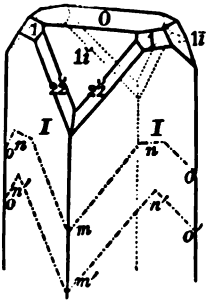
Obs.—Fluellite is a rare mineral found at Stenna-gwyn, in Cornwall, in minute crystals quartz, along with wavellite and uranite.

164. CRYOLITE. Chryolith, Thonerde mit Flussäure *Abildgaard*, Scherer's J., ii. 502, 179 d'Andrada, ib., iv. 37, 1800. Kryolith *Karst.*, Tab., 28, 73, 1800; id. (with anal.) *Klapr.*, J. Phys., li. 473, 1800, Beitr., iii. 207, 1802; *Vauq.*, Ann. Ch., xxxvii. 89, 1801. Alumine fluat alcaline *H.*, Tr., ii. 1801. Cryolite. Eisstein *Germ.*

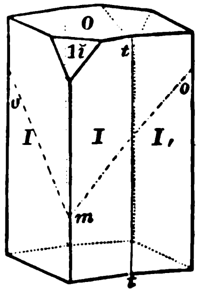
Orthorhombic? $I \wedge I$=88° 30′ to 88°, $O \wedge I\text{-}\bar{i}$=125° 57′; $a : b : c$=1·378 1 : 1·0265. Observed planes as in the figures. $O \wedge 1\text{-}\breve{i}$=126° 40′, $O \wedge 1$

117° 30′. Prisms often a little tapering, and marked with striæ parallel to the edges *I* / 1-ĭ, and sometimes also to edges *I* / 1-ī, and *I* / 1, as indicated by dotted lines *mno* in fig. 130. Twins: composition-face *I*, reëntering angle *I* ∧ *I*=177°, f. 131; no reëntering angle or apparent suture on plane *O*. Cleavage: basal perfect; diagonal less so. Massive, cleavable. H. = 2·5. G. = 2·9 — 3·077, fr. Greenland; 2·95 — 2·96, fr. Miask, Durnef. Lustre vitreous; slightly pearly on *O*. Color snow-white; sometimes reddish or brownish to brick-red and even black. Subtransparent — translucent. Immersion in water increases the transparency. Brittle.

130



131



Comp.—$3\,NaF + Al^2F^3$=Aluminum 13·0, sodium 32·8, fluorine 54·2=100. Analyses: 1, Klaproth (l. c.); 2, Berzelius (Ak. H. Stockh., 315, 1823); 3, Chodnef (Verh. Gos. Min. St. Pet., 1845–46, 219); 4, Durnef (Pogg., lxxxiii., 588):

	F	Al	Ca	Na
1. Greenland	——	12·8	——	26·8 Klaproth.
2. “	[54·07]	13·00	——	32·93 Berzelius.
3. “	[53·23]	13·23	——	32·71, Mn, Mg 0·83 Chodnef.
4. Miask	[53·38]	13·41	0·35	32·31, Mn, Fe 0·55 Durnef.

Pyr., etc.—Fusible in the flame of a candle. B.B. in the open tube heated so that the flame enters the tube, gives off hydrofluoric acid, etching the glass; the water which condenses at the upper end of the tube reacts for fluorine with Brazil-wood paper. In the forceps fuses very easily, coloring the flame yellow. On charcoal fuses easily to a clear bead, which on cooling becomes opaque; after long blowing, the assay spreads out, the fluorid of sodium is absorbed by the coal, a suffocating odor of fluorine is given off, and a crust of alumina remains, which, when heated with cobalt solution in O.F., gives a blue color. Soluble in sulphuric acid, with evolution of hydrofluoric acid.

Obs.—Occurs in a bay in Arksut-fiord, in West Greenland, at Evigtok, about 12 m. from the Danish settlement of Arksut, where it constitutes a large bed or vein in gneiss, and contains galenite, sphalerite, siderite, pyrite, arsenopyrite, fluorite, columbite, cassiterite, all often in fine crystals. The exposure of the cryolite is about 300 feet in length. It is shipped in large quantities to Europe, and to the United States (Pennsylvania), where it is used for making soda, and soda and alumina salts; also of late, in Pennsylvania, for the manufacture of a white glass which is a very good imitation of porcelain. It has also been used for the manufacture of aluminum. The first specimens of cryolite came through Denmark from Greenland, and the earliest notice of it was by Schumacher in the Abh. Nat. Ges. Copenhagen, iv. 1795. The locality was described from personal observation by Giesecké in Ed. Encyc., x. 97, and Ed. Phil. J., vi. 141, 1822; and recently by J. W. Taylor in the Q. J. G. Soc., xii. 140. Taylor states that the cryolite is not white, except within 10 to 15 feet from the surface, and that below this it becomes dark-colored, and even black. He attributes the bleaching above to the heat of two trap-dykes; but as the dykes are not in contact with the cryolite, and the evidence is not clear that they ever overlaid it, this cause may be questioned. The contained ores and other minerals are most abundant near the junction with the gneiss.

Dr. Hagemann described the crystals (Am. J. Sci., II. xlii. 268) as orthorhombic. The author obtained the above figures from specimens kindly furnished by Dr. H. They occur implanted on the massive cryolite. The twin, by the absence of a reëntering angle on plane *O*, appears to prove that the form is orthorhombic and not oblique. Yet Descloizeaux states that the optical characters, as observed by him, indicate a monoclinic form. Owing to the striations of the crystals and their minuteness, the measurements of the author were not very satisfactory *O* ∧ 1-ĭ, in front, gave 126° 40′ (5 measurements 126° 30′—126° 40′, and three of them 126° 40′), *O* ∧ 1-ĭ, back, 125° 10′—125° 37′, *O* ∧ 1-ī about 126°, 1-ī ∧ 2-2̆ about 159° 40, *O* ∧ 1 about 115° 30′, 1-ĭ, front, ∧ 1-ĭ, back, =71° 25′. The angles obtained point to a monoclinic form, and but for the twin, would have been regarded as decisive. The angle *I* ∧ *I* varied from 89° 30′ to 85°. T planes 2-2̆ and 1 were not observed on the back of the crystal. Hagemann found 1-ĭ ∧ 1-ĭ=70° 3

165. ARKSUTITE. Arksudite *G. Hagemann*, Am. J. Sci., II. xlii. 94, 1866.

Granular massive. Cleavage: one quite distinct.

H.=2·5. G.=3·029—3·175. Lustre vitreous, somewhat pearly on cleavage face. Color white. Translucent. Brittle.

Comp.—$2\,(Ca, Na)\,F + Al^2\,F^3$, with Ca : Na=1 : 3,=Aluminum 18·6, sodium 23·3, calcium 6 fluorine 51·3=100. Analysis: Hagemann (l. c.):

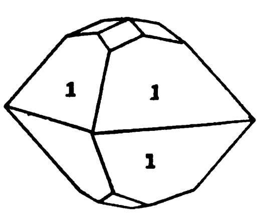
F	Al	Ca	Na	Ḣ	Insol.
51·03	17·87	7·01	23·00	0·57	0·74=100·22

Pyr., etc.—Fuses at a red heat, yielding no water.

Obs.—From the cryolite vein of Iviktok, near Arksut-fiord, in South Greenland. The speci gravity 3·175, it is said, may have owed its excess above that of the other trials to the presen of a little pyrite.

166. CHIOLITE. Chiolith (fr. Miask) *Hermann & Auerbach*, J. pr. Ch., xxxvii. 188, 1846.

131A



Ilmen Mts.

Tetragonal. *O* ∧ 1-*i*=133° 49½′; *a*=1·0418 Observed form f. 131A. 1 ∧ 1, pyr.,=108° 23′; 1 ∧ basal, = 111° 40′; 1 ∧ 1, over summit, = 68° 2 Cleavage indistinct. Twins: composition-face 1, in f. 50. Occurs massive granular, resembling cr olite; structure crystalline.

H.=4. G. = 2·72, Hermann; 2·842 — 2·89 Ramm. Color snow-white. Lustre somewhat r sinous. Translucent.

Comp.—$3\,NaF + 2\,Al^2\,F^3$=Fluorine 58·0, aluminum 18·6, sodium 23·4=100. **Analyses:** Hermann (l. c.); 2, Rammelsberg (Pogg., lxxiv. 315, 1848):

	Al	Na	F	
1. Miask	18·69	23·78	[57·53]	Hermann.
2. "	(⅔) 18·44	24·05	[57·51]	Ramm.

Pyr.—Like cryolite.

Obs.—From the Ilmen Mts., near Miask, where it occurs in granite, with topaz, fluorite, phe cite, and cryolite.

For Kokscharof on cryst., see Verh. Min. Ges. St. Pet., 1850, '51, and Min. Russl., iv. 393.

Kenngott makes crystals from the topaz mine of Mursinsk orthorhombic (Ber. Ak. Wien, 980), with the prismatic angle 124° 22′, and having the acute edge of the prism truncated, a *I* ∧ *i*-ĭ=117° 49′.

167. CHODNEFFITE. Chiolith (fr. Miask) *v. Wörth & Chodnef*, Verh. Russ. Min. G 1845–46, 208, 216, 1846. Chodneffite *Dana*, Min., 234, 1850; Cryolite, ib., 97, 1854. Nip lith *Naum.*, Min., 219, 1864.

G.=2·62—2·77, v. Wörth; 3·00, Ramm. Like chiolite in physi characters.

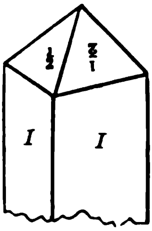
Comp.—$2\,Na\,F + Al^2\,F^3$=Fluorine 56·4, aluminum 16·3, sodium 27·3=100 **Analyses:** 1, Chodnef (l. c.); 2, Rammelsberg (Pogg., lxxiv. 314):

	F	Al	Na
1. Miask	$\frac{3}{2}$ [56·82]	16·48	26·70 Chodnef.
2. "	$\frac{4}{3}$ [56·57]	15·75	27·68 Ramm.

Obs.—Rammelsberg by his analyses appears to show that besides cryolite there are two other related compounds at Miask, one of his analyses sustaining the chiolite of Hermann, and the other the chiolite of Wörth and Chodnef; and on the basis of his results this species is made distinct from the others.

168. PACHNOLITE. Pachnolit *Knop.*, Ann. Ch. Pharm., cxxvii. 61, 1866.

132



Monoclinic. $I \wedge I$=98° 34′, $\frac{1}{2} \wedge \frac{1}{2}$=108° 15′, $I \wedge \frac{1}{2}$=153° 37′, $O \wedge I$=90° 20′, front edge of pyr. on front edge of prism 146° 45′, Descl. Twins: composition-face *i-ì* (f. 132); crystals always twins; $\frac{1}{2} \wedge \rotatebox{180}{$\frac{1}{2}$}$ adjacent 94° 13′. Cleavage: *O* and *I*, unequal. Lustre vitreous. Colorless to white. Transparent to subtransparent. Optic-axial plane and one bisectrix normal to *i-ì*; and inclined 10°—15° to a normal to *i-ì*, and 23° 15′—18° 15′ to a normal to the front edge of the pyramid.

Comp.—3 (Ca, Na) F+$\mathrm{Al}^2\ \mathrm{F}^3$+2 $\dot{\mathrm{H}}$, with Ca : Na=3 : 2=Fluorine 51·12, aluminum 12·29, calcium 16·14, sodium 12·38, water 8·07=100. Analyses: 1, Knop (l. c.); 2, G. Hagemann (Am. J. Sci., II. xli. 119):

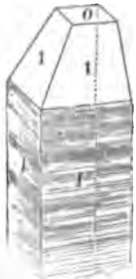
F	Al	Ca	Na	$\dot{\mathrm{H}}$
50·79	13·14	17·25	12·16	9·60=102·94 Knop.
51·15	10·37	17·44	12·04	8·63=99·63 Hagemann.

Pyr., etc.—In the closed tube, heated gently, yields water which is neutral; at a higher heat, that which is acid. Heated rapidly it is decomposed with crackling, and the formation of a white cloud which condenses on the walls of the tube. Decomposed by sulphuric acid, giving out fluohydric acid.

Obs.—Incrusts the cryolite of Greenland, being a result of its alteration. The pyramidal planes sometimes have a stair-like appearance, from interrupted combination.

169. THOMSENOLITE. Dimetric Pachnolite *G. Hagemann*, Am. J. Sci., II. xlii. 93, 1866. Thomsenolite *Dana*.

133



Monoclinic. $I \wedge I$ about 89°; $O \wedge I$ approx. 92° and 88°; $O \wedge 1$=121°—124°, Dana. Prisms slender, a little tapering; *I* horizontally striated. Cleavage: basal very perfect. Also massive, opal, or chalcedony-like.

H.=2·5—4. G.=2·74—2·76, of crystals. Lustre vitreous, of a cleavage-face a little pearly, of massive waxy. Color white, or with a reddish tinge. Transparent to translucent.

Comp.—2 (Ca, Na) F+$\mathrm{Al}^2\ \mathrm{F}^3$+2 $\dot{\mathrm{H}}$, with Ca : Na=7 : 3=Fluorine 52·2, aluminum 15·0, calcium 15·4, sodium 7·6, water 9·8=100. Analysis: Hagemann (l. c.):

	F	Al	Ca	Na	$\dot{\mathrm{H}}$	$\ddot{\mathrm{S}}\mathrm{i}$
Crystals	50·08	14·27	14·51	7·15	9·70	2·0=97·71

The compact afforded Dr. Hagemann a similar result.

Pyr., etc.—Fuses more easily than cryolite to a clear glass. The massive decrepitates remarkably in the flame of a candle. In powder easily decomposed by sulphuric acid.

Obs.—Found with pachnolite on the cryolite of Greenland, and a result of the alteration of cryolite.

The crystals often have an ochre-colored coating, especially the terminal portion; and on this account, and the striated tapering sides, the measurements are only approximations. The mineral was first noticed by Dr. Julius Thomsen of Copenhagen, the originator of the cryolite industry after whom it is here named. It differs strikingly from pachnolite in its pearly basal cleavage an its nearly square prisms; and from cryolite in the horizontal striæ of the same and the facility o cleavage. The compact variety, first observed by Dr. Hagemann (to whom the author is indebte for his acquaintance with it), has much of the aspect of chalcedony; it incrusts cryolite or occupies seams or cavities in it, and is covered by the chalky gearksutite; the incrustations are sometimes half an inch or more thick.

169A. HAGEMANNITE. Hagemannite *Shepard*, Am. J. Sci., II. xlii. 246, 1866. Closely resembles in aspect and condition the compact thomsenolite, but passes sometimes into a yellow, opaqu jaspery variety. It incrusts the cryolite, and also constitutes seams ⅛ to ½ in. thick. It sometime traverses a drusy ferruginous pachnolite. It is ochre-yellow to wax-yellow in color, rarely fai greenish, dull, or with only a faintly glimmering lustre, and looks like an iron flint, or the yello chloropal of Alar, Bavaria. H.=3–3·5. G.=2·59–2·60. Adheres but feebly to the tongue.

Hagemann obtained in an analysis F 40·30, Al 12·06, Fe 5·96, Mg 2·30, Ca 11·18, Na 8·45, 7·79, $\dot{H}$ 10·44. Decrepitates surprisingly in the flame of a candle.

The analysis corresponds to the atomic ratio for F, Si, (Al, Fe), (Mg, Ca, Na), 4:1:1:2. Ta ing 2 F for the Si, to make Si F^2, it leaves only 2 F for the bases. No probable formula can deduced. Excluding the Si, Mg, Fe, the composition is that of thomsenolite.

170. GEARKSUTITE.

Earthy, kaolin-like in aspect.
H.=2. Lustre dull. Color white, opaque.

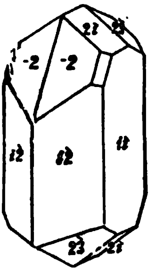
Comp.—$Ca^2 F + Al^2 F^3 + 4 \dot{H}$, or essentially like that of arksutite, excepting the water and t presence of but little soda. Analysis: G. Hagemann (private contrib.):

F 41·18 Al 15·52 Ca 19·25 Na 2·46 $\dot{H}$ 20·22.

Obs.—Occurs with the Greenland cryolite, and is one of the results of its alteration. The auth is indebted for his knowledge of the mineral to Dr. Hagemann. The underlying material is co pact thomsenolite. At the request of Dr. Hagemann, it is named by the author from γῆ, *earth*, a *arksutite*, alluding to its earthy aspect.

171. PROSOPITE. Prosopit *Scheerer*, Pogg., xc. 315, 1853, xcii., 612, ci. 361.

134



Altenberg.

Monoclinic. $I \wedge I = 115° 14'$; $i\text{-}2 \wedge i\text{-}2 = 76° 15'$, $-2 \wedge -2 = 13$ 30′, $2\text{-}\bar{i} \wedge 2\text{-}\bar{i} = 116° 30'$, $2\text{-}3 \wedge 2\text{-}3 = 120° 56'$. Only in imbedd crystals.

H.=4·5. G.=2·890–2·898. Lustre weak. Colorle white, or grayish.

Comp.—Analysis by Scheerer (Pogg., ci. 361, 385):

	Si F^2	$\ddot{Al}$	$\dot{Mn}$	$\dot{Mg}$	$\dot{Ca}$	$\dot{K}$	$\dot{H}$
Altenberg	10·71	42·68	0·31	0·25	22·98	0·15	15·50=92·58.

The loss of 7·42 p. c. is regarded by Scheerer as proving that 5·50 p. c. of oxygen is replaced by fluorine; the mineral is thence regarded by him as cons ing of $\frac{3}{2}$ Si F^2, 6 $\ddot{Al}$, 1 $\dot{Ca}$, 5 Ca F, 12 $\dot{H}$, or, differently arranged, $\frac{3}{2}$ Si F^2, 1 $\ddot{Al}$ 5 $\ddot{Al}$, 2 Ca F, 4 $\dot{Ca}$, 12 $\dot{H}$.

Pyr., etc.—In the glass tube affords water and fluorid of silicon. Decomposable by sulph acid.

Obs.—Occurs at the tin mines of Altenberg, in crystals, part of which are a kind of kaolin, others, according to observations by G. J. Brush (Am. J. Sci., II. xxv. 411), cleavable violet fl and others still fluor partly kaolinized.

Also found at the Schlackenwald tin mines; but Scheerer infers, without an analysis, that crystals from this place (Pogg., xcii. 612) are a phosphate with fluorid, and he gives the hypot ical formula ($\dot{R}^3 \dddot{P}$, R F) Al $F^3 + y\dot{H}$.

The crystals are closely like datolite in form, as shown by the author in the last edition of work (p. 502). Descloizeaux has stated that *optically* they are triclinic.

It is yet doubtful whether unaltered prosopite has been described or seen.

Named from προσωπεῖον, a mask, in allusion to the deceptive character of the mineral.

V. OXYGEN COMPOUNDS.

The grand divisions of Oxygen Compounds among minerals are mentioned on page 1.

I. OXYDS.

General Arrangement.

1. **Oxyds of Elements of Series I.**
    - *a.* Anhydrous.
    - *b.* Hydrous.
2. **Oxyds of Elements of the Arsenic and Sulphur Groups, Series II.**
3. **Oxyds of Elements of the Carbon-Silicon Group, Series II.**

---

1. OXYDS OF ELEMENTS OF SERIES I.

A. ANHYDROUS OXYDS.

The elements of Series I. whose oxyds are here included are those of the iron and tin groups, none of the gold group occurring native. The oxyds have, with few exceptions, the general formulas $\not{R}\,O$, $R\,O$, $R^2\,O^3$, $R\,O+R^2\,O^3$, and $R\,O^2$.

Isometric forms occur under the formulas			$\not{R}\,O$; $R\,O$; $R\,O+R^2\,O^3$.
Hexagonal	"	"	$R\,O$; $R^2\,O^3$.
Tetragonal	"	"	$R\,O^2$; $2\,R\,O+R\,O^2$.
Orthorhombic	"	"	$R\,O$; $R\,O+R^2O^3$; $R\,O^2$.

The following are the groups of Anhydrous Oxyds:

1. PROTOXYDS—$\not{R}\,O$, $R\,O$.

1. CUPRITE AND PERICLASITE GROUPS.—Isometric.

172. **Cuprite**	$\not{\mathrm{C}}\mathrm{u}$	174. **Bunsenite**	$\dot{\mathrm{N}}\mathrm{i}$
173. **Periclasite**	$\dot{\mathrm{M}}\mathrm{g}$		

2. ZINCITE GROUP.—Hexagonal.

175. **Water**	$\dot{\bar{\mathrm{H}}}$	176. **Zincite**	$\dot{\bar{\mathrm{Zn}}}$

3. MASSICOT GROUP.—Isometric and orthorhombic.

177. **Massicot**	$\dot{\bar{\mathrm{Pb}}}$	178. **Melaconite**	$\dot{\bar{\mathrm{Cu}}}$

2. SESQUIOXYDS—R^2O^3.

1. CORUNDUM GROUP.—Hexagonal.

179. **Corundum**	$\dddot{\bar{\mathrm{Al}}}$	181. **Menaccanite**	$(\mathrm{Fe, Ti})^2\,\mathrm{O}^3$ or $(\mathrm{Fe, Ti})^2\,\mathrm{O}^3$ · n
180. **Hematite**	$\dddot{\bar{\mathrm{Fe}}}$	182. **Perofskite**	$(\mathrm{Ca, Ti})^2\,\mathrm{O}^3$

3. COMPOUNDS OF PROTOXYDS AND SESQUIOXYDS—In the ratio 1 : 1, or $R\,O+R^2$

1. SPINEL GROUP.—Isometric.

183. **Spinel**	$\dot{\mathrm{Mg}}\,(\dddot{\bar{\mathrm{Al}}}, \dddot{\bar{\mathrm{Fe}}})$	187. **Magnesioferrite**	$\dot{\mathrm{Mg}}\,\dddot{\bar{\mathrm{Fe}}}$
184. **Hercynite**	$\dot{\mathrm{Fe}}\,\dddot{\bar{\mathrm{Al}}}$	188. **Franklinite**	$(\dot{\mathrm{Zn}}, \dot{\mathrm{Fe}}, \dot{\mathrm{Mn}})\,(\dddot{\bar{\mathrm{Fe}}}, \dddot{\bar{\mathrm{Mn}}})$
185. **Gahnite**	$(\dot{\mathrm{Zn}}, \dot{\mathrm{Fe}}, \dot{\mathrm{Mg}})\,(\dddot{\bar{\mathrm{Al}}}, \dddot{\bar{\mathrm{Fe}}})$	189. **Chromite**	$(\dot{\mathrm{Fe}}, \dot{\mathrm{Mg}}, \dot{\mathrm{Cr}})\,(\dddot{\bar{\mathrm{Al}}}, \dddot{\bar{\mathrm{Fe}}}, \dddot{\bar{\mathrm{Cr}}})$
186. **Magnetite**	$\dot{\mathrm{Fe}}\,\dddot{\bar{\mathrm{Fe}}}$	190. **Uraninite**	? $\dot{\mathrm{U}}\,\dddot{\bar{\mathrm{U}}}$

2. CHRYSOBERYL GROUP.—Orthorhombic.

191. **Chrysoberyl**	$\dot{\mathrm{Be}}^3\,\dddot{\bar{\mathrm{Al}}}$

4. DEUTOXYDS—$R\,O^2$.

1. RUTILE GROUP.—Tetragonal.

192. **Cassiterite**	$\ddot{\mathrm{Sn}}$	195. **Hausmannite**	$\dot{\mathrm{Mn}}^2, \dddot{\bar{\mathrm{Mn}}}$
193. **Rutile**	$\ddot{\mathrm{Ti}}$	196. **Braunite**	$2\,\dot{\mathrm{Mn}}^2\,\dddot{\bar{\mathrm{Mn}}}+\dddot{\bar{\mathrm{Mn}}}\,\dddot{\mathrm{Si}}$
194. **Octahedrite**	$\ddot{\mathrm{Ti}}$	197. ? **Minium**	$\dot{\mathrm{Pb}}^2\,\ddot{\mathrm{Pb}}$

2. BROOKITE GROUP.—Orthorhombic.

198. **Brookite**	$\ddot{\mathrm{Ti}}$	199. **Pyrolusite**	$\ddot{\mathrm{Mn}}$

5. COMPOUNDS OF PROTOXYDS AND SESQUIOXYDS—In the ratio 3 : n, or $3\,RO+n\,R^2$

200. **Crednerite** (Monoclinic) $\dot{\mathrm{Cu}}^3\,\dddot{\bar{\mathrm{Mn}}}^2$

Appendix. 201. **Plattnerite.**

Some points in the above table require explanation. Admitting the principle stated on pa 33, that in oxyds crystallizing in the *hexagonal* system the number of atoms of the *negative* eleme oxygen, is 3, or a multiple of 3; and that in those crystallizing in the *tetragonal* system t number is 2 or 4, or a multiple of 4; and that the sesquioxyds Fe^2O^3, Al^2O^3 are hexagonal spec in accordance with this principle, and the deutoxyds $Ti\,O^2$, $Sn\,O^2$ are tetragonal in exemplificati of it,* we have reasons for the following conclusions. In the Zincite group, since water (ice) a zincite are hexagonal, these species, *when thus crystallized* (whatever be true in other states), m have the formulas H^3O^3, and Zn^3O^3. In the Massicot group, since the two species mention occur both in isometric and orthorhombic forms; and since the orthorhombic form is in an closely like that of orthorhombic Ti O^2 (brookite), the angles $I \wedge I$ and $I \wedge \frac{1}{2}$ being 99° 39′, 126° 29′ in cuprite, and 99° 50, 126° 15′ in brookite, it would seem to be true that while the isometric kinds have the formulas Pb O and Cu O, as ordinarily written, the orthorhombic have the formulas $Pb^2 O^2$ and $Cu^2 O^2$ (or $\overline{C}u\ O^2$); and that the latter ought to be arranged with the deutoxyds, in the same group with brookite, which also has 2 of oxygen. (This arrangement would have been adopted above, if distinct orthorhombic forms of the species had been observed in nature.)

---

* The principle does not require that when the number of atoms of oxygen is 2 or 4, or a multi of 4, that the forms should be *necessarily* tetragonal, but recognizes that tetragonal forms are th possible. The oxyd $Ti\,O^2$ crystallizes not only in tetragonal forms, but also in orthorhombic.

Again, under the Rutile group are arranged the species hausmannite and braunite, ores of manganese. The formula of *hausmannite* is commonly written $\dot{M}n\ \dddot{\overline{M}}n$, making it analogous to species of the Spinel group. But it accords better with its tetragonal crystallization and its relations to Ti O^2, to write it $\dot{M}n^2\ \ddot{M}n$. *Braunite* has been shown by Rammelsberg to have a composition that may be represented by the formula $(Mn\ Si)^2\ O^3$, in which Mn and Si appear as replacing one another. The constituents, as deduced by analysts, are $3\ \dddot{\overline{M}}n + \dot{M}n + \ddot{S}i$, which include 8 of Mn and Si to 12 of oxygen, in accordance with the above formula. But braunite has closely the crystallization of Ti O^2 in rutile; and this relation is brought out in the formula $2\ \dot{M}n^2\ \ddot{M}n + \dot{M}n\ \ddot{S}i$ above given, which represents it as corresponding to 2 of hausmannite and 2 of a silicate analogous to zircon, with which silicate also it is isomorphous. The close relation and isomorphism of Mn and Si assumed in the formula $(Mn, Si)^2\ O^3$ is unsustained by facts.

---

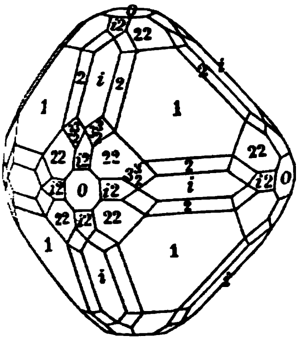
1. PROTOXYDS.

172. **CUPRITE.** Aes caldarium rubro-fuscum, *Germ.* Lebererzkupfer, *Agric.*, Foss., 334, Interpr., 462, 1546. Minera cupri calciformis pura et indurata, colore rubro, vulgo Kupferglas, Kupfer Lebererz., *Cronst.*, Min., 173, 1758. Cuprum tessulatum nudum *Linn.*, Syst., 172, tab. viii., 1756; Cuprum cryst. octaëdrum *ib.*, 1768. Octahedral Copper Ore, Red Glassy Copper Ore, *Hill*, Foss., 1771. Mine rouge de cuivre *Sage*, Min., 1772. Mine de cuivre vitreuse rouge *de Lisle*, Crist., 1772, 1783. Rothkupfererz. Cuivre oxidulé. Oxydulated copper. Zigueline *Beud.*, Tr., ii. 713, 1832. Ruberite *Chapm.*, Pract. Min., 63, 1843. Cuprit *Haid.*, Handb., 548, 1845.

Ziegelerz=Tile Ore; Kupferlebererz; Hepatinerz.

Haarformiges Rothkupfererz; Cuivre oxidulé capillaire, *H.*; Kupferblüthe *Hausm.*; Capillary Red Oxyd of Copper. Chalkotrichit *Glock.*, Grundr., 369, 1839.

135



Isometric. Observed planes, *O*, 1, *i*, *i*-2 (e′), *i*-5, 2 (a″), 3, 2-2 (a′), 3-$\frac{3}{2}$ (o). Figs. 1 to 8, and f. 135. Cleavage: octahedral. Sometimes cubes lengthened into capillary forms. Also massive, granular; sometimes earthy.

H.=3·5–4. G.=5·85–6·15; 5·992, Haidinger. Lustre adamantine or submetallic to earthy. Color red, of various shades, particularly cochineal-red; occasionally crimson-red by transmitted light. Streak several shades of brownish-red, shining. Subtransparent—subtranslucent. Fracture conchoidal, uneven. Brittle.

Comp., Var.—Oxyd of copper, $\overline{C}u$=Oxygen 11·2, copper 88·8=100. Sometimes affords traces of selenium.

Var. 1. *Ordinary* (*a*) Crystallized; commonly in octahedrons, dodecahedrons, cubes, and intermediate forms; the crystals often with a crust of malachite; (*b*) massive.

2. *Capillary*; *Chalcotrichite.* In capillary or acicular crystallizations, supposed formerly to be orthorhombic, but, according to Brooke and A. Knop, really cubes elongated in the direction of the octahedral axis (Knop, Jahrb. Min., 521, 1861).

3. *Earthy; Tile Ore* (Ziegelerz *Germ.*). Brick-red or reddish-brown and earthy, often mixed with red oxyd of iron; sometimes nearly black

The *hepatinerz*, or *liver-ore*, of Breithaupt has a liver-brown color. Von Bibra found (J. pr. Ch., xcvi. 203) the tile-ore of Algodon bay, Bolivia, to contain chlorine, and to be a mixture of atacamite, cuprite, hematite, and other earthy material; he obtained for one, atacamite 81·32, cuprite 10·85, sesquioxyd of iron 20·50, gangue 34·42, water, antimony, and loss 2·87. In two others, atacamite 28·40, 33·25, cuprite 12·77, 13·02, limonite 25·00, 19·07, gangue 30·81, 32·57, water, antimony and loss 3·02, 2·09.

Pyr., etc.—Unaltered in the closed tube. B.B. in the forceps fuses and colors the flame emerald-green; if previously moistened with muriatic acid, the color imparted to the flame is momentarily azure-blue from chlorid of copper. On charcoal first blackens, then fuses, and is reduced t metallic copper. With the fluxes gives reactions for oxyd of copper. Soluble in concentrate muriatic acid.

Obs.—Occurs at Camsdorf and Saalfield in Thuringia, at Les Capanne Vecchie in Tuscany; o Elba, in cubes; in Cornwall, in fine translucent crystals with native copper and quartz, at Whea Gorland and other Cornish mines; in Devonshire near Tavistock; in isolated crystals, sometime an inch in diameter, in lithomarge, at Chessy, near Lyons, which are generally coated with malachite; at Katherinenberg in Siberia; in South Australia; also abundant in Chili, Peru, Bolivia the crystals in which regions, as far as examined by D. Forbes, are simple cubes (private communication); very fine crystals from Andacollo near Coquimbo.

It has been observed at Schuyler's, Somerville, and Flemington copper mines, N. J., crystallize and massive, associated with chrysocolla and native copper; also near New Brunswick, N. J., i red shale; 2 m. from Ladenton, Rockland Co., N. Y., with green malachite in trap; at Cornwall Lebanon Co., Pa.; in the Lake Superior region.

When found in large quantities this species is valuable as an ore of copper.

Named *cuprite* by Haidinger from the Latin *cuprum*, *copper*. Chapman's name *ruberite* (from th Latin *ruber*, *red*) is prior in date (l. c.); but the laws of derivation would change it to *rubrite*; an instead of introducing this altered name, that next in priority, already long used, is here adopte

Alt.—A deoxydation of this oxyd of copper sometimes takes place, producing native coppe It also becomes carbonated and green, by means of carbonated waters, changing to malachite c azurite; or through a silicate in solution it is changed to chrysocolla; or by taking oxygen it becomes melaconite. Limonite occurs as a pseudomorph by substitution after cuprite.

173. **PERICLASITE.** Periclasia *Scacchi*, Mem. Min., Naples, 1841. Periklas *Germ.*

Isometric. Figs. 1, 2. Cleavage: cubic, perfect. Also in grains.

H.= nearly 6. G. = 3·674, Damour. Color grayish to dark-greer Transparent to translucent.

Comp.—$\dot{M}g$; or magnesia, with 1 part in 25 of protoxyd of iron. Analyses: 1, Scacchi (l. c. 2, 3, Damour (Ann. d. M., IV. iii. 360, and Bull. Soc. G. Fr., 1849, 313):

1.	$\dot{M}g$ 89·04	$\dot{F}e$ 8·56=97·60 Scacchi.
2.	93·86	5·97=99·83 Damour.
3.	93·38	6·01=99·39 Damour.

Pyr., etc.—B.B. unaltered and infusible. With cobalt solution after long blowing assumes faint flesh-red color. The pulverized mineral shows an alkaline reaction when moistened, an dissolves in mineral acids without effervescence.

Obs.—Occurs disseminated through ejected masses of a white limestone, and in spots of sma clustered crystals, on Mt. Somma, sometimes with forsterite and earthy magnesite.

Named from περι, *about*, and κλάσις, *cleavage*.

Artif.—Formed in crystals of a cubo-octahedral form by making lime to act at a high temperature on borate of magnesia (Ebelmen); by the action of chorhydric gas on magnesia (Deville); b the action of chlorid of magnesium on lime (Daubrée).

174. **BUNSENITE.** Nickeloxydul *C. Bergemann*, J. pr. Ch., lxxv. 243, 1858. Protoxyd c Nickel. Bunsenite *Dana.*

Isometric. In octahedrons, sometimes having truncated edges.

H.=5·5. G.=6·398. Lustre vitreous. Color pistachio-green. Strea brownish-black. Translucent. [Characters of minute crystals half a lin in diameter.] Artificial crystals observed in slags have a metallic lustre, and brownish-black color.

Comp.—$\dot{\mathrm{N}}\mathrm{i}$, or pure protoxyd of nickel.

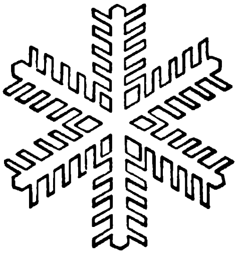
Obs.—Occurs in cavities with other nickel ores, and ores of uranium, at Johanngeorgenstadt (C. Bergemann, J. pr. Ch., lxxv. 239).

Named after Prof. Bunsen, who observed long since artificial crystals of this oxyd of nickel.

175. WATER

Hexagonal. Usual in compound stellate forms, one form of which is shown in f. 136.

136



G.=0·918, Brunner; 0·9178 at 32° F., L. Dufour. Colorless. Inodorous. Tasteless. Liquid above 32° F., and boils at 212° F. A cubic inch of pure water at 60° F., and 30 inches of the barometer, weighs 252·458 grains.

Comp.—HO=Oxygen 88·89, hydrogen 11·11=100.

Obs.—The density of water is greatest at 39°·1 F., according to Joule and Playfair. Despretz obtained 39°·176; Hallström 39°·38; Blagden and Gilpin 39°; Hope 39°·5; Muncke 38°·804. Below this temperature it expands as it approaches 32°, owing to incipient crystallization.

Water as it occurs in nature is seldom pure. It ordinarily contains some atmospheric air, often pure oxygen and carbonic acid, besides various saline ingredients, as salts of magnesia, lime, iron, soda, potash, and sometimes traces of zinc, arsenic, lead, copper, antimony, and even tin, these ingredients being derived from the rocks or soil of the region. For citation of numerous recent analyses of waters, see Kenngott's Uebersicht, 1844–1862; also the Jahresbericht f. Ch., etc.

Obs.—See on the Crystallization of Ice, Leydolt, Ber. Ak. Wien., vii. 477. Also A. E. Nordenskiöld, who states that it is dimorphous; one form probably orthorhombic (J. pr. Ch., lxxxv. 431).

176. ZINCITE. Red Oxyd of Zinc *A. Bruce*, Bruce's Min. J., i., No. 2, 96, 1810. Zinkoxyd, Rothzinkerz, *Germ.* Zinc oxydé, *Fr.* Red Zinc Ore. Zinkit *Haid.*, Handb., 548, 1845. Spartalite *B. & M.*, 218, 1852. Sterlingite F. Alger, Min., 565, 1844.

Hexagonal. $O \wedge 1 = 118° 7'$; $a = 1·6208$. In quartzoids with truncated summits, and prismatic faces I. $1 \wedge 1 = 127° 40'$ (to 43′), Rose; $I \wedge 1 = 151° 53'$; 152° 20′, Levy. Cleavage: basal, eminent; prismatic, sometimes distinct. Usual in foliated grains or coarse particles and masses; also granular.

H.=4–4·5. G.=5·43–5·7. 5·684, orange-yellow crystals, W. P. Blake. Lustre subadamantine. Streak orange-yellow. Color deep red, also orange-yellow. Translucent—subtranslucent. Fracture subconchoidal. Brittle.

Comp.—$\dot{\mathrm{Z}}\mathrm{n}$=Oxygen 19·74, zinc 80·26=100; containing oxyd of manganese as an unessential ingredient. Analyses: 1, Bruce (l. c.); 2, Berthier (Ann. d. M., iv. 483); 3, 4, Whitney (Pogg., lxxi. 169); 5, A. A. Hayes (Am. J. Sci., xlviii. 261); 6, W. P. Blake (Mining Mag., II. ii. 94, 1860):

		$\dot{\mathrm{Z}}\mathrm{n}$	$\dot{\mathrm{M}}\mathrm{n}$	$\dddot{\bar{\mathrm{M}}}\mathrm{n}$	$\dddot{\bar{\mathrm{F}}}\mathrm{e}$	
1.	*Red*	92	——	8		=100 Bruce.
2.	"	88	12		——	=100 Berthier.
3.	"	94·45	——	*tr.*	——	, Frankl. 4·49, ign. 1·09=100·03 Whit.
4.	"	96·19	——	3·70	——	, *undec.* 0·10=99·99 Whitney.
5.	"	93·48	5·50	——	0·36	, scales $\dddot{\bar{\mathrm{F}}}\mathrm{e}$ 0·44=99·78 Hayes.
6.	*Yellow*	99·47	——	0·68	——	, ign. 0·23=100·38 Blake.

Thin scales magnified and viewed by transmitted light are deep yellow. The author finds b means of a high magnifying power that this ore is free from foreign scales of red oxyd of iron o other substances; and consequently the color is probably due, as held by G. Rose and J. D Whitney, to the presence of $\ddot{\text{Mn}}$. The crystals analyzed by Blake (anal. 6), which contain les than 1 p. c. of $\ddot{\text{Mn}}$, were orange-yellow in color.

Pyr., etc.—Heated in the closed tube blackens, but on cooling resumes the original color B.B. infusible; with the fluxes, on the platinum wire, gives reactions for manganese, and on charcoal in R.F. gives a coating of oxyd of zinc, yellow while hot, and white on cooling. The coating moistened with cobalt solution and treated in R.F., assumes a green color. Soluble in acid without effervescence. On exposure to the air it suffers a partial decomposition at the surface and becomes invested with a white coating, which is carbonate of zinc.

Obs.—Occurs with Franklinite and also with calcite at Stirling Hill and Mine Hill, Sussex Co. N. J., sometimes in lamellar masses in pink calcite. It was first noticed, described, and analyzed by Dr. Bruce. Reported as forming pseudomorphs after blende at Schneeberg.

An oxyd of zinc, mixed with hydrate of iron, occurs on marmatite at Bottino in Tuscany, whic afforded C. Bechi (Am. J. Sci., II. xiv. 62) $\dot{\text{Zn}}$ 31·725, $\overline{\text{Fe}}$ 47·450, $\dot{\text{H}}$ 20·825.

Artif.—Mitscherlich has observed minute six-sided prisms in the iron furnaces of Königshütte in Silesia. Similar crystals have been met with in the zinc furnaces near Siegen; also in th furnaces and roast-heaps at the New Jersey zinc mines; surface drusy, color white to amber yellow (Am. J. Sci., II. xiii. 417); in hexagonal prisms in the zinc furnaces at Bethlehem. Pa. and Newark, N. J.; by L. Stadtmuller at the iron furnace of Van Deusenville, Mass.; also a other furnaces in Europe and America.

177. MASSICOT. Bleiglätte. Lead-ochre. Plumbic Ochre. Oxyd of Lead. Plomb oxidé

Massicot *Huot*, Min., 346, 1841.

Orthorhombic and isometric (artif.). Massive; structure scaly crystalline or earthy.

H.=2. G.=8·0; 7·83—7·98, from Mexico, Pugh; 9·2—9·36 whe pure. Lustre dull. Color between sulphur and orpiment-yellow, some times reddish. Streak lighter than the color. Opaque. Does not soil.

Comp.—$\dot{\text{Pb}}$=Oxygen 7·17, lead 92·83=100; more or less impure. **Analyses:** 1, John (Schw J., iv. 219, xxxii. 106); 2, 3, Pugh (Ann. Ch. Pharm., c. 128):

	$\dot{\text{Pb}}$	$\ddot{\text{C}}$	$\overline{\text{Fe}}$, $\dot{\text{Ca}}$	$\ddot{\text{Si}}$
1.	89·10	3·84	0·48	2·40=95·82 John.
2. Mexico	92·91	1·88	$\overline{\text{Fe}}$ 5·57	*tr.*, S and loss 0·14 Pugh.
3. "	92·40	1·38	" 4·85	0·14, " 1·23 Pugh.

The specimens analyzed by Pugh were from the mine of Guillermo, near Perote, in the distri of Vera Cruz, where native lead also is reported to occur in galena.

Pyr., etc.—B.B. fuses readily to a yellow glass, and on charcoal is easily reduced to metall lead.

Obs.—It is said to occur at Badenweiler in Baden, in quartz. Gerolt states that it has bee ejected from the volcanoes of Popocatapetl and Jztaccituall, in Mexico. It is found in man places in the provinces of Chihuahua and Cohahuila in considerable quantities, having been co lected along the streams between Ceralvo and Monterey, being supposed to come from the rang of mountains running nearly north of Monterey. The specimens (often 2 or more cubic inches i size) are between orpiment and sulphur-yellow in color, and glisten like a granular mica of nearly golden color. The natural surface is slightly crystalline and shining, and when broken shows a scaly texture (Bailey in Am. J. Sci., II. viii. 420).

Occurs also at Austin's mines, Wythe Co., Va.

Artif.—Artificial crystals have been obtained among furnace products and by direct chemic methods, as well as from fusion, which were orthorhombic (rhombic octahedrons, etc.); an others that were isometric (cubes, dodecahedrons, etc.).

178. MELACONITE. Kupferschwärze *Wern.*, Bergm. J., 1789. Black Oxyd of Coppe

Black Copper. Melaconite *Huot*, Min., 326, 1841. Tenorite *Semmola*, Opere Minori, 45, Napo 1841, Bull. G. Fr., xiii. 206, 1841-42. Melaconisa *A. Scacchi*, Distrib. Sist. Min., 40, Napo 1842. Melaconite *Dana*, Min., 518, 1850.

Isometric and orthorhombic (artif.). Earthy; massive; pulverulent; also in shining flexible scales. Rarely in cubes with truncated angles (pseudomorphous ?).

H.=3. G.=6·25, massive, Whitney; 5·952, ib., Joy. Lustre metallic, and color steel or iron-gray when in thin scales; dull and earthy, with a black or grayish-black color, and ordinarily soiling the fingers when massive or pulverulent.

Var.—1. Earthy-black, sometimes under the forms of crystals. 2. In scales, with a metallic lustre.

Comp.—Cu O, or Ȼu O^2 (the latter for the orthorhombic)=Oxygen 20·15, copper 79·85=100. Analyses: 1, 2, Joy (Pogg., lxxx. 287); 3, id. (Ann. Lyc. N. Y., viii. 121):

	Ċu	F̶e	Ċa	S̄i
1. Copper Harbor	99·45	——	——	——=99·45 Joy.
2. " "	[95·20]	1·19	0·23	3·38=100 Joy.
3. " "	93·06	1·07	0·22	3·08=97·43 Joy.

Pyr., etc.—B.B. in O.F. infusible; other reactions as for cuprite (p. 134). Soluble in muriatic and nitric acids.

Obs.—Found on lava at Vesuvius in scales from a twentieth to a third of an inch across, often hexagonal and sometimes triangular (Semmola); and also pulverulent (Sacchi, who uses the name melaconise for the mineral). Common in the earthy form about copper mines, as a result of the decomposition of chalcopyrite and other copper ores. Abundant thus at the Ducktown mines in Tennessee, and also formerly at Copper Harbor, Keweenaw Point, L. Superior. At the latter place a vein afforded, some years since, 40,000 lbs. of this ore. Imbedded in its mass there were numerous perfect crystals, having the form of cubes with truncated angles. These crystals have been regarded as pseudomorphs after cuprite by Teschemacher, Hayes, and others. J. D. Whitney has pronounced them (Rep. L. Sup., ii. 99) original crystals of the species, on the ground that the red copper now in the vein occurs only in octahedrons.

Artif.—Becquerel obtained tetrahedral crystals by fusing oxyd of copper with potash (Ann. Ch. Phys., li. 102); and Jenzsch has described (Pogg., cvii. 647) orthorhombic crystals, found in the hearth of a calcining furnace at Freiberg, having $I \wedge I$=99° 39′, $I \wedge \frac{1}{2}$=126° 29′, $I \wedge 1\text{-}\bar{i}$=122° 58′, $I \wedge 1\text{-}\breve{i}$=113° 58′, approaching the angles of brookite, and showing a relation of this oxyd of copper to the deutoxyds; $I \wedge I$ in brookite being 99° 50′, and $I \wedge \frac{1}{2}$=126° 15′.

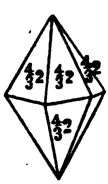
Marcylite Shepard (Marcy's Expl. Red River, 135, 1854, Shep. Min., 1857, 405) is an uncertain mixture from the Red River, near the Wachita Mts., Arkansas. Shepard made it (l. c.) a mixed hydrous chlorid and oxyd of copper, as if containing atacamite. Specimens put by him into the hands of S. W. Tyler for analysis were found to contain (Am. J. Sci., II. xli. 111) 63·42 p. c. of copper and 17·22 of sulphur, with a "supposed" amount of oxygen and water set down at 8 of oxygen and 9 of water, whence it is supposed to consist of oxyd of copper (Cu O) 39·70, sulphid of copper (Cu S) 47·70, with 9 of water. It is evidently a result of the alteration of a sulphid of copper.

2. SESQUIOXYDS.

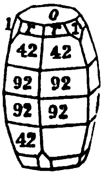
179. CORUNDUM. Corindon (=Sapphire, Corundum, and Emery united) *H.*, Gilb. Ann., xx. 187, 1805, Lucas Tabl., i. 257, 1806.

Rhombohedral. $R \wedge R$=86° 4′, $O \wedge 1(R)$=122° 26′; (122° 25′, Kokscharof); a=1·363. Observed planes: rhombohedrons, $\frac{1}{3}$, $\frac{1}{2}$, $1(R)$, -2, -1; pyramids, $\frac{4}{3}$-2 (f. 137, 139, 140, and plane r in f. 138), $\frac{14}{9}$-2, 2-2, $\frac{7}{3}$-2, $\frac{8}{3}$-2, 4-2, $\frac{16}{3}$-2, 8-2, 9-2; scalenohedrons, $\frac{2}{3}^{\frac{5}{3}}$, $\frac{2}{5}^{3}$, $\frac{1}{4}^{5}$ (=$\frac{10}{9}$-$\frac{5}{4}$, $\frac{6}{5}$-$\frac{3}{2}$, $\frac{5}{4}$-$\frac{5}{3}$); also I, i-2, i-$\frac{8}{7}$, O.

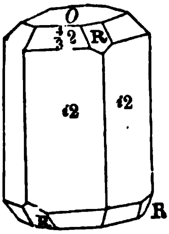
137



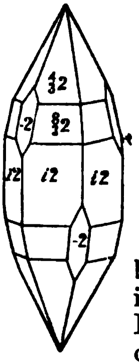
138



139



140



$O \wedge \frac{1}{3} = 152° 19'$
$O \wedge \frac{1}{2} = 141\ 48$
$O \wedge 2 = 107\ 38$
$O \wedge 2\text{-}2 = 110\ \ 9$
$O \wedge \frac{4}{3}\text{-}2 = 118\ 49$
$O \wedge 4\text{-}2 = 100\ 24$
$O \wedge \frac{6}{5}\text{-}\frac{3}{2} = 120\ 59$
$O \wedge \frac{10}{9}\text{-}\frac{5}{4} = 121\ 58$
$\frac{4}{3}\text{-}2 \wedge \frac{4}{3}\text{-}2$, pyr. $= 128\ \ 2$
$2\text{-}2 \wedge 2\text{-}2$, " $= 124$
$i\text{-}2 \wedge R = 136\ 58$
$i\text{-}2 \wedge \frac{4}{3}\text{-}2 = 151\ 11$
$2 \wedge 2 = 78\ 45$

Cleavage: basal, sometimes perfect, but interrupted, commonly imperfect in the blue variety; also rhombohedral. Large crystals usually rough. Twins: composition-face *R*. Also massive granular or impalpable; often in layers from composition parallel to *R*.

H.=9. G.=3·909—4·16. Lustre vitreous; sometimes pearly on the basal planes, and occasionally exhibiting a bright opalescent star of six rays in the direction of the axis. Color blue, red, yellow, brown, gray, and nearly white; streak uncolored. Transparent—translucent. Fracture conchoidal—uneven. Exceedingly tough when compact.

Comp., Var.—Pure alumina $\bar{\ddot{A}}$l=Oxygen 46·6, aluminum 53·4=100.

There are three subdivisions of the species prominently recognized in the arts, and until early in this century regarded as distinct species; but which actually differ only in purity and state of crystallization or structure. Haüy first (in 1805) formally united them under the name here accepted for the species, though the fact that adamantine spar and sapphire were alike in crystallization did not escape the early crystallographer Romé de Lisle, and led him to suggest their identity.

VAR. 1. SAPPHIRE.—'Υάκινθος (bluish S.) *Gr.*; Hyacinthos (id.) *Plin.*, xxxvii. 44; Asteria (the asteriated) *id.*, xxxvii. 49. Jacut *Arab.* [fr. name in India, and thence Hyacinthus *Vet.* (?) King]. 'Ανθραξ (red S., the Greek meaning *burning coal*) pt., *Theophr.* Carbunculus, Lychnis (red S.), pt., *Plin.*, xxxvii. 25, 29. Saphir, Sapphirus, *Wall.*, Min., 116; Orientalisk Rubin, id., 117, 1747. Télésie *H.*, Tr., 1801. Corindon hyalin *H.*, 1805.

Includes the purer kinds of fine colors, transparent to translucent, useful as gems. Stones are named according to their colors; true *Ruby*, or *Oriental Ruby*, red; *O. Topas*, yellow; *O. Emerald*, green; *O. Amethyst*, purple. A variety having a stellate opalescence when viewed in the direction of the vertical axis of the crystal, is the *Asteriated* Sapphire (*Asteria* of Pliny). The ruby sapphire was probably included under the ἄνθραξ of Theophrastus, and the *Carbunculus* and *Lychnis* of Pliny.

2. CORUNDUM.—Adamas Siderites *Plin.*, xxxvii. 15. Karund *Hind.* Corivindum, Corivendum (fr. India), *Woodw.*, Cat. Foss., 1714, 1725. Adamantine Spar (fr. India) *Black*, 178–? according to Greville and Klaproth (v. seq.). Demantspath *Klapr.*, Mem. Acad., Berlin, 1786–87, Berlin, 1792; Beitr., i. 47, 1795; *Wern.*, Bergm. J., i. 375, 390, 1789. Spath adamantin *Delameth.*, J. de Phys., xxx. 12, 1787; *Haüy*, ib., 193. Corundum *Greville*, Phil. Trans., 1798. Corindon *H.*, Tr., 1801. Corindon harmophane *H.* Corindon adamantin *Brongn.*, Min., i. 429, 1807. Korund *Germ.*

Includes the kinds of dark or dull colors and not transparent, colors light blue to gray, brown, and black. The original adamantine spar from India has a dark grayish smoky-brown tint, but greenish or bluish by transmitted light, when translucent, and either in distinct crystals often large, or cleavable-massive. It is ground and used as a polishing material, and being purer, is superior in this respect to emery. It was thus employed in ancient times, both in India and Europe. The "Armenian stone" below is supposed by King to have been corundum rather than emery.

3. EMERY.—'Ακόνη ἐξ 'Αρμενίας [=Armenian Whetstone], *Theophr.* Σμύρις *Dioscor.*, v. 165 Naxium (fr. Naxos), Naxium ex Armenia, *Plin.*, xxxvi. 10. Pyrites vivus (?) *Plin.*, xxxvi. 30

Smyris, Smiris, *Agric.*, Foss., 1546. Smergel, Smiris ferrea, *Wall.*, Min., 267, 1747. Smirgel, Schmirgel, *Germ.* Emeril *H.*, Tr., 1801; Corindon granuleux *H.*, 1805.

Includes granular corundum, of black or grayish-black color, and contains magnetite or hematite intimately mixed. Feels and looks much like a black fine-grained iron ore, which it was long considered. There are gradations from the evenly fine-grained emery to kinds in which the corundum is in distinct crystals. This last is the case with part of that at Chester, Massachusetts.

The following are analyses by J. Lawrence Smith, taken from elaborate papers in the Am. J. Sci., II. x. 354, xi. 53, xlii. 83. The column of hardness gives the effective abrasive power of the powdered mineral, that of sapphire being 100; Mag. stands for *Magnetite:*

		H.	G.	$\ddot{\bar{A}}l$	Mag.	$\dot{C}a$	$\ddot{S}i$	$\dot{H}$
1.	*Sapphire*, India	100	4·06	97·51	1·89	——	0·80	——=100·20.
2.	*Ruby*, India	90	——	97·32	1·09	——	1·21	——=99·62.
3.	*Corundum*, Asia Minor	77	3·88	92·39	1·67	1·12	2·05	1·60=98·83.
4.	" Nicaria	65	3·92	87·52	7·50	0·82	2·01	0·68=99·53.
5.	" Asia	60	3·60	86·62	8·21	0·70	3·85	1·16=101·04.
6.	" India	58	3·89	93·12	0·91	1·02	0·96	2·86=98·87.
7.	" "	55	3·91	84·56	7·06	1·20	4·00	3·10=99·92.
					$\ddot{\bar{F}}e$			
8.	*Emery*, Kulah	57	4·28	63·50	33·25	0·92	1·61	1·90=101·18.
9.	" Samos	56	3·98	70·10	22·21	0·62	4·00	2·10=99·03.
10.	" Nicaria	50	3·75	71·06	20·32	1·40	4·12	2·53=99·43.
11.	" Kulah	53	4·02	63·00	30·12	0·50	2·36	3·36=98·34.
12.	" Gumuch	47	3·82	77·82	8·62	1·80	8·13	3·11=99·48.
13.	" Naxos	46	3·75	68·53	24·10	0·86	3·10	4·72=101·31.
14.	" Nicaria	46	3·74	75·12	13·06	0·72	6·88	3·10=98·88.
15.	" Gumuch	42	4·31	60·10	33·20	0·48	1·80	5·62=101·20.
16.	" Kulah	40	3·89	61·05	27·15	1·30	9·63	2·00=101·13.
17.	" Chester	33	——	44·01	50·21	——	3·13	*und.*
18.	" "	40	——	50·02	44·11	——	3·25	"
19.	" "	39	——	51·92	42·25	——	5·46	"
20.	" "	45	——	74·22	19·31	——	5·48	"
21.	" "	—	——	84·02	9·63	——	4·81	"

Dr. C. T. Jackson makes the formula of emery $\dot{F}e\ \ddot{\bar{A}}l$, and puts the mineral in the spinel family. But neither microscopic nor chemical investigations appear to sustain this view.

Pyr., etc.—B.B. unaltered; slowly dissolved in borax and salt of phosphorus to a clear glass, which is colorless when free from iron; not acted upon by soda. The finely pulverized mineral, after long heating with cobalt solution, gives a beautiful blue color. Not acted upon by acids, but converted into a soluble compound by fusion with bisulphate of potash or soda. Friction excites electricity, and in polished specimens the electrical attraction continues for a considerable length of time.

Obs.—This species is associated with crystalline rocks, as granular limestone or dolomite, gneiss, granite, mica slate, chlorite slate. The fine sapphires are usually obtained from the beds of rivers, either in modified hexagonal prisms or in rolled masses, accompanied by grains of magnetic iron ore, and several species of gems. The emery of Asia Minor, according to Dr. Smith, occurs in granular limestone.

The best ruby sapphires occur in the Capelan mountains, near Syrian, a city of Pegu, and in the kingdom of Ava; smaller individuals occur near Bilin and Merowitz in Bohemia, and in the sand of the Expailly river in Auvergne. Blue sapphires are brought from Ceylon: this variety was called *Salamstein* by Werner. Corundum occurs in the Carnatic on the Malabar coast, in the territories of Ava, and elsewhere in the East Indies; also near Canton, China. At St. Gothard, it occurs of a red or blue tinge in dolomite, and near Mozzo in Piedmont, in white compact feldspar. Adamantine spar is met with in large coarse hexagonal pyramids on the Malabar coast, and in Gellivara, Sweden. Emery is found in large boulders at Naxos, Nicaria, and Samos of the Grecian islands; also in Asia Minor, 12 m. E. of Ephesus, near Gumuch-dagh, where it was discovered in situ by Dr. J. Lawrence Smith, associated with margarite, chloritoid, pyrite, calcite, etc.; and also at Kulah, Adula, and Manser, the last 24 m. N. of Smyrna; also with the nacrite (?) of Cumberland, England. Other localities are in Bohemia near Petschau; in the Ural, near Katharinenburg; and in the Ilmen mountains, not far from Miask; Frederick Valley, Australia.

In N. America, in *Maine*, at Greenwood, in cryst. in mica schist, with beryl, zircon, lepidolite, rare. In *Massachusetts*, at Chester, corundum and emery in a large and valuable vein, consisting mainly of emery and magnetite, associated with diaspore, ripidolite, margarite, etc.; the corundum occasionally in blue bi-pyramidal crystals. In *Connecticut*, at W. Farms, near Litchfield, in pale blue crystals; at Norwich, with sillimanite, rare. In *New York*, at Warwick, bluish and pink, with spinel, and often in its cavities; Amity, white, blue, reddish crystals, with spinel and rutile in gran. limestone. In *New Jersey*, at Newton, blue crystals in gran. limestone, with gra green hornblende, mica, tourmaline, rare; at Vernon, near State line, red crystals, often seve inches long. In *Pennsylvania*, in Delaware Co., in Aston, near Village Green, in large crystal at Mineral Hill, in loose cryst.; in Chester Co., at Unionville, abundant in crystals, some mas weighing 4,000 lbs., and crystals occasionally 4 in. long, with tourmaline, margarite, and albi In *N. Carolina*, in Buncombe Co., blue massive, cleavable, in a boulder; in Gaston Co., cryst and massive corundum. In *Georgia*, in Cherokee Co., red sapphire. In *California*, in Los Ange Co., in the drift of San Francisqueto Pass. In *Canada*, at Burgess, red and blue crystals. A called *emery* from Arrowsic, Maine, ground and sold under this name, is nothing but massi garnet, much of it mixed with hornblende.

Red sapphire is the most highly esteemed. A crystal weighing four carats, perfect in tra parency and color, has been valued at half the price of a diamond of the same size. They seld exceed half an inch in length. Two splendid red crystals, however, having the form of t pyramidal dodecahedron, and "de la lougueur du petit doigt," with a diameter of about an in are said to be in the possession of the king of Arracan. Transparent blue sapphires are so times over three inches long.

The *sapphire* of the Greek (σαπφειρος) was the lapis lazuli, which agrees with the charac given it by Theophrastus, Pliny, Isidorus, and others. Pliny remarks, "Sapphirus cœrule est cum purpura, habens pulveres aureos sparsos," particles of pyrite which are frequently d seminated through lapis lazuli, looking like gold. The ancient names applied to the species ha already been given in the synonymy. See further on this subject, *King on Precious Stones.*

C. U. Shepard, after showing (Descr. of Em. of Chester, Mass., London, 1865) that the Ches emery is identical crystallographically with corundum, takes the precaution to propose the na *emerite* for emery, in case it should hereafter be established as a distinct species. But a na thus given has no claim to recognition.

Alt.—Corundum under some circumstances absorbs water and changes to diaspore; a perhaps also to the mica-like mineral margarite. It is also replaced by silica, forming *qua* pseudomorphs.

Artif.—Formed in crystals by exposing to a high heat 4 pts. of borax and 1 of alumina (Eb men); by decomposing potash alum by charcoal (Gaudin); by subjecting in a carbon ves fluorid of aluminum to the action of boric acid, the process yielding large rhombohedral pla (Deville & Caron); by addition to the last of fluorid of chromium, affording the red sapphire ruby, or with less of the fluorid of chromium, blue sapphire, or with much of this chrome fluo a fine green kind; by action of chlorid of aluminum on lime (Daubrée).

180. HEMATITE. 'Αιματίτης [=Blood-stone] pt. *Theophr.*, 325 B.C.; *Dioscor.*, v. 143, 40. Hæmatites pt. *Plin.*, xxxvi. 28, 38, A.D. 77. (1) Galenæ genus tertium omnis met inanissimum, *Germ.* Eisenglanz, (2) Hæmatites pt.=*Germ.* Blutstein, Glaskopf, *Agric.*, Inter 465, 468, 1546. (1) Speglande Jernmalm, Minera ferri specularis, (2) Hæmatites ruber, Ochra rubra, *Wall.*, 259–266, 1747. Rotheisenstein. (1) Järnmalm tritura rubra, Speglat Eisenglimmer, (2) Hæmatites ruber, (3) Ochra pt., *Cronst.*, 178–185, 1758. Specular Iron; Hematite, Red Ochre. Fer speculaire, (2) Hematite rouge, Sanguine, *Fr.* (1) Eisenglanz, Roth Eisenstein, Rother Glaskopf, Rother Eisenrahm, *Wern.*, Bergm. J., 1789. Iron Glan Red Iron Ore, Red Oxyd of Iron, Micaceous Iron Ore. (1) Fer oligiste, (2) Fer oxydé rou *H.*, Tr., 1801. Hämatit *Hausm.*, Haid. Handb., 552, 1845, Hausm. Handb., 232, 1847.

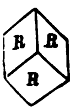
Rhombohedral. $R \wedge R = 86° 10'$, $O \wedge R = 122° 30'$; $a = 1{\cdot}3591$. C served planes: rhombohedrons, $\frac{1}{10}$, $\frac{1}{4}$, $\frac{1}{2}$, $\frac{4}{7}$, $\frac{5}{8}$, 1 (R), $\frac{5}{2}$, 4, -5, -2, $-\frac{3}{2}$, - -1, $-\frac{1}{2}$, $-\frac{2}{7}$, $-\frac{1}{4}$, $-\frac{1}{5}$, $-\frac{1}{6}$, $-\frac{1}{8}$; scalenohedrons, $\frac{1}{4}^3$, $\frac{2}{5}^3$, 1^3, $\frac{1}{4}^5$, 4^2, $4^{\frac{11}{4}}$, $4^{\frac{3}{2}}$, $-\frac{1}{2}^3$, – -2^3; pyramids, $\frac{1}{3}$-2, $\frac{2}{3}$-2, $\frac{4}{3}$-2, $\frac{10}{3}$-2, 4-2; prisms I, i-2, i-$\frac{3}{2}$, i-$\frac{5}{4}$; and t basal plane O.

$O \wedge 2 = 107° 40'$	$2 \wedge 2 = 68° 47'$	$R \wedge \frac{4}{3}\text{-}2 = 154° 2'$
$O \wedge \frac{2}{3}\text{-}2 = 137\ 49$	$5 \wedge 5 = 61\ 34$	$R \wedge \frac{1}{4} = 143\ 55$
$O \wedge \frac{4}{3}\text{-}2 = 118\ 53$	$\frac{1}{4} \wedge \frac{1}{4} = 143\ 7$	$R \wedge i\text{-}2 = 136\ 55$
$O \wedge 1^3 = 103\ 32$	$\frac{1}{2} \wedge \frac{1}{2} = 115\ 22$	$1^3 \wedge i\text{-}2 = 162\ 41$

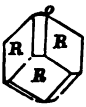
Cleavage: parallel to R and O; often indistinct. Twins: compositi face R; also O (f. 145A). Also columnar—granular, botryoidal, and stal titic shapes; also lamellar, laminæ joined parallel to *O*, and variously bent—thick or thin; also granular, friable or compact.

H.=5·5—6·5. G.=4·5—5·3; of some compact varieties, as low as 4·2. Lustre metallic and occasionally splendent; sometimes earthy. Color dark steel-gray or iron-black; in very thin particles blood-red by transmitted light; when earthy, red. Streak cherry-red or reddish-brown. Opaque, except when in very thin laminæ, which are faintly translucent and blood-red. Fracture subconchoidal, uneven. Sometimes attractable by the magnet, and occasionally even magnetipolar.

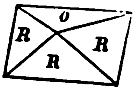
141



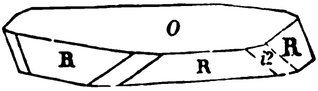
141A



142

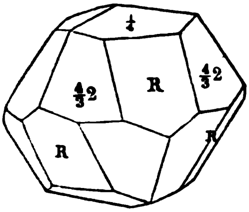


143



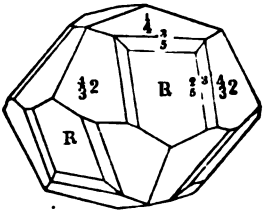
Vesuvius.

144



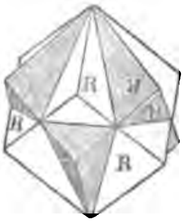
Elba.

145



Elba.

145A



Comp., Var.—Sesquioxyd of iron, $\overline{\text{Fe}}$=Oxygen 30, iron 70=100. Sometimes containing titanium and magnesium.

In a tabular crystalline hematite from Vesuvius, Rammelsberg found (Pogg., cvii. 453) $\dot{\text{Fe}}$ 3·11 and Mg 0·74; it was magnetic, and G.=5·303; the hematite may have contained some magnetite as impurity. Some hematite contains titanium. Crystals from Krageröe afforded Rammelsberg (Pogg., civ. 528) $\overline{\text{Fe}}$ 93·63, $\ddot{\text{Ti}}$ 3·55, $\dot{\text{Fe}}$ 3·26=100·44=$\dot{\text{Fe}}\,\ddot{\text{Ti}}+13\,\overline{\text{Fe}}$, or $(\text{Fe Ti})^2\,\text{O}^3+13\,\overline{\text{Fe}}$.

The varieties depend on texture or state of aggregation, and in some cases the presence of impurities.

Var. 1. *Specular.* Lustre metallic, and crystals often splendent, whence the name *specular iron.* (*b*) When the structure is foliated or micaceous, the ore is called *micaceous* hematite.

2. *Compact columnar;* or fibrous. The masses often long radiating; lustre submetallic to metallic: color brownish-red to iron-black. Sometimes called *red hematite*, the name hematite among the older mineralogists including the fibrous, stalactitic, and other solid massive varieties of this species, limonite, and turgite.

3. *Red Ochreous.* Red and earthy. Often specimens of the preceding are red ochreous on some parts. *Reddle* and *red chalk* are red ochre, mixed with more or less clay.

4. *Clay Iron-stone; Argillaceous hematite.* Hard, brownish-black to reddish-brown, heavy stone; often in part deep-red; of submetallic to unmetallic lustre; and affording, like all the preceding, a red streak. It consists of oxyd of iron with clay or sand, and sometimes other impurities. (*b*) When reddish in color and jasper-like in texture, often called *jaspery* clay iron-stone. (*c*) When oolitic in structure (consisting of minute flattened concretions), it is the *lenticular iron ore.*

Itabiryte is a schist resembling mica-schist, but containing much specular ore in grains or scales or in the micaceous form.

Breithaupt states that some rhombohedrons of hematite have a magnetic axis crossing obliquely the vertical axis, passing between two opposite lateral angles (B. H. Ztg., xxv. 149); and further, that the three cleavages of the rhombohedron are not quite equal.

Pyr., etc.—B.B. infusible; on charcoal in R.F. becomes magnetic; with borax in O.F. gives a bead, which is yellow while hot and colorless on cooling; if saturated, the bead appears red while hot and yellow on cooling; in R.F. gives a bottle-green color, and if treated on charcoal w metallic tin, assumes a vitriol-green color. With soda on charcoal in R.F. is reduced to a g magnetic metallic powder. Soluble in concentrated muriatic acid.

Obs.—This ore occurs in rocks of all ages. The specular variety is mostly confined to cryst line or metamorphic rocks, but is also a result of igneous action about some volcanoes, as at Ve vius. Many of the geological formations contain the argillaceous variety or clay iron-stone, wh is mostly a marsh-formation, or a deposit over the bottom of shallow, stagnant water; but t kind of clay iron-stone (that giving a red powder) is less common than the corresponding vari of limonite or siderite. The beds that occur in metamorphic rocks are sometimes of very gr thickness, and, like those of magnetite in the same situation, have resulted from the alteration stratified beds of ore, originally of marsh origin, which were formed at the same time with the encl ing rocks, and underwent metamorphism, or a change to the crystalline condition, at the same tin

Beautiful crystallizations of this species are brought from the island of Elba, which has afford it from a very remote period, and is described by Ovid as "Insula inexhaustis chalybdum gener metallis." The surfaces of the crystals often present an irised tarnish and brilliant lustre; t faces *O* and ½ are usually destitute of this tarnish and lustre, and may therefore assist, wh present, in determining the situation of other planes when the crystal is quite complex. Gothard affords beautiful specimens, composed of crystallized plates grouped in the form of rosett (*Eisenrose*), and accompanying crystals of feldspar. Near Limoges, France, it occurs in la crystals. Fine crystals are the result of volcanic action at Etna and Vesuvius, and particularly Fossa Cancharone, on Monte Somma, where it incrusts the ejected lavas; also formed in m recent eruptions about the fumeroles; in that of 1855, in fine crystallizations about the fumaro some so thin as to be blood-red by transmitted light (Scacchi). Arendal in Norway, Longban Sweden, Framont in Lorraine, Dauphiny, and Switzerland, also Cleator Moor in Cumberla afford splendid specimens. Red hematite occurs in reniform masses of a fibrous concent structure, near Ulverstone in Lancashire, in Saxony, Bohemia, and the Harz. In Westphalia occurs as pseudomorphs of calcite. In Brazil it is associated with quartz. In Chili there immense beds.

In *N. America*, widely distributed, and sometimes in beds of vast thickness in rocks of t Azoic age, as in the Marquette region in northern Michigan; and in Missouri, at the Pilot Kn and the Iron Mtn.; the former 650 feet high, consisting mainly of an Azoic quartz rock, and ha ing specular iron in the upper part, the iron ore in heavy beds interlaminated with quartz; t latter 200 feet high, and consisting at surface of massive hematite in loose blocks, many 10 to tons in weight; in Arizona and New Mexico.

Besides these regions of enormous beds, there are numerous others of workable value, eith crystallized or argillaceous. Some of these localities, interesting for their specimens, are in northe New York, at Gouverneur, Antwerp, Hermon, Edwards, Fowler, Canton, etc.; Woodstock a Aroostook, Me.; at Hawley, Mass., a micaceous variety; at Piermont, N. H., id.; in New Yo in Oneida, Herkimer, Madison, Wayne Cos., a lenticular argillaceous var., constituting one or t beds in the Upper Silurian; the same in Pennsylvania, and as far south as Alabama; and Canada, and Wisconsin to the west; in North and South Carolina a micaceous variety in schisto rocks, constituting the so-called *specular schist*, or *itabirite*.

This ore affords a considerable portion of the iron manufactured in different countries. T varieties, especially the specular, require a greater degree of heat to smelt than other ores, but t iron obtained is of good quality. Pulverized red hematite is employed in polishing metals, a also as a coloring material. This species is readily distinguished from magnetite by its red strea and from turgite by its greater hardness and its not decrepitating before the blowpipe.

Named *hematite* from αιμα, *blood*, it seeming, says Theophrastus, as if formed of concreted blo This old Greek author speaks afterwards of a second kind of hematites ('Αιματιτης ξανθη), whi was of a yellowish-white color, probably a yellow ochre, an impure form of limonite, the spec long called *brown hematite*.

Alt.—By deoxydation through organic matter forms *magnetite* or protoxyds; and from the lat comes spathic iron by combination with carbonic acid; or by further deoxydation through s phuretted hydrogen forms *pyrite*. By combination with water forms limonite. Limonite, ma netite, and pyrite constitute occurring pseudomorphs after hematite.

Artif.—Formed in crystals by the action of steam on chlorid of iron, regarded as the proba method of origin of the hematite of lavas; also by the action of perchlorid of iron on li (Daubrée); by the action of a stream of muriatic acid gas on $\bar{\mathrm{F}}\mathrm{e}$, the application being made ve slowly, lest the $\bar{\mathrm{F}}\mathrm{e}$ be all converted to chlorid.

180 A. MARTITE. (Martit *Breith.*, Char., 233, 1832). Martite is sesquioxyd of iron under isometric form, occurring in octahedrons like magnetite (f. 2), and supposed to be pseudom phous, mostly after magnetite. H.=6—7. G.=4·809—4·832, Brazil, Breith.; 4·65, Puy Dome; 4·35, Frassem, Devalque; 5·15, Brazil, Ramm.; 5·33, Monroe, N. Y., Hunt. Lustre s metallic. Color iron-black, sometimes with a bronzed tarnish. Streak reddish-brown or purpli brown. Fracture conchoidal. Not magnetic, or only feebly so.

The crystals are sometimes imbedded in the massive sesquioxyd. They are distinguished from magnetite by the red streak, and very feeble, if any, action on the magnetic needle.

Found at the localities mentioned; also in Vermont at Chittenden; in the Marquette iron region north of L. Superior, where crystals are common in the ore, as if all of it, or the greater part, were martite; Bass lake, Canada West; at Monroe, N. Y., in a rock containing quartz, feldspar, and hornblende, and imbedded in each of these minerals; in Moravia, near Schönberg, in granite.

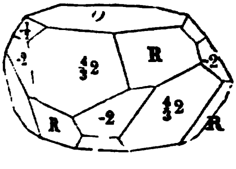
The martite of Monroe contains some $\dot{\mathrm{F}}\mathrm{e}$, Brush. The octahedral crystals from Chittenden, Vt., according to D. Olmstead, are part true magnetite, with a black powder: part give a slightly reddish streak, with little $\dot{\mathrm{F}}\mathrm{e}$; and part give a red powder and contain no $\dot{\mathrm{F}}\mathrm{e}$.

Whether the crystals of martite are original crystals or pseudomorphs is still questioned; but the latter seems to be the most probable view. Pseudomorphism after magnetite would imply that the Marquette ore bed was once all magnetite in composition, $Fe^3 O^4$, and has been changed to the sesquioxyd, $Fe^2 O^3$, by an addition of oxygen. Rammelsberg found 1·83—2·30 p. c. of protoxyd of iron in the Brazil crystals. The octahedrons from the fumeroles of Vesuvius afforded Rammelsberg (Min. Ch., 159) $\bar{\mathrm{F}}\mathrm{e}$ 92·91, $\dot{\mathrm{F}}\mathrm{e}$ 6·17, $\dot{\mathrm{M}}\mathrm{g}$ 0·82=99·90. The crystals from Frassem, France, contain 0·2 p. c. of sulphur, which suggests that these may be pseudomorphs after pyrite.

181. **MENACCANITE.** Specular Iron pt., Eisensand pt., of last cent. Menachanite (fr. Cornwall) *Wm. McGregor*, J. de Phys., 72, 152, 1791, Crell's Ann., 1791, and Kirwan's Min., 1796 (making it to consist of iron and an oxyd of a probably new metal). Eisenhaltige Titanerze, Menakanit (fr. Cornw.) *Klapr.*, Beitr., ii. 226; (fr. Aschaffenberg) ib., 232, 235, 1797. Titane oxydé ferrifère *H.*, Tr., 1801. Mänaken *Karst.*, Tab., 74, 1808. Titaneisenstein, Titaneisen, *Germ.* Titanic or Titaniferous Iron. Crichtonite (spelt Craitonite) *Bourn.*, Cat., 430, 1813. Axotomes Eisenerz (fr. Gastein) *Mohs*, Grundr., ii. 462, 1824.=Kibdelophan *v. Kob.*, Schweig. J., lxiv. 1832. Ilmenit (fr. L. Ilmen) *A. T. Kupfer*, Kastn. Arch., x. 1, 1827. Mohsite (fr. Dauphiné) *Levy*, Phil. Mag., i. 221, 1827. Hystatisches Eisenerz, Hystatite (fr. Arendal), *Breith.* Uib., 64, 1830, Char., 236, 1832. Basanomelan (fr. St. Gothard,=Eisenrose) *v. Kob.*, Grundr., 318, 1838. Washingtonite (fr. Conn.) *Shep.*, Am. J. Sci., xliii. 364, 1842. Titanioferrite *Chapm.*, Min., 1843. Paracolumbite (fr. Taunton) *Shep.*, ib., II. xii. 209, 1851.

Rhombohedral; tetartohedral to the hexagonal type. $R \wedge R$=85° 40′–86° 10′, 86° 5′, Rose and Descloizeaux, 85° 59′, Mohs. Observed planes: rhombohedrons, $\frac{2}{5}$, 1(R), –5, $-\frac{2}{5}$, –2, $-\frac{1}{2}$; pyramids, $\frac{2}{3}$-2, $\frac{4}{3}$-2, $\frac{10}{3}$-2, which are hemihedral; also I, i-2, O. Angles nearly as in hematite; $O \wedge R$=122° 23′, and $R \wedge \frac{4}{3}$-2=154° 0′ when $R \wedge R$=86°. Often a cleavage parallel with the terminal plane, but properly due to planes of composition. Crystals usually tabular. Twins: composition-face O; sometimes producing, when repeated, a form resembling f. 144. Often in thin plates or laminæ; in loose grains as sand.

146



H.=5–6. G.=4·5–5. Lustre submetallic. Color iron-black. Streak submetallic, powder black to brownish-red. Opaque. Fracture conchoidal. Influences slightly the magnetic needle.

Comp., Var.—$(Ti, Fe)^2 O^3$ (or hematite, with part of the iron replaced by titanium), the proportion of Ti to Fe varying. Rammelsberg writes the formula $\dot{\mathrm{F}}\mathrm{e}\,\ddot{\mathrm{T}}\mathrm{i}+n\,\bar{\mathrm{F}}\mathrm{e}$, which is equivalent to $(\frac{1}{2} Fe+\frac{1}{2} Ti)^2 O^3+n\, Fe^2 O^3$, the $Fe^2 O^3$ being in varying proportions. Sometimes also containing magnesia or manganese, whence the more general formula $(Ti, Fe, Mn, Mg)^2 O^3$.

The varieties recognized arise mainly from the proportions of iron to titanium. They have been named as follows, commencing with that containing the most titanium. No satisfactory external distinctions have yet been made out:

1. *Kibdelophane.* About 30 p. c. titanium (anal. 1). In crystals, but usually massive, or in thin plates; $R \wedge R$=85° 59′; G.=4·661, fr. Gastein, Mohs; 4·723–4·735, ib., Breith.

2. *Crichtonite.* Composition essentially like that of the preceding (anal. 2 and 23). In acute

rhombohedrons, with basal cleavage; *R* ∧ *R*=86° 62½′; -5 ∧ -5=61° 27′; G.=4·79, from St Cristophe (original); 4·689, same compound from Ingelsberg, Ramm. (anal. 23); lustre bright.

3. *Ilmenite.* 26—30 p. c. titanium, and near the preceding in composition, but containing more sesquioxyd of iron (anal. 3–6, 27). Crystallized and massive; *R* ∧ *R*=85° 43′; G.=4·895, fr Ilmen Mts. (original), Breith.; 4·81—4·873, ib., Ramm. For same compound fr. Egersund, 4·744—4·791, Ramm.; fr. Krageröe 4·701.

4. *Menaccanite.* About 25 p. c. of titanium, and with more sesquioxyd of iron than in the preceding (anal. 7–10, 28, 29). Massive, and in grains or as a sand (Eisensand). G.=4·7—4·8, fr. near Menaccan, Cornwall (orig.). Similar compound from Iserwiese, 4·676—4·752, Ramm. (Iserine?)

5. *Hystatite.* 15—20 p. c. titanium, and much $\overline{\text{Fe}}$ (anal. 11–14). *R* ∧ *R*=86° 10′; G.=5, fr Arendal (orig.). *Washingtonite* belongs here (anal. 13, 14. 30). Occurs in large tabular rather dull crystals; *R* ∧ *R*=86° approximately; G.=4·963, fr. Westerly, R. I., and 5·016, fr. Litchfield, Ct. (orig.), Shepard; for latter, 4·986, Ramm.

6. *Uddevallite* D. About 10 p. c. titanium and 70 p. c. of $\overline{\text{Fe}}$ (anal 15). The Aschaffenberg titanic iron is near this. It occurs massive and in plates, and has G.=4·78.

7. *Basanomelan* (*Eisenrose* of the Alps). 6 to 8 p. c. Ti, and 75 to 83 of $\overline{\text{Fe}}$ (anal. 17). G = 4·95—5·21. It is properly a titaniferous hematite.

8. *Krageröe hematite.* Containing less than 3 p. c. of titanium (anal. 35).

9. *Magnesian Menaccanite; Picrotanite* D. Contains 10 to 15 p. c. of magnesia, anal. 24; formula ($\dot{\text{Fe}}$, $\dot{\text{Mg}}$) $\ddot{\text{Ti}}$; G.=4·293—4·313. Named from πικρός, *bitter*, in allusion to the magnesia.

The *Mohsite* is of uncertain locality and composition. The occurring rhombohedron affords the angle 73° 45′ (Levy); crystals tabular; in twins; no cleavage observable.

The loose *Iron-sand* of Iserwiese, called *iserine*, is in part, at least, in isometric octahedrons; and the *trappisches Eisenerz*, Breith., is similar. See ISERINE beyond.

Paracolumbite is an iron-black mineral from 1 m. S.W. of Taunton, Mass., having H. about 5. Pisani has proved it to be of this species. He found G.=4·353, H. 4·5.

Analyses: 1, v. Kobell (Schw. J., lxiv. 59, 245); 2, Marignac (Ann. Ch. Phys., III. xiv. 50); 3, 4, Mosander (Ak. H. Stockh., 1829, 220, Pogg., xix. 211); 5, Delesse (Thèse sur l'empl. de l'anal., etc., p. 46); 6, H. Rose (Pogg., iii. 163); 7, v. Kobell (l. c.); 8–12, Mosander (l. c.); 13, Kendall (This Min., 2d edit., 527); 14, Marignac (l. c.); 15, Plantamour (J. pr. Ch., xxiv. 302); 16–18, v. Kobell (l. c.); 19, T. S. Hunt (Rep. G. Can., 1849, 1850, 105, and 1863, 501); 20, J. Müller (Jahrb., 1859, 775); 21, 22, Damour (Ann. Ch. Phys., li. 445); 23–35, Rammelsberg (Pogg., civ. 497, and Min. Ch., 406):

			$\ddot{\text{Ti}}$	$\overline{\text{Fe}}$	$\dot{\text{Fe}}$	$\dot{\text{Mn}}$	$\dot{\text{Mg}}$	Ca
1.	Gastein,	*Kibdel.*	59·00	4·25	36·00	1·65	——	——=100 Kobell.
2.	St. Christophe,	*Cricht.*	52·27	1·20	46·53	——	——	——=100 Marignac.
3.	Ilmen Mts.,	*Ilmenite*	46·92	10·74	37·86	2·73	1·14	——=99·39 Mosander.
4.	"	"	46·67	11·71	35·37	2·39	0·60	0·25, $\overline{\text{Er}}$ 0·38, $\ddot{\text{Si}}$ 2·80=100·17 M.
5.	"	"	45·4	40·7	14·1	——	——	0·5, $\ddot{\text{Sn}}$ 0·5, $\dot{\text{Pb}}$ 0·2=101·4 Del.
6.	Egersund	"	43·73	42·70	13·57	——	——	——=100 Rose.
7.	"	*Menacc.*	43·24	28·66	27·91	——	——	——=99·81 Kobell.
8.	"	"	42·57	23·21	29·27	——	1·22	0·50, $\overline{\text{Er}}$ 0·33, $\ddot{\text{Si}}$ 1·65=98·75 M.
9.	"	"	41·08	25·93	29·04	——	1·94	0·49, $\dot{\text{Y}}$t, $\overline{\text{Ce}}$ 0·58, $\ddot{\text{Si}}$ 0·07=99·13 M.
10.	"	"	39·04	29·16	27·23	0·21	2·30	0·90, $\overline{\text{Er}}$ 0·12, $\ddot{\text{Si}}$ 0·31=99·13 M.
11.	Arendal,	*Hystatite*	24·19	53·01	19·91	——	0·68	0·33, $\ddot{\text{Si}}$ 1·17=99·29 M.
12.	"	"	28·59	58·51	13·90	——	1·10	0·86, $\overline{\text{Er}}$ 0·44, $\ddot{\text{Si}}$ 1·88=100·28 M.
13.	Litchfield,	"	25·28	51·84	22·86	——	——	——=99·98 Kendall.
14.	"	"	22·21	59·07	18·72	——	——	——=100 Marignac.
15.	Uddewalla,	*Titan. I.*	15·56	71·25	11·32	——	——	——, F, $\ddot{\text{Si}}$, loss 1·87 Plantamour.
16.	Aschaffenberg,	"	14·16	75·00	10·04	0·80	——	——=100 Kobell.
17.	Schweiz,	*Basanom.*	12·67	82·49	4·84	——	——	——=100 Kobell.
18.	"	*Titanic I.*	10·0	88·5	1·5	*tr.*	——	——=100 Kobell.
19.	St. Paul's, Canada		48·60	10·42	37·06	——	3·60	——=99·68 Hunt.
20.	Maxhoven, Bav.		51·60	——	41·79	——	——	0·30, $\overline{\text{Al}}$, $\ddot{\text{Si}}$ 2·47=100·16 Müller.
21.	Antioquia, R. Chico		57·09	——	42·11	0·80	——	——=100 Damour.
22.	"	Cienaga	48·14	——	50·17	1·69	——	——=100 Damour.

		Sp. gr.	$\ddot{\text{Ti}}$	$\overline{\text{Fe}}$	$\dot{\text{Fe}}$	$\dot{\text{Mn}}$	$\dot{\text{Mg}}$	$\dot{\text{Fe}}\ddot{\text{Ti}}$: $\overline{\text{Fe}}$
23.	Ingelsberg	4·689	53·03	2·66	38·30	4·30	1·65=99·94	1 :
24.	Warwick, N. Y.	4·313, 4·293	57·71	——	26·82	0·90	13·71=99·14	1 : 0
25.	Ilmen Mts.	4·81, 4·873	45·93	14·30	36·52	2·72	0·59=100·06	6 : 1
26.	Egersund	4·744, 4·791	51·30	8·87	39·83	*tr.*	0·40=100·40	9 : 1

	Sp. gr.	$\ddot{\mathrm{Ti}}$	$\dddot{\overline{\mathrm{Fe}}}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Mn}}$	$\dot{\mathrm{Mg}}$	Ratio. $\dot{\mathrm{Fe}}\,\ddot{\mathrm{Ti}}:\dddot{\overline{\mathrm{Fe}}}$
27. Krageröe	4·701	46·92	11·48	39·82	——	1·22=99·50	9 : 1
28. Iserwiese	4·752	37·13	28·40	29·20	3·01	2·97=100·71	3 : 1
29. "	4·676	42·20	23·36	30·57	1·74	1·57=99·44	3 : 1
30. Litchfield, Ct.	4·986	23·72	53·71	22·39	0·25	0·50=100·57	1 : 1
31. Eisenach	5·060	16·20	69·91	12·60	0·77	0·55=100 03	1 : 2
32. Snarum	4·943	10·02	77·17	8·52	——	1·33, $\dddot{\overline{\mathrm{Al}}}$ 1·46=98·50	1 : 4
33. Binnen Val.	5·127, 5·150(½)	9·18	81·92	8·60	——	——=99·70	1 : 4
34. St. Gothard	5·187, 5·209	9·10	83·41	7·63	0·44	*tr.* =100·58	1 : 4
35. Krageröe	5·2406	3·55	93·63	2·26	——	——=100·44	1 : 13

With the analyses 23 to 35 the ratio of $\dot{\mathrm{Fe}}\,\ddot{\mathrm{Ti}}$ to $\dddot{\overline{\mathrm{Fe}}}$ is given in the last column, from Rammelsberg, who writes the formula for 23, 24, $\dot{\mathrm{Fe}}\,\ddot{\mathrm{Ti}}$; for 25, 6 $\dot{\mathrm{Fe}}\,\ddot{\mathrm{Ti}}+\dddot{\overline{\mathrm{Fe}}}$; for 26, 9 $\dot{\mathrm{Fe}}\,\ddot{\mathrm{Ti}}+\dddot{\overline{\mathrm{Fe}}}$, and so on. But calculating the ratio between the metals combined and the oxygen, for these same analyses, we have:

	Metals.	Oxygen.	Ratio.		Metals.	Oxygen.	Ratio.
Anal. 23.	21·77	32·11	1 : 1·48	Anal. 30.	20·52	30·80	1 : 1·50
" 24.	22·71	34·64	1 : 1·52	" 31.	20·29	30·62	1 : 1·51
" 25.	20·67	31·55	1 : 1·50	" 32.	20·14	30·29	1 : 1·50
" 26.	20·09	32·11	1 : 1·60	" 33.	20·07	30·14	1 : 1·50
" 27.	20·58	31·48	1 : 1·53	" 34.	20·23	30·41	1 : 1·50
" 28.	21·17	31·67	1 : 1·50	" 35.	20·13	30·22	1 : 1·50
" 29.	20·62	31·64	1 : 1·54				

These ratios are, with two or three exceptions, almost exactly 2 : 3, which shows still better that they correspond with the general formula $R^2\,O^3$. Analyses 1 to 22 afford this same ratio and formula. Rose made the formula m $\dddot{\overline{\mathrm{Ti}}}$ + n $\dddot{\overline{\mathrm{Fe}}}$, assuming that the $\dot{\mathrm{Fe}}$ obtained in the analyses arose from the oxydation of a supposed titanic oxyd ($Ti^2\,O^3$) at the expense of the $\dddot{\overline{\mathrm{Fe}}}$. This view is not sustained, since it has been proved that the $\dot{\mathrm{Fe}}$ exists as such in the ore.

For other analyses: fr. Harzburg in Gabbro, Streng, B. H. Ztg., xxiii. 55; fr. Cape de Verd Isles, Silva, C. R., lxv. 1867; fr. Löbauer Berg, E. Calberla, Ber. Iris Dresd., 1866, 136.

Paracolumbite afforded Pisani $\ddot{\mathrm{Ti}}$ 35·66, $\dddot{\overline{\mathrm{Fe}}}$ 3·48, $\dot{\mathrm{Fe}}$ 39·08, $\dot{\mathrm{M}}$ g1·94, $\dot{\mathrm{Ca}}$ 2·06, $\ddot{\mathrm{Si}}$ and insoluble matters 10·66, $\dddot{\overline{\mathrm{Al}}}$ 7·66 (Am. J. Sci., II. xxxvii. 359). It is so mixed with the gangue that it is extremely difficult to obtain it pure. A menaccanite found at Rajamäki, Finland, contains some columbic acid replacing part of the titanic (Pogg., cxxii. 615).

Pyr., etc.—B.B. infusible in O.F. although slightly rounded on the edges in R.F. With borax and salt of phosphorus reacts for iron in O.F., and with the latter flux assumes a more or less intense brownish-red color in R.F.; this treated with tin on charcoal changes to a violet-red color when the amount of titanium is not too small. The pulverized mineral, heated with muriatic acid, is slowly dissolved to a yellow solution, which, filtered from the undecomposed mineral and boiled with the addition of tin-foil, assumes a beautiful blue or violet color. Decomposed by fusion with bisulphate of soda or potash.

Obs.—The principal European localities of this species have been enumerated above. One of the most remarkable is at Krageröe, Norway, where it occurs in veins or beds in diorite, which sometimes afford crystals weighing over 16 pounds. Fine crystals, sometimes an inch in diameter, occur in Warwick, Amity, and Monroe, Orange Co., N. Y., imbedded in serpentine and white limestone, and associated with spinel, chondrodite, rutile, etc.; also 4 m. west of Edenville, and near Greenwood furnace with spinel and chondrodite; also at Chester and South Royalston, Mass. Vast deposits or beds of titanic ore occur at Bay St. Paul in Canada, in syenite: one bed, 90 feet thick, continues on in view for 300 feet, and probably far beyond; also in the Seignory of St. Francis, Beauce, mixed with magnetite as a bed 45 feet thick in serpentine; G.=4·56—4·66; also with labradorite at Château Richer. Grains are found in the gold sand of California.

181A. **ISERITE.** (Titaneisenstein pt., Magnetischer Eisen-Sand pt., *Wern.* Iserin (fr. Iser) *Wern.*, Letztes Min., 26, 52, 1817, Hoffm. Min., iv. 258, 1817. Oktaëdrisches Titaneisen-Oxyd *Wern.* Iserin *Breith.*, Char., 51, 1820. Hexaedrisches Eisen-Erz *Mohs*, Min., 436, 1839.) Iserite is supposed to be isometric titanic iron, and, like martite, to be pseudomorphous. Forms like f. 2, 5, 6, 8.

Analyses: 1, Rammelsberg (Min. Ch., 419); 2, v. Hauer (Ber. Ak. Wien, xix. 350); 3, Edwards (Rep. Brit. Assoc., 1855); 4, Vogel and Rischauer (Jahresb., 1856, 840):

	$\ddot{\mathrm{Ti}}$	$\dddot{\overline{\mathrm{Fe}}}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Mg}}$
1. Iserwiese	57·19	15·67	26·00	1·94=100·60 Ramm.
2. Plattensee, Hung.	30·71	49·93	18·88	3·79=103·31 Hauer.
3. Mersey	13·20	42·08	31·10, $\dddot{\overline{\mathrm{Al}}}$ 8·62, $\ddot{\mathrm{Si}}$ 4·02=99·02 Edwards.	
4. Silberberg	18·53	63·00	17·79	——=99·32 V. & R.

The locality of Iserwiese gave the name to this mineral. The titanic iron-sand is partly i octahedral forms, and this portion, if not all, is the *iserine.* Yet it is still doubted whether th otahedrons are regular octahedrons, or whether they are acute rhombohedrons with truncate apices, and therefore true ilmenite. The Iserwiese crystals, as analyzed by Rammelsberg (ana 1), give for the ratio between the metals and oxygen 2 : 2·33, which is much more oxygen tha the formula $R^2 O^3$ requires, and is still further remote from that of magnetite. The ore from Sic Fok, on the Platensee, as analyzed by v. Hauer (anal. 2), affords the general formula $(Fe, Ti)^2$ C $+ Fe^2 O^3$, equivalent to $Fe O \; Ti O^2 + Fe^2 O^3$ (or $\dot{\mathrm{F}}\mathrm{e} \; \ddot{\mathrm{T}}\mathrm{i} + \bar{\mathrm{F}}\mathrm{e}$). G.=4·817. The grains were i part octahedrons, and some with truncated angles.

The sand on the Mersey comes from the shores nearly opposite Liverpool, and is mixed wit magnetite. This is indicated in the analysis, which affords the formula $3 \; Fe O, Ti O^2$ (or 3 (F Ti)$^2 O^3$) + 5 $\dot{\mathrm{F}}\mathrm{e} \; \bar{\mathrm{F}}\mathrm{e}$ (or 5 of magnetite). Minute octahedrons occur at Ballycrogan, Mull of Cantyr Sand from Müggelsee, near Berlin, having G.=5·075, afforded Rammelsberg a similar compos tion, but with only 5·20 p. c. $\ddot{\mathrm{T}}\mathrm{i}$, it giving him the formula $Fe O \; Ti O^2 + 6$ of magnetite. It is n stated that this sand is octahedral. The ore from Silberberg, near Bodenmais, in Bavaria, corr sponds nearly to 4½ $(Fe, Ti)^2 O^3 + 8 \; Fe^2 O^3$, and therefore comes under the general formula R^2 O

Waltershausen has obtained from octahedral crystals of an iron-sand from Etna (Vulk. Ges 121), having G.=4·43, $\ddot{\mathrm{T}}\mathrm{i}$ 12·38 and $\bar{\mathrm{F}}\mathrm{e}$ 92·18=104·56. The analysis needs repetition, A. Kn obtained for a titanic iron-sand a composition corresponding to magnetite in atomic ratio, giving t ratio 1 : 1·25 between the metals and oxygen. See under MAGNETITE.

Iserine is reported also from Bohemia, Saxony, Calabria, Puy-de-Dome in France.

182. PEROFSKITE. Perowskit *G. Rose*, Pogg., xlviii. 558. 1839, Reis. Ural., ii. 128.

Isometric, Rose (fr. Ural). (Rhombohedral?). Observed planes: *O*, 1, 2, $i\text{-}\frac{3}{2}$, $i\text{-}\frac{4}{3}$, $i\text{-}\frac{5}{4}$, 2-2, 3-3, $2\text{-}\frac{4}{3}$, $\frac{3}{2}\text{-}\frac{9}{4}$. Habit cubic; f. 1, 5, 16; also 17, exce that the planes are $i\text{-}\frac{3}{2}$. Rhombohedral, Descl. (fr. Zermatt); with $R \wedge$ nearly 90°. Perhaps dimorphous. Cleavage: parallel to the cubic, rhombohedral; faces rather perfect.

H.=5·5. G.=4·017, fr. Achmatovsk; 4·03—4·039, fr. Zermatt, Damou 4·02, fr. Schelingen, Seneca. Lustre metallic—adamantine; color pa yellow, honey-yellow, orange-yellow, reddish-brown, grayish-black to iro black; streak colorless, grayish. Transparent to opaque.

Comp.—$(Ca + Ti) O^3 = R^2 O^3$=Titanic acid 59·4, lime 40·6=100. Analyses: 1, Jacobson (Pog lxii. 596); 2, Brooks (ib.); 3, 4, F. Seneca (Ann. Ch. Pharm., civ. 371); 5, Damour (Ann. d. V. vi. 512):

			$\ddot{\mathrm{T}}\mathrm{i}$	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\mathrm{F}}\mathrm{e}$	
1.	Achmatovsk, *black*		58·96	39·20	2·06	$\dot{\mathrm{M}}\mathrm{g}$, $\dot{\mathrm{M}}\mathrm{n}$ *tr.*=100·22 Jacobson.
2.	“ *brown*		59·00	36·76	4·79	“ 0·11—100·07 Brooks.
3.	Schelingen, *black*		58·95	35·69	6·23	=100·87 Seneca.
4.	“ “		59·30	35·94	5·99	=101·23 Seneca.
5.	Zermatt, *yellow*	$(\frac{2}{2})$	59·23	39·92	1·14	=100·29 Damour.

Pyr., etc.—In the forceps and on charcoal infusible. With salt of phosphorus in O.F. dissolv easily, giving a greenish bead while hot, which becomes colorless on cooling; in R.F. the be changes to grayish-green, and on cooling assumes a violet-blue color. Entirely decomposed boiling sulphuric acid.

Obs.—Occurs in small crystals or druses of crystals, all of dark colors, associated with cryst lized chlorite, and magnetic iron in chlorite slate, at Achmatovsk, near Slatoust in the Ural; Schelingen in the Kaiserstbal, in white or yellowish granular limestone, with mica, magnetite, a pyrochlore; in the valley of Zermatt, near the Findelen glacier, where crystalline masses occ in talcose schist, as large as the fist, and the interior, if not the whole, is of a light yellow co (showing that the darker shades are due to alteration), along with garnet, idocrase, sphene, zirc corundum, rutile, titanic iron, serpentine. etc.; at Wildkreuzjoch, between Pfitsch and Pfund in the Tyrol, a crystal, probably of this species, having, according to Hessenberg, the planes *O*, $i\text{-}\frac{3}{2}$, 3-3, $2\text{-}\frac{4}{3}$, $\frac{3}{2}\text{-}\frac{9}{4}$. Also in black cubo-octahedrons at Magnet Cove, Arkansas (Shepard).

Named after v. Perofski of St. Petersburg.

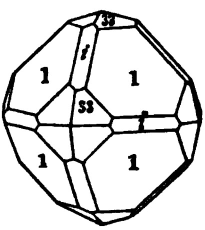
On cryst., see G. Rose, l. c; Kokscharof, Min. Russl., i. 197; Hessenberg, Min. Not., iv. 2 Descloizeaux. Ann. d. M., V. xiv. 417. If the forms were all isometric, they would still be clos isomorphous with the rhombohedron of hematite.

Artif.—Formed in crystals by making lime to act at a high temperature on silicate of titani (Ebelmen).

3. COMPOUNDS OF PROTOXYDS AND SESQUIOXYDS.

183. SPINEL.

147



Isometric. Observed planes: 1, *I*, *O*, 2, 3-3. Habit octahedral; f. 2, 7, 8, 20. Faces of octahedron sometimes convex. Cleavage: octahedral. Twins: f. 50; composition-face 1.

H.=8. G.=3·5—4·1; 3·523, Haidinger; 3·575, red spinel. Lustre vitreous; splendent—nearly dull. Color red of various shades, passing into blue, green, yellow, brown and black; occasionally almost white. Streak white. Transparent—nearly opaque. Fracture conchoidal.

Comp., Var.—Consists of alumina and magnesia, $\dot{M}g\ \ddot{\bar{A}}l$, with more or less of the magnesia ($\dot{M}g$) usually replaced by protoxyd of iron ($\dot{F}e$), and sometimes also in part by lime ($\dot{C}a$), protoxyd of manganese ($\dot{M}n$); and the alumina in part by sesquioxyd of iron ($\ddot{\bar{F}}e$). There is thence a gradation into kinds containing little or no magnesia, which stand as distinct species, viz.: *Hercynite* and *Gahnite*. $\dot{M}g\ \ddot{\bar{A}}l$=Alumina 72, magnesia 28=100.

Var. 1. *Ruby*, or *Magnesia Spinel*. 'Ανθραξ pt., 'Ανθρακια περὶ Μίλητον, *Theophr.* Carbunculus pt., Lychnis pt. [rest ruby sapphire], *Plin.*, xxxvii. 25, 29. Spinella, Carbunculus pt., Rubinus pt., Carb. ruber parvus, = *Germ.* Spinel, Ballagius (a pallido colore videtur appellasse), = *Germ.* Ballas, Lychnis, = *Germ.* Gelblichter Rubin, *Agric.*, Foss., 293, Interpr., 463, 1546. Rubin orientales octaedrici, seu octo hedris comprehensi, quæ modo triangula sunt, modo trapezia, aliquando hedræ oblongæ angulos solidos occupant, etc., *Cappeler*, Prod. Crystallogr. Lucerne, 1723. Rubinus pt. (Spinell, Ballas, Rubicelle), *Wall.*, Min., 115, 1447. Rubis spinelle octaëdre (Spinelle, Balais), *de Lisle*, Crist., ii. 224, 1783 [by *de L.* first made distinct in species from Ruby Sapphire]. —Clear red or reddish; transparent to translucent; sometimes subtranslucent. G.=3·52—3·58. Composition $\dot{M}g\ \ddot{\bar{A}}l$, with little or no $\dot{F}e$, and sometimes oxyd of chrome as a source of the red color.

Varieties are denominated as follows: (*a*) *Spinel-Ruby*, deep-red; (*b*) *Balas-Ruby*, rose-red; (*c*) *Rubicelle*, yellow or orange-red; (*d*) *Almandine*, violet.

2. *Ceylonite*, or *Iron-Magnesia Spinel*. Ceylanite (fr. the French spelling of Ceylon) *Delameth.*. J. de Phys., xlii. 23, 1793. Zeylanit *Karst.*, Tab., 28, 72, 1800. Pleonaste *H.*, Tr., 1801. Ceylonit *Ramm.* Candite (fr. Candy, Ceylon) *Bourn.*—Color dark-green, brown to black, mostly opaque or nearly so; G.=3·5—3·6. Composition ($\dot{M}g$, $\dot{F}e$) $\ddot{\bar{A}}l$ or ($\dot{M}g$, $\dot{F}e$) ($\ddot{\bar{A}}l$, $\ddot{\bar{F}}e$).

3. *Magnesia-Lime Spinel?* Color green. From analyses of specimens of green spinel from Franklin, N. J., and Amity, N. Y., by Thomson (Min. i. 214), about which it may be right to have doubts.

4. *Chlorospinel*, or *Magnesia-Iron Spinel*. Chlorospinel (fr. Slatoust) *G. Rose*, Pogg., l. 652, 1850. Gahnit *B. de Marni*, 1833.—Color grass-green, owing to the presence of copper; G.= 3·591—3·594. Composition $\dot{M}g$ ($\ddot{\bar{A}}l$, $\ddot{\bar{F}}e$), the iron being in the state of sesquioxyd.

5. *Picotite* Charpentier, J. d. M., xxxii. 1812, Gilb. Ann., xlvii., 205. *Chrome-ceylonite.*—Contains over 7 p. c. of oxyd of chrome, and has the formula ($\dot{M}g$, $\dot{F}e$) ($\ddot{\bar{A}}l$, $\ddot{\bar{F}}e$, $\ddot{\bar{C}}r$). Color black; lustre brilliant; G.=4·08. The original was from a rock occurring about L. Lherz, called *Lherzolite* by Delametherie (T. T., ii. 281, 1797), and earlier described by Picot de la Peyrouse (Mem. Ac. Toulouse, iii. 410), after whom *picotite* is named, the constituents of which rock are stated by Descloizeaux (Min., i. 65) to be chrysolite, a brown infusible pyroxene-mineral related to hypersthene, a green fusible pyroxene, and disseminated grains (rarely octahedral crystals) of *picotite*.

Analyses: 1, 2, Abich (Pogg., xxiii. 305); 3, Berzelius (Gehlen's J., vi. 304); 4, 5, Thomson (Min., i. 214); 6, C. Gmelin (Jahresb., iv. 156); 7–10, Abich (l. c.); 11, Abich (Ak. H., Stockh., 1842, 6); 12, Scheerer (Pogg., lxv. 294); 13, Erdmann (Ak. H., Stockh., 1848); 14, Pisani (C. R., lxiii.); 15, 16, H. Rose (Pogg., l, 652); 17, Damour (Bull. G. Soc., II. xix. 418); 18, Hilger (Jahrb. Min., 1866, 399):

	$\ddot{\bar{A}}l$	$\ddot{\bar{F}}e$	$\dot{F}e$	$\dot{M}g$	$\dot{C}a$	$\ddot{S}i$
1. Ceylon, *red*	69·01	——	0·71	26·21	——	2·02, $\ddot{\bar{C}}r$ 1·10=99·05 Ab.
2. Aker. *blue*	68·94	——	3·49	25·72	——	2·25=100·47 Abich.
3. " "	72·25	——	4·26	14·63	——	5·48=96·62 B. and H.

	$\dddot{\overline{\text{Al}}}$	$\dddot{\overline{\text{Fe}}}$	$\dot{\text{Fe}}$	$\dot{\text{Mg}}$	$\dot{\text{Ca}}$	$\ddot{\text{Si}}$
4. Franklin, N. J., *green*	73·31	——	——	13·63	7·42	5·62=99·98 Thomson.
5. Amity, N. Y.	61·79	——	——	17·87	10·56	—— $\dot{\text{Ca}}\ddot{\text{C}}$ 2·80, $\dot{\text{H}}$ 0·98=99·60 T
6. Ceylon, *Ceylonite*	57·20	——	20·51	18 24	——	3·15=99·11 Gmelin.
7. Ural, *Pleonaste*	65·27	——	13·97	17·58	——	2·50=99·32 Abich.
8. Monzoni, "	66·89	——	8·07	23·61	——	1·23=99·80 Abich.
9. Vesuvius, "	67·46	——	5·06	25·94	——	2·38=100·85 Abich.
10. Iserwiese, "	59·66	——	19·29	17·70	——	1·79=99·17 Abich.
11. Vesuvius, "	62·84	6·15	3·87	24·87	——	1·83=99·56 Abich.
12. Arendal, "	55·17	——	18·33	17·65	——	5·09, $\dot{\text{Mn}}$ 2·71=98·95 S.
13. Tunaberg, "	62·95	——	23·46	13 03	——	——=99·44 Erdmann.
14. Auvergne, "	59·06	10·72	13·60	17·20	——	——=100·58 Pisani.
15. Ural, *chlorospinel*	64·13	8·70	——	26·77	0·27	—— $\dot{\text{Cu}}$ 0·27=100·14 Rose.
16. " "	57·34	14·77	——	27·49	——	—— $\dot{\text{Cu}}$ 0·62=100·22 Rose.
17. L. Lherz, *Picotite*	55·34	——	24·60	10·18	——	1·98, $\dddot{\overline{\text{Cr}}}$ 7·90=100 Damour.
18. Hofheim, "	53·93	11·40	3·85	23·59	——	—— $\dddot{\overline{\text{Cr}}}$ 7·23=100 Hilger.

Pyr., etc.—B.B. alone infusible; red variety changes to brown, and even black and opaqu as the temperature increases, and on cooling becomes first green, and then nearly colorless, an at last resumes the red color. Slowly soluble in borax, more readily in salt of phosphorus, wit which it gives a reddish bead while hot, becoming faint chrome-green on cooling. The blac varieties give reactions for iron with the fluxes. Soluble with difficulty in concentrated sulphur acid. Decomposed by fusion with bisulphate of soda or potash.

Obs.—Spinel occurs imbedded in granular limestone, and with calcite in serpentine, gneis and allied rocks. It also occupies the cavities of masses ejected from some volcanoes.

In Ceylon, in Siam, and other eastern countries, it occurs of beautiful colors, as rolled pebbl in the channels of rivers. Pleonaste is found at Candy, in Ceylon. At Aker, in Sweden, found a pale-blue and pearl-gray variety in limestone. Small black splendent crystals occur i the ancient ejected masses of Mount Somma, with mica and idocrase; also in compact gehleni at Monzoni, in the Fassa valley.

From Amity, N. Y., to Andover, N. J., a distance of about 30 miles, is a region of granular lim stone and serpentine, in which localities of spinel abound. At Amity crystals are occasionally 1 in. in diameter; and one collected by Dr. Heron weighs 49 lbs.; it is in three pieces, and contai cavities studded with crystals of corundum; colors, green, black, brown, and less commonly re along with chondrodite and other minerals. A mile S.W. of Amity, on J. Layton's farm, is remarkable locality; also on W. Raynor's farm, a mile N.; another half mile N. affording grayis red octahedrons; and others to the south. Localities are numerous about Warwick, and also Monroe and Cornwall, though less favorable for exploration than those at Amity (form 1, also 4, 3-3, f. 147). Franklin, N. J., affords crystals of various shades of black, blue, green, and re which are sometimes transparent, and a bluish-green ceylonite variety here, has the lustre polished steel; Newton, N. J., pearl-gray crystals, along with blue corundum, tourmaline, a rutile; at Byram, red, brown, green, and black colors, along with chondrodite; at Sterling, Spart Hamburgh, and Vernon, N. J., are other localities. Light-blue spinels occur sparingly in lim stone in Antwerp, Jefferson Co., N. Y., 2½ m. S. of Oxbow, and rose and reddish-brown in Go verneur, 2 m. N. and ¾ m. W. of Somerville, St. Lawrence Co.; green, blue, and occasionally r varieties occur in granular limestone at Bolton, Boxborough, Chelmsford, and Littleton, Ma Soft octahedral crystals occur in Warwick, which are pseudomorphs, consisting partly of steati or serpentine. Good black spinel is found in Burgess, Canada West; blue with clintonite Daillebout, C. E.

Alt.—Observed altered to steatite, serpentine, völknerite, mica.

Artif.—Formed in crystals by heating a mixture of alumina and magnesia with boracic ac and also, for red spinel, some oxyd of chrome; for black, oxyd of iron (Ebelmen); by using fluori of aluminum and magnesium and boracic acid, with heat (Deville & Caron); by action of chlo of aluminum in vapor on magnesia (Daubrée).

184. HERCYNITE. Hercynit *F. X. Zippe*, Min. Böhm., 1839. Hercinite *bad orthogr.* Iro Spinel.

Isometric. Occurs massive, fine granular.

H.=7·5—8. G.=3·91—3·95. Lustre vitreous, externally dull. Col black. Streak dark grayish-green to leek-green. Opaque.

Comp.—$\dot{\mathrm{Fe}}\,\overline{\mathrm{Al}}$=Alumina 58·9, oxyd of iron 41·1=100. Analysis by B. Quadrat (Ann. Ch Pharm., lv. 357):

$\overline{\mathrm{Al}}$ 61·17 $\dot{\mathrm{Mg}}$ 2·92 $\dot{\mathrm{Fe}}$ 35·67=99·76.

Pyr., etc.—B.B. infusible. The heated powder becomes brick-red, and gives iron reactions. With soda fuses only imperfectly to an olive-green mass.

Obs.—From Ronsberg, at the eastern foot of the Böhmerwald Mts.

Named from the Latin of the Bohemian Forest, *Silva Hercynia* (Plin., iv. 25, 28).

185. **GAHNITE.** Zinc-Spinel. Automolite (fr. Fahlun) *Ekeberg*, Afh., i. 84, 1806. Gahnit *v Moll*, Efem., iii. 78, 1807. Spinelle Zincifère *H.*, Tabl., 67, 99, 1809. Dysluite (fr. Sterling, N. J.) *Keating*, J. Ac. N. Sci., Philad., ii. 287, 1821; *Shep.*, Min., i. 158, 1832, ii. 176, 1835; *Thomson*, Min., i. 220, 1836. Kreittonite *v. Kob.*, J. pr. Ch., xliv., 99, 1848. Spinellus superius *Breith.*, Handb., 623, 1847.

Isometric. In octahedrons, dodecahedrons, etc., like spinel.

H.=7·5—8. G.=4—4·6. Lustre vitreous, or somewhat greasy. Color dark green, grayish-green, deep leek-green, greenish-black, bluish, black, yellowish, or grayish-brown; streak grayish. Subtranslucent to opaque.

Comp., Var.—$\dot{\mathrm{Zn}}\,\overline{\mathrm{Al}}$, with little or no magnesia. The oxyd of zinc sometimes replaced in small part by protoxyd of manganese or of iron ($\dot{\mathrm{Mn}}$, $\dot{\mathrm{Fe}}$), and the alumina in part by sesquioxyd of iron ($\overline{\mathrm{Fe}}$). $\dot{\mathrm{Zn}}\,\overline{\mathrm{Al}}$=Alumina 61·3, oxyd of zinc 38·7=100.

Var. 1. *Automolite*, or *Zinc Gahnite*, $\dot{\mathrm{Zn}}\,\overline{\mathrm{Al}}$, with sometimes a little iron. G.=4·1—4·6. Colors as above given.

2. *Dysluite*, or *Zinc-Manganese-Iron Gahnite.* Composition ($\dot{\mathrm{Zn}}$, $\dot{\mathrm{Fe}}$, $\dot{\mathrm{Mn}}$) ($\overline{\mathrm{Al}}$, $\overline{\mathrm{Fe}}$). Color yellowish-brown or grayish-brown. G.=4—4·6. Form the octahedron, or the same with truncated edges.

3. *Kreittonnite*, or *Zinc-Iron Gahnite.* Composition ($\dot{\mathrm{Zn}}$, $\dot{\mathrm{Fe}}$, $\dot{\mathrm{Mg}}$) ($\overline{\mathrm{Al}}$, $\overline{\mathrm{Fe}}$). Occurs in crystals, and granular massive. H.=7—8. G.=4·48—4·89. Color velvet to greenish-black; powder grayish-green. Opaque.

Analyses: 1, Ekeberg (Gehlen's N. J., v. 418); 2, 3, Abich (Ak. H. Stockh., 1842, 6); 4, F. A. Genth (Am. J. Sci., II. xxxiii. 196); 5, Thomson (Min., i. 221); 6, v. Kobell (l. c.):

	$\overline{\mathrm{Al}}$	$\overline{\mathrm{Fe}}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Mn}}$	$\dot{\mathrm{Zn}}$	$\ddot{\mathrm{Si}}$
1. Fahlun, *Automolite*	60·00	9·25	——	——	*tr.*	24·25	4·75=98·25 E.
2. " "	55·14	5·85	——	5·25	*tr.*	30·02	3 84=100·10 A.
3. Franklin, N. J. "	57·09	——	4·55	2·22	*tr.*	34·80	1·22=99·38 A.
4. Canton mine "	53·37	6·68	3·01	3·22	0·20	30·27	2·37, $\dot{\mathrm{Cu}}$ 1·23=100·35 G.
5. Sterling, N. J., *Dysl.*	30·49	41·93	——	——	7·60	16·80	2·97, $\dot{\mathrm{H}}$ 0·40 T.
6. Bodenmais, *Kreitt.*	44·66	16·63	——	3·05	1·30	24·00	Insol. 10=99·64 K.

Pyr.. etc.—A coating of oxyd of zinc when treated with a mixture of borax and soda on charcoal. Otherwise like spinel.

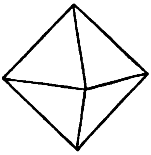
Obs.—*Automolite* is found at Fahlun, Sweden, in talcose schist; at Franklin, N. Jersey, with franklinite and willemite; at the Canton mine, Ga. (of the form 1, *i*); *Dysluite* at Sterling, N. J.; *Kreittonite* at Bodenmais in Bavaria.

Named after the Swedish chemist Gahn. The name *Automolite*, of Ekeberg, is from αὐτόμολος, *a deserter*, alluding to the fact of the zinc occurring in an unexpected place. Von Moll objected to such an idea in nature, and named the species the next year after Gahn, the discoverer. His name is here applied to the whole group of zinc spinels, and automolite retained for the special variety so named.

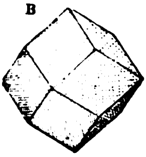
186. **MAGNETITE.** 'Ηράκλεια λίθος (fr. Heraclea, in Lydia) *Gr.* [Λίθος] σίδηρον ἄγουσα, *Theophr.* Not μαγνῆτις λίθος [=Talc] *Theophr.* Μαγνὴς λιθ ς *Dioscor.*, v. 147. Magnes, Sideritis, Heraclion, *Plin.*, xxxvi. 25; Id., *Germ.* Siegelstein *Agric.*, Foss., 243, 466. (1) Minera ferri nigricans, magneti amica, (2) Magnet, (3) Jern Sand, *Wall.*, 256, 262, 1746. Minera Ferri attractoria, Magnet, *Cronst.*, 184, 1758. Magnetischer Eisenstein (incl. Eisensand) *Wern.* Magneteisenstein, Magneteisenerz, *Germ.* Magnetic Iron Ore; Octahedral Iron Ore. Fer oxydulé *H.* Oxydulated Iron. Magnetite *Haid.*, Handb., 551, 1845.

Isometric. Observed planes, *O*, 1, *I*, *i*-2, 2, 3-3, 10-10, 16-16, 3-$\frac{3}{2}$, 5-$\frac{5}{3}$, $\frac{21}{5}$-3. Figs. 2 and 3, common, also 4, 5, 6, 7, 8, 7+8, 19, 19+2; fig. 149 is a distorted dodecahedron. Cleavage: octahedral, perfect to imperfect.

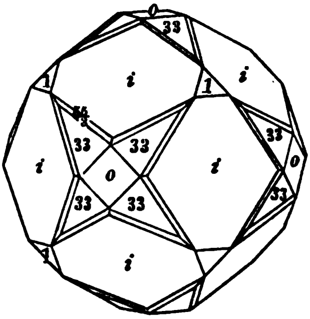
147A



B

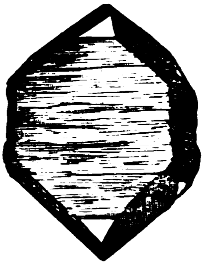


148



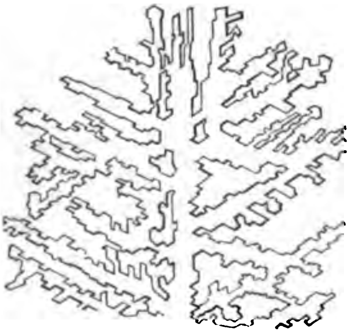
Achmatovsk.

149



Haddam.

150



In mica, Pennsbury.

Dodecahedral faces commonly striated parallel to the longer diagonal (f. 149). Twins like f. 50; also in dendrites, branching at angles of 60° (f. 150), indicating composition parallel to a dodecahedral face. Massive, structure granular—particles of various sizes, sometimes impalpable.

H.=5·5–6·5. G.=4·9–5·2; 5·168—5·180, crystals, Kenngott, and 5·27 after long heating. Lustre metallic—submetallic. Color iron-black; streak black. Opaque; but in very thin dendrites (f. 150) in mica sometimes transparent or nearly so; and varying from almost colorless to pale smoky-brown and black. Fracture subconchoidal, shining. Brittle. Strongly magnetic, sometimes possessing polarity.

Comp., Var.—$\dot{\mathrm{F}}\mathrm{e}\,\bar{\mathrm{F}}\mathrm{e}$=Oxygen 27·6, iron 72·4=100; or sesquioxyd of iron 68·97, protoxyd 31·03=100. The iron sometimes replaced in small part by magnesia. Also sometimes titaniferous. E. Sochting obtained from the magnetite of Pfitsch valley (Pogg., cxxvii. 172) 30·94 $\dot{\mathrm{F}}\mathrm{e}$; and D. Finkler, from the same, 30·75 $\dot{\mathrm{F}}\mathrm{e}$.

Var. 1. *Ordinary.* (*a*) In crystals. (*b*) Granular, coarse or fine. (*c*) As loose sand. Kokscharof figures the above dodecahedral form modified by planes *O*, 1, 3-3, 5-$\frac{5}{3}$; and another with the same, and also $\frac{21}{5}$-3, both from Achmatovsk, Urals.

2. *Magnesian* ($\dot{\mathrm{F}}\mathrm{e}$, $\dot{\mathrm{M}}\mathrm{g}$) $\bar{\mathrm{F}}\mathrm{e}$. (Talk-eisenerz *Breith.*, Schw. J., lxviii. 287, 1833.) G.=4·41—4·42; lustre submetallic; weak magnetic; from Sparta, N. J., in crystals, *Breith.* Prof. Andrews found in ore from the Mourne Mts., Ireland (Ch. Gaz., 379, 1852), $\bar{\mathrm{F}}\mathrm{e}$ 71·41, $\dot{\mathrm{F}}\mathrm{e}$ 21·59, $\dot{\mathrm{M}}\mathrm{g}$ 6·45. An octahedron from Eisenach gave Rammelsberg (Min. Ch., 158) $\bar{\mathrm{F}}\mathrm{e}$ 69·88, $\dot{\mathrm{F}}\mathrm{e}$ 27·88, $\dot{\mathrm{M}}\mathrm{g}$ 1·20, $\ddot{\mathrm{T}}\mathrm{i}$ 0·10.

3. *Titaniferous.* Octahedrons from Meiches, in the Vogelsberg, afforded A. Knop (Ann. Ch. Pharm., cxxiii. 348) $\bar{\mathrm{F}}\mathrm{e}$ 21·75, $\dot{\mathrm{F}}\mathrm{e}$ 51·29, $\ddot{\mathrm{T}}\mathrm{i}$ 24·95, $\dot{\mathrm{M}}\mathrm{n}$ 1·75, which corresponds to ($\dot{\mathrm{F}}\mathrm{e}$, $\dot{\mathrm{M}}\mathrm{n}$)+$\frac{1}{2}$ $\dot{\mathrm{F}}\mathrm{e}$ $\ddot{\mathrm{T}}\mathrm{i}$+$\frac{1}{2}$ $\bar{\mathrm{F}}\mathrm{e}$=($\dot{\mathrm{F}}\mathrm{e}$, $\dot{\mathrm{M}}\mathrm{n}$)+$(\mathrm{Fe, Ti})^2\mathrm{O}^3$, and hence differing from iserine in coming under the general formula of magnetite instead of that of hematite. Magnetite from Ytterby afforded J. A. Michaelson (J. pr. Ch., xc. 107) $\bar{\mathrm{F}}\mathrm{e}$ 68·54, $\dot{\mathrm{F}}\mathrm{e}$ 30·18, $\ddot{\mathrm{T}}\mathrm{i}$ 2·03=100·75.

4. *Ochreous.* (Eisenmulm *Germ.*) Black and earthy. A kind from near Siegen afforded F. A. Genth, as a mean of 3 anal. (Ann. Ch. Pharm., lxvi. 277), $\bar{\mathrm{F}}\mathrm{e}$ 66·20, $\dot{\mathrm{F}}\mathrm{e}$ 13·87, $\dot{\mathrm{M}}\mathrm{n}$ 17·00, $\dot{\mathrm{C}}\mathrm{u}$ 0·09, sand, etc., 1·75=98·91=($\dot{\mathrm{F}}\mathrm{e}$, $\dot{\mathrm{M}}\mathrm{n}$) $\bar{\mathrm{F}}\mathrm{e}$. G.=3·76.

b. From the normal proportion of $\dot{\mathrm{F}}\mathrm{e}$ to $\overline{\mathrm{F}}\mathrm{e}$, 1 : 1, there is occasionally a wide variation, and thus a gradual passage to the sesquioxyd ($\overline{\mathrm{F}}\mathrm{e}$); and this fact may be regarded as evidence that the octahedral $\overline{\mathrm{F}}\mathrm{e}$, martite, is only an altered magnetite. Schwalbe has found (ZS. nat. Ver. Halle, xx. 198) in two magnetites from Landu, in Bengal, India:

	$\overline{\mathrm{F}}\mathrm{e}$	$\dot{\mathrm{F}}\mathrm{e}$	$\dot{\mathrm{M}}\mathrm{g}$	$\dot{\mathrm{C}}\mathrm{a}$	$\ddot{\mathrm{S}}\mathrm{i}$	$\overline{\mathrm{A}}\mathrm{l}$	$\overline{\mathrm{F}}\mathrm{e}$: $\dot{\mathrm{F}}\mathrm{e}$
1.	69·27	29·48	0·49	0·05	0·28	0·03=99·60	8 : 1 nearly.
2.	86·90	11·97	0·17	0·38	0·18	0·22=99·82	3½ : 1

No. 1 was polar-magnetic and columnar; 2, granular, and not polar-magnetic. Von Kobell has found in the cylindrical magnetite of Schwarzenstein, in the Zillerthal, the ratio 4 : 3; and the same in an ore from Arendal. G. Winkler found in a specimen from the Pfitsch valley, $\dot{\mathrm{F}}\mathrm{e}$ 19·66, $\overline{\mathrm{F}}\mathrm{e}$ 79·66, giving the ratio 2 : 1; but this is not confirmed by the later analyses given above.

Pyr., etc.—B.B. very difficultly fusible. In O.F. loses its influence on the magnet. With the fluxes reacts like hematite. Soluble in muriatic acid.

Obs.—Magnetite is mostly confined to crystalline rocks, and is most abundant in metamorphic rocks, though found also in grains in eruptive rocks. In the Azoic rocks the beds are of immense extent, and occur under the same conditions as those of hematite (see p. 142). It is an ingredient in most of the massive variety of corundum called emery. The earthy magnetite is found in bogs like bog-iron ore.

The beds of ore at Arendal, and nearly all the celebrated iron mines of Sweden, consist of massive magnetite; Dannemora and the Täberg in Smaoland are entirely formed of it. Still larger mountains of it exist at Kurunavara and Gelivara, in Lapland. Fahlun in Sweden, and Corsica, afford octahedral crystals (f. 2), imbedded in chlorite slate. Splendid dodecahedral crystals occur at Normark in Wermland. The most powerful native magnets are found in Siberia, and in the Harz; they are also obtained on the island of Elba.

In N. America, it constitutes vast beds (some scores of feet thick) in the Azoic, in the Adirondack region, Warren, Essex, and Clinton Cos., in Northern N. York, while in St. Lawrence Co the iron ore is mainly hematite; also similarly in Canada, in Hull, Grenville, Madoc, etc,; and at Cornwall in Pennsylvania, and at Magnet Cove, Arkansas. It occurs also in *N. York*, in Saratoga, Herkimer, Orange, and Putnam Cos.; at O'Neil mine, Orange Co., in crystals (f. 1, 2, 3, 5, 6). In *Maine*, Raymond, Davis's Hill, in an epidotic rock; at Marshall's island, masses strongly magnetic. In *N. Hampshire*, at Franconia, in epidote and quartz; at Swanzey near Keene, and Unity. In *Vermont*, at Marlboro', Rochester, Bethel, and Bridgewater, in crystals (f 11) in chlorite slate. In *Conn.*, at Haddam, in crystals (f. 4, 8, 149), etc. In *N. Jersey*, at Hamburg, near Franklin furnace. In *Penn.*, at Goshen, Chester Co.; at Webb's mine, Columbia Co.; in dendritic delineations (f. 150) forming hexagonal figures, in mica at Pennsbury and New Providence. In *Maryland*, at Deer Creek. In *California*, in Sierra Co., abundant, massive, and in crystals; in Plumas Co.; Mariposa Co., east of the Mariposa estate, on the trail to the Yosemite; Placer Co., Utt's ranch; Los Angeles Co., at Cañada de las Uvas; El Dorado Co., near the Boston copper mine, in oct., and at the El Dorado Excelsior copper mine. In *Canada*, at Sutton, in crystals; Bromet, etc. In *N. Scotia*, Digby Co, Nichol's Mt., in fine crystals.

No ore of iron is more generally diffused than the magnetic, and none superior for the manufacture of iron. It is easily distinguished by its being attracted readily by the magnet, and also by means of the black color of its streak or powder, which is some shade of red or brown in hematite and limonite. The ore when pulverized may be separated from earthy impurities by means of a magnet, and machines for this purpose are in use.

Named from the loc. *Magnesia*, bordering on Macedonia. But Pliny favors Nicander's derivation from Magnes, who first discovered it, as the fable runs, by finding, on taking his herds to pasture, that the nails of his shoes and the iron ferrule of his staff adhered to the ground.

Alt.—By deoxydation through organic matter changed to protoxyd, which may become a carbonate or siderite. By oxydation becomes sesquioxyd of iron or hematite.

Artif.—Formed in crystals by the action of chlorhydric acid on the sesquioxyd heated, producing a partial deoxydation (Deville); by decomposition of the sesquioxyd with boracic acid (Deville and Caron, Ann. Ch. Phys., IV. v. 108).

185A. *Dimagnetite* of Shepard (Am. J. Sci., II. xiii. 392) appears to be a magnetite pseudomorph. The slender rhombic prisms occur upon a surface which is covered with small cubo-octahedrons, dodecahedrons, and cubo-dodecahedrons of magnetite, and some small irregular cavities in the dimagnetite crystals contain similar crystals; moreover no difference of lustre is perceived in a fractured surface of the magnetite and dimagnetite. The species imitated in the pseudomorph is probably Lievrite. The angle of the prism varies between 110° and 115°, according to the author's measurements (Shepard gives the angle 130°). One crystal gave approximately 110° and 70°; another 114° 20′ and 65° 40′; another 112° and 68°, and the obtuse edge was bevelled in this last crystal by planes (*i*-2) inclined to the larger ones at an angle of about 160½°. The faces are even but not very bright. From Monroe, Orange Co., N. Y.

187. MAGNESIOFERRITE. Magnoferrit *Ramm.*, Pogg., cvii. 451, 1859. Magneferrit *Kenng.*, Ueb. J., 1859, 98, 1860.

Isometric. In octahedrons, and octahedrons with truncated edges (f. 8). H.=6—6·5. G.=4·568—4·654. Lustre, color, and streak as in magnetite. Strongly magnetic.

Comp.—$\dot{\mathrm{Mg}}\ \bar{\mathrm{Fe}}$=Magnesia 20, oxyd of iron 80=100; but the crystals usually intersected by hematite in innumerable very thin laminæ, parallel to the octahedral faces. Analyses: 1–5, Rammelsberg (Pogg., cvii. 451, Min. Chem., 160):

	$\bar{\mathrm{Fe}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Cu}}$
1. Vesuvius, erupt. of '55	86·96	12·58	——=99·54
2. " "	85·00	13·69	0·60=99·29
3. " "	85·05	13·95	1·01=100·01
4. " older erupt.	84·20	16·00	——=100·20
5. " "	84·35	15·65	——=100

Regarding a fourth of the sesquioxyd of iron as a mixture, the results give Rammelsberg the above formula. For the purpose of analysis, the magnesioferrite was separated from the mixed hematite by means of a magnet.

Pyr., etc.—B.B. like hematite. Difficultly soluble in muriatic acid.

Obs.—Formed about the fumaroles of Vesuvius, and especially those of the eruption of 1855, as observed by Scacchi, who particularly described the crystals and their associations. The laminæ of hematite intersecting the octahedrons have rhombohedral planes on their edges. Crystals of hematite occur at the same fumaroles.

Rammelsberg first detected the magnesian nature of the crystals, and, in allusion to it, named the species *magnoferrite.* But *magno* has its own different signification in Latin; and the word should be *magnesioferrite.*

Artif.—Formed in crystals by heating together $\bar{\mathrm{Fe}}$ and $\dot{\mathrm{Mg}}$, and subjecting to the action of chlorhydric acid vapor (Deville).

188. FRANKLINITE. *Berthier*, Ann. d. M., iv. 489, 1819.

Isometric. Observed planes: 1, *I*, *O*, 2, 2-2. Figs. 2, 7, 8, common. Cleavage: octahedral, indistinct. Also massive, coarse or fine granular to compact.

H.=5·5—6·5. G.=5·069, Thomson; 5·091, Haidinger. Lustre metallic. Color iron-black. Streak dark reddish-brown. Opaque. Fracture conchoidal. Brittle. Acts slightly on the magnet.

Comp.—$(\dot{\mathrm{Fe}}, \dot{\mathrm{Zn}}, \dot{\mathrm{Mn}}), (\bar{\mathrm{Fe}}, \bar{\mathrm{Mn}})$. Analyses: 1, Berthier (l. c.); 2, Thomson (Min., i. 438); 3, Abich (Pogg., xxiii. 342); 4, 5, G. J. Dickerson (C. T. Jackson's Rep. on N. J. zinc mines); 6, G. J. Brush (Am. J. Sci., II. xxix. 371); 7, Steffens (B. H. Ztg., xix. 463); 8, J. A. Dahlgren (ib.); 9, Rammelsberg (Pogg., cvii. 312); 10, v. Kobell (J. pr. Ch., xcviii. 129):

	$\bar{\mathrm{Fe}}$	$\bar{\mathrm{Mn}}$	$\dot{\mathrm{Zn}}$
1. New Jersey	66	16	17=99 Berthier.
2. "	66·10	14·96	17·43, $\ddot{\mathrm{Si}}$ 0·20, $\dot{\mathrm{H}}$ 0·56=99·25 Thomson.
3. "	68·88	18·17	10·81, " 0·40, $\ddot{\bar{\mathrm{Al}}}$ 0·73=98·99 Abich.
4. "	66·07	12·24	21·39, " 0·29=100 Dickerson.
5. "	66·12	11·99	21·77, " 0·13=100 Dickerson.
6. "	65·05	14·77	23·30, insol. 0·30=103·12 Brush.
7. "	66·08	12·24	21·40, $\ddot{\mathrm{Si}}$ 0·28=100 Steffens.
8. "	66·11	11·99	21·77, " 0·13=100 Dahl.
9. "	64·51	13·51	25·30=103·52 Ramm.
10. "	66·20	12·42	21·00, $\ddot{\bar{\mathrm{Al}}}$ 0·80=100·42 Kobell.

Von Kobell states that the magnetic character of the mineral shows that the iron is partly protoxyd; and he deduces from his analysis (l. c.), for the most probable composition, $\bar{\mathrm{Fe}}$ 58·36, $\bar{\mathrm{Mn}}$

7·75. $\overline{\text{Al}}$ 0·80, $\dot{\text{Fe}}$ 7·06, $\dot{\text{Mn}}$ 3·48, $\dot{\text{Zn}}$ 21, with mixed $\overline{\text{Mn}}$ 0·79=99·24, corresponding to the formula $\dot{\text{Mn}}\,\overline{\text{Mn}}+2\,\dot{\text{Fe}}\,\overline{\text{Fe}}+5\,\dot{\text{Zn}}\,\overline{\text{Fe}}$=Sesquioxyd of iron 58·99, id. of manganese 8·32, protoxyd of iron 7·58, id. of manganese 3·74, oxyd of zinc 21·37=100. Rammelsberg, in his most recent paper (Pogg., cxxx. 146, 1867) adopts essentially the same view The evolution of chlorine in the treatment of the mineral is attributed by v. Kobell tc the presence of a little $\overline{\text{Mn}}$ (0·80 p. c.) as mixture, which Rammelsberg observes may have come from the oxydation of some of the protoxyd of manganese.

Pyr., etc.—B.B. infusible. With borax in O.F. gives a reddish amethystine bead (manganese), and in R.F. this becomes bottle-green (iron) With soda gives a bluish-green manganate, and on charcoal a faint coating of oxyd of zinc, which is much more marked when a mixture of borax and soda is used. Soluble in muriatic acid, with evolution of a small amount of chlorine.

Obs.—Occurs in cubic crystals near Eibach in Nassau; in amorphous masses at Altenberg, near Aix la Chapelle.

Abundant at Hamburg, N. J., near the Franklin furnace (whence the name of the species), with red oxyd of zinc and garnet, in granular limestone; also at Stirling Hill, in the same region, where it is associated with willemite, in a large vein, in which cavities occasionally contain crystals from one to four inches in diameter.

Artif.—Formed in crystals by action of perchlorid of iron and chlorid of zinc on lime, with heat (Daubrée).

189. CHROMITE. Fer chromaté aluminé (fr. Var) *Vauq.*, Bull. Soc. Philom. 1800, 55, 57. Eisenchrom (fr. Ural) *Meder*, Crell's Ann., 1798, i. 500; *Karst.*, Tab., 56, 79, 1800, 74, 1808. Fer chromaté *H.*, Tr., iv. 1801. Chromate of Iron, Chromic Iron, Chromiron. Chromsaures Eisen, Chromeisenstein, *Germ.* Eisenchrome *Beud.*, 1832. Siderochrome *Huot*, i. 287, 1841. Chromoferrite *Chapm.*, Min., 1843. Chromit *Haid.*, Handb., 550, 1845.

Isometric. In octahedrons (f. 2). Commonly massive; structure fine granular, or compact.

H.=5·5. G.=4·321, crystals, Thomson; 4·498, a variety from Styria; 4·568, Texas, Pa. Lustre submetallic. Streak brown. Color between iron-black and brownish-black. Opaque. Fracture uneven. Brittle. Sometimes magnetic.

Comp.—$\dot{\text{Fe}}\,\overline{\text{Cr}}$, or ($\dot{\text{Fe}}$, $\dot{\text{Mg}}$, $\dot{\text{Cr}}$) ($\overline{\text{Al}}$, $\overline{\text{Fe}}$, $\overline{\text{Cr}}$). $\dot{\text{Fe}}\,\overline{\text{Cr}}$=Oxyd of iron 32, oxyd of chromium 68 =100. Analyses: 1, 2, Seybert (Am. J. Sci., iv. 321); 3, 4, Abich (Pogg., xxiii. 335); 5, 6, Laugier (Ann. Mus. d'Hist. N., vi.); 7, 8, T. S. Hunt (Logan's Rep. G., Canada, 1849); 9, Moberg (J. pr. Ch., xliii. 119); 10, A. Rivot (Ann. Ch. Phys., III. xxx. 202); 11, C. Bechi (Am. J. Sci. II xiv. 62); 12, 13, Starr and Garrett (Am. J. Sci., II. xiv. 45):

		$\dot{\text{Fe}}$	$\dot{\text{Mg}}$	$\overline{\text{Cr}}$	$\overline{\text{Al}}$	$\ddot{\text{Si}}$	
1.	Chester Co., Pa.	35·14	——	51·56	9·72	2·90	=99·32 Seybert.
2.	Baltimore	36·00	——	39·51	13·00	10·60	=99·11 Seybert.
3.	" *massive*	18·97	9·96	44·91	13·85	0·83	=98·25 Abich.
4.	" *cryst.*	20·13	7·45	60·04	11·85	——	=99·45 Abich.
5.	Siberia	24·	——	53·	11·	1·	$\dot{\text{Mn}}$ 1=100 Laugier.
6.	Röraas	25·66	5·36	54·08	9·02	4·83	=98·95 Laugier
7.	Bolton, Canada	35·68	15·03	45·90	3·20	——	=99·81 Hunt.
8.	L. Memphramagog	21·28	18·13	49·75	11·30	——	=100·46 Hunt.
9.	Beresof	18·42	6·68	64·17	10·83	0·91	=101·01 Moberg
10.	Baltimore	30·04	——	63·37	1·95	2·21	* $\dot{\text{Ca}}$ 2·02=99·60 Rivot.
11.	Volterra, Tuscany	33·93	——	42·13	19·84	4·75	=100·65 Bechi.
12.	Chester, Pa.	$\overline{\text{Fe}}$ 38·95	——	60·84	0·93	0·62,	$\dot{\text{Ni}}$ 0·10 Starr.
13.	Texas, Pa.	" 38·66	——	63·38	——	——	" 2·28 Garrett.

* With some titanic acid ?

In Moberg's analysis the chromium is supposed to be partly protoxyd, giving the formula ($\dot{\text{Fe}}$, $\dot{\text{Mg}}$, $\dot{\text{Cr}}$) ($\overline{\text{Cr}}$, $\overline{\text{Al}}$). Garrett's analysis of the Texas ore corresponds to $\dot{\text{Fe}}\,\overline{\text{Cr}}$ 93·16 + $\dot{\text{Fe}}\,\overline{\text{Fe}}$ 0·59 + $\dot{\text{Ni}}\,\overline{\text{Fe}}$ 7·15. In grains that were magnetic, Garrett found $\overline{\text{Cr}}$ 41·55, $\overline{\text{Fe}}$ 62·02, $\ddot{\text{Si}}$ 1·25, corresponding to $\dot{\text{Fe}}\,\overline{\text{Cr}}$ 61·07 + $\dot{\text{Fe}}\,\overline{\text{Fe}}$ 38·64 + $\ddot{\text{Si}}$ 1·25=100·96 (loc. cit).

Pyr., etc.—B.B. in O.F. infusible; in R.F. slightly rounded on the edges, and becomes magnetic With borax and salt of phosphorus gives beads, which, while hot, show only a reaction for iron, but on cooling become chrome-green; the green color is heightened by fusionon charcoal with metallic tin.

Not acted upon by acids, but decomposed by fusion with bisulphate of potash or soda.

Obs.—Occurs in serpentine, forming veins, or in imbedded masses. It assists in giving the variegated color to verde-antique marble.

Occurs in the Gulsen mountains, near Kraubat in Syria; in crystals in the islands of Unst and Fetlar, in Shetland; in the province of Drontheim in Norway; in the Department du Var in France; in Silesia and Bohemia; abundant in Asia Minor (Am. J. Sci., II. vii. 285); in the Eastern and Western Urals; in New Caledonia, affording ore for commerce.

At Baltimore, Md., in the Bare Hills, in large quantities in veins or masses in serpentine; also in Montgomery Co., 6 m. north of the Potomac; at Cooptown, Harford Co., and in the north part of Cecil Co., Md. In Pennsylvania, in W. Goshen (crystals), Nottingham, Mineral Hill, and elsewhere; Chester Co., near Unionville, abundant; at Wood's Mine, near Texas, Lancaster Co., very abundant. Massive and in crystals at Hoboken, N. J., in serpentine and dolomite; in the south-western part of the town of New Fane, and in Jay, Troy, and Westfield, Vt.; Chester and Blanford, Mass.; on I. à Vache, near San Domingo; at Bolton and Ham, Canada East. In California, in Monterey Co.; also Santa Clara Co., near the N. Almaden mine.

This ore affords the oxyd of chrome, used in painting, etc. The ore employed in England is obtained mostly from Baltimore, Drontheim, and the Shetland Isles; it amounts to about 2,000 tons annually.

IRITE *Herm.*, J. pr. Ch., xxiii. 276, 1841, was described by Hermann as occurring in the Urals in black shining octahedrons, with G.=6·506, and as consisting of Iridium 56·04, osmium 9·53, iron 9·72, chromium 9·40, traces of manganese, with a loss of 15·25, which he reckoned as oxygen. But Claus has shown that the mineral is only a mixture of iridosmine, chromite, etc., and sustains this by a mechanical examination of the substance obtained by Hermann's method of separation (J. pr. Ch., lxxx. 285).

190. URANINITE. Schwarz Beck-Erz (fr. Joach.) *Brückm.*, Magn. Dei, 204, 1727. Beck-Blände=Pseudogalena picea pt. [rest (? all) pitch-like Zinc-blende] *Wall.*, 249, 1747. Swart Blende=Pechblende (fr. Saxony, etc) pt. [id.] *Cronst.*, 198, 1758. Pseudogalena nigra compacta, Pechblende (fr. Joach and Joh.), *De Born*, Lithoph., 133, 1772. Pechblende, Eisenpecherz [put under Iron Ores] *Wern.*, Bergm. J., 1789. Uranerz (fr. Joach.) *Klapr.*, Mém. Ac. Berl., 1786–87, 160, pub. in 1792, *Beitr.*, ii. 197, 1797 (discov. of metal uranium). Pecherz *Karst.*, Tab., 56, 1800. Urane oxydulé *H.*, Tr., 1801. Uranpecherz, Pechuran, *Germ.* Pitchblende, Protoxyd of Uranium. Uranatemnite *Chapm.*, Pract. Min., 148, 1853. Uranin *Haid.* Handb., 549, 1845.

Schweruranerz (fr. Przibram) *Breith.*, Handb., 903, 1847. Coracite (fr. L. Sup.) *Le Conte*, Am. J. Sci., II. iii. 117, 173, 1847. Kristallisirtes Uranpecherz (fr. Norway) *Th. Scheerer*, Pogg., lxxii. 570, 1847=Uranoniobit *Herm.*, J. pr. Ch., lxxvi. 326, 1859.

Isometric. Observed forms: f. 2, 7, 8. Usually massive and botryoidal; also in grains: structure sometimes columnar, or curved lamellar.

H.=5·5. G.=6·4–8. Lustre submetallic, to greasy or pitch-like, and dull. Color grayish, greenish, brownish, velvet-black. Streak brownish-black, grayish, olive-green, a little shining. Opaque. Fracture conchoidal, uneven.

Comp., Var.—$\dot{U}\,\dddot{\text{Ʉ}}$, Ramm.=Protoxyd of uranium 32·1, sesquioxyd 67·9=100; but analyses vary much in their results through mixtures with other substances.

Var. 1. *Crystallized.* Color pure black; G.=6·71. Occurs in Norway. It is Hermann's *Urano-niobite.*

2. *Ordinary* massive. G.=6·4–7·0. Breithaupt found in 11 trials of the ore from Johanngeorgenstadt and Schneeberg (the heaviest from the latter place) G.=6·44–6·934, with one at 5·625. A specimen from the former locality gave F. Marian 7·08–7·23; and one from Joachimsthal gave Hermann (anal. 5) 6·97. The Przibram ore (*Schweruranerz*) gave Breithaupt, in 4 trials, G.=7·968–8·025.

3. *Coracite.* Coracite is probably pitchblende mixed with some gummite (the hydrous ore). It is pitch-black in color, and affords a grayish powder; G.=4·378, Le Conte. In Whitney's analysis (No. 8) he obtained 15·92 p. c. of carbonate of lime, which accounts for the low specific gravity. The lime was separated by Genth, as far as possible, before making his analysis (No. 9). Genth found the oxygen ratio for the $\dot{\mathrm{U}}$ and $\bar{\mathrm{U}}$ nearly 1 to 4.

Haidinger's name is retained for the species, with the addition of the terminal syllable *ite*. Chapman's has precedence; but it is badly made, its derivation requiring the form *Uranatomite*; and moreover, until crystals are known and found to be without cleavage, or until crystals are proved to be an impossibility, it cannot be asserted that the species is *uncleavable*.

Analyses: 1, Klaproth (Beitr., ii. 197); 2, Rammelsberg (Pogg., lix. 35, and Min. Ch., 175); 3, Theyer (Ramm. Min. Ch., 175); 4, Ebelmen (Ann. Ch. Phys., 1843, 498); 5, Hermann (J. pr. Ch., lxxvi. 326); 6, Pfaff (Schw. J., xxxv. 326); 7, v. Hauer (Jahrb. G. Reichs., 1853, 197); 8, Whitney (Am. J. Sci., II. vii. 434); 9, Genth (ib., xxiii. 421); 10, Scheerer (Pogg., lxxii. 561):

	$\dot{\mathrm{U}}\,\bar{\mathrm{U}}$	$\dot{\mathrm{F}}$e	$\dot{\mathrm{C}}$a	$\dot{\mathrm{M}}$g	$\dddot{\mathrm{S}}$i
1. Joachimsthal	86·5	2·5	——	——	5·0, Pb S 6·0=100 Klaproth.
2. "	79·15	3·90	2·81	0·46	5·30, Pb 6·20, As 1·12, Bi 0·65, $\dot{\mathrm{H}}$ 0·36=99·61 R.
3. "	68·51	5·70	2·17	0·22	3·50, Pb 6·57, S 1·75, Cu 3·95, Zn 0·70, Bi 0·52, As 4·36, $\ddot{\mathrm{C}}$ 2·14=100·39 Theyer.
4. "	75·94	3·10	5·24	2·07	3·48, Pb 4·22, S 0·60, $\dot{\mathrm{M}}$n 0·82, $\dot{\mathrm{N}}$a 0·25, $\ddot{\mathrm{C}}$ 3·32, $\dot{\mathrm{H}}$ 1·85=100·89 Ebelmen.
5. "	81·21	$\bar{\mathrm{F}}$e 1·88	5·78	0·41	2·45, $\dot{\mathrm{P}}$b 0·74, Pb S 2·84, $\dddot{\mathrm{A}}$l 0·33 $\dddot{\mathrm{B}}$i 1·23, $\dot{\mathrm{M}}$n 0·14, $\dot{\mathrm{H}}$ 2·59 Hermann.
6. J-Georgenstadt	84·52	8·24	——	——	2·02, Pb S 4·20, $\dot{\mathrm{C}}$o 1·14=100·12 Pfaff.
7. Przibram	80·52	2·86	2·97	0·64	1·79, Pb 6·07, S 1·18, Sb 2·09, $\ddot{\mathrm{C}}$ 0·89, $\dot{\mathrm{H}}$ 0·48=99·49 Hauer.
8. *Coracite*	72·60	2·74	5·99	——	5·33, $\dot{\mathrm{P}}$b 6·56, $\dddot{\mathrm{A}}$l 1·10, $\dot{\mathrm{H}}$ 5·68=100 Whitney.
9. "	62·68	$\bar{\mathrm{F}}$e 3·51	5·33	0·56	18·15, $\dot{\mathrm{P}}$b 7·39, $\dddot{\mathrm{A}}$l 0·52, $\ddot{\mathrm{C}}$, $\dot{\mathrm{H}}$ 6·14=99·28 Genth.
10. Norway, *Uranoni.*	76·6	$\dot{\mathrm{P}}$b, $\ddot{\mathrm{C}}$b, $\dddot{\mathrm{S}}$i 15·6, $\dot{\mathrm{M}}$n 1·0, $\dot{\mathrm{H}}$ 4·1, insol. and loss 2·7 Scheerer.				

Scheerer, in anal. 5, obtained $\bar{\mathrm{U}}$ 52·37, and $\dot{\mathrm{U}}$ 28·84; and Genth, in anal. 9, $\bar{\mathrm{U}}$ 46·21, and $\dot{\mathrm{U}}$ 16·47.

Pyr., etc.—B.B. infusible, or only slightly rounded on the edges, sometimes coloring the outer flame green (copper). With borax and salt of phosphorus gives a yellow bead in O.F., becoming green in R.F. (uranium). With soda on charcoal gives a coating of oxyd of lead, and frequently the odor of arsenic. Many specimens give reactions for sulphur and arsenic in the open tube. Soluble in nitric acid. Not attractable by the magnet.

Obs.—Uraninite accompanies various ores of silver and lead at Johanngeorgenstadt, Marienberg and Schneeberg in Saxony, at Joachimsthal and Przibram in Bohemia, and Retzbanya in Hungary. It is associated with torbernite at Tincroft and Tolcarn mines near Redruth in Cornwall; also near Adrianople, Turkey; at the Middletown feldspar quarry, in octahedrons with truncated edges, according to Shepard.

Coracite is from about 90 m. above Sault St. Marie, on the north side of L. Superior.

Very valuable in porcelain painting, affording an orange color in the enamelling fire, and a black color in that in which the porcelain is baked. A laboratory has been opened at Joachimsthal, where the ore is converted into uranate of soda for use.

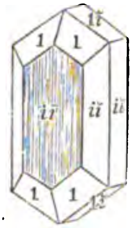
Alt.—The hydrous ore called gummite occurs as a result of the alteration of this species; also uranic ochre.

191. CHRYSOBERYL. [Not Chrysoberyl (=var. Beryl) of *the Ancients.*] Krisoberil *Wern.*, Bergm. J., 373, 387, 1789; 84, 1790. Chrysoberyll *Karsten*, *Lenz*, etc. Cymophane *H.*, J. de M., iv. 5, 1798. Alexandrite *Nordenskiöld*, Schr. Min. Ges., St. Petersb., 1842. Alaunerde + Kieselerde *Klap.*, Beitr., i. 97, 1795; *Arfvedson*, Ak. H. Stockh., 1822. Aluminate of Glucina, mainly, *Seybert*, Am. J. Sci., viii. 105, 1824; *Bergemann*, De Chrys., Gött., 1826.

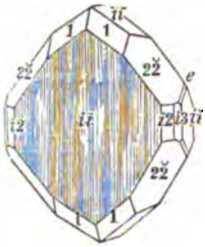
Orthorhombic. $I \wedge I = 129° \ 38'$, $O \wedge 1\text{-}\bar{i} = 129° \ 1'$; $a : b : c = 1·2285 : 1 : 2·1267$. Observed planes: vertical, $i\text{-}\bar{i}$, $i\text{-}\breve{i}$, $i\text{-}\breve{\frac{3}{2}}$, $i\text{-}\breve{2}$, $i\text{-}\breve{3}$, $i\text{-}\breve{\frac{7}{2}}$; domes, $\frac{4}{3}\text{-}\bar{i}$, $1\text{-}\bar{i}$, $1\text{-}\breve{i}$, $3\text{-}\breve{i}$ (only as a composition-face); octahedral, 1, $1\text{-}\breve{2}$, $2\text{-}\breve{2}$, ? $6\text{-}\breve{6}$ (*e*, f. 152), $2\text{-}\bar{2}$.

i-ĭ ∧ i-3̆ = 144° 39½′
i-ĭ ∧ i-2̆ = 133 13½
i-ĭ ∧ 2-2̆ = 126 8
i-ĭ ∧ 1 = 110 3½
i-ī ∧ 1 = 136° 52′
i-ī ∧ 2-2̆ = 128 52
1-ĭ ∧ 1-ĭ, top, = 119 46
3-ĭ ∧ 3-ĭ, ov. i-ĭ, = 120 13
1 ∧ 1, ov. 1-ĭ, = 73° 3′
1 ∧ 1, front, = 139 53
i-ī ∧ 1-ĭ = 90
i-ĭ ∧ 1-ĭ = 120 7

151

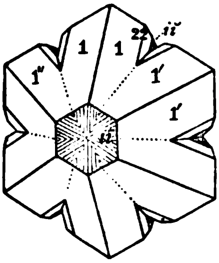


152



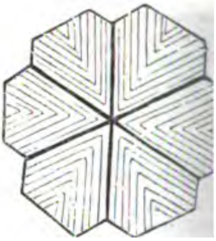
Norway, Me.

153



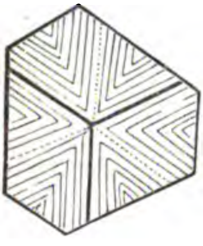
Alexandrite.

154



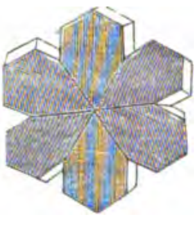
Haddam.

155



Haddam.

155A



Haddam.

Plane i-ĭ vertically striated ; a sometimes also i-ĭ, and other vertic planes. Cleavage: 1-ĭ quite distinc i-ĭ imperfect; i-ī more so. Twin composition-face 3-ĭ, as in f. 153, 15 made up of 6 parts by the crossing 3 crystals, united along the dott line, as shown by the striæ, the for either stellate, or simply hexago pyramids with truncated summi also (2) conjointly, 3-ĭ and i-ĭ, in f. 154, 155, each made by the crossing of 3 pairs of twins, each secto pair twinned by 3-ĭ, and united to the next pair by i-ĭ.

H. = 8·5. G. = 3·5—3·84. Lustre vitreous. Color asparagus-gre grass-green, emerald-green, greenish-white, and yellowish-green ; sometin raspberry or columbine-red by transmitted light. Streak uncolored. Tra parent—translucent. Sometimes a bluish opalescence internally. Fract conchoidal, uneven.

Var. 1. *Ordinary.*—Color pale green, being colored by iron. G.=3·597, Haddam; 3· Brazil; 3·689, Ural, Rose; 3·835, Orenburg, Kokscharof.

2. *Alexandrite.*—Color emerald-green, but columbine-red by transmitted light. G.=3·644, m of results, Kokscharof. Supposed to be colored by chrome. Crystals often very large, an twins, like fig. 153, either six-sided or six-rayed.

Comp.—$\dot{\mathrm{B}}\mathrm{e}^{3}\,\dddot{\mathrm{A}}\mathrm{l}$=Alumina 80·2, glucina 19·8=100. Analyses: 1, 2, 3, Avdejef (Pogg., 118); 4, 5, Damour (Ann. Ch. Phys., III. vii. 173):

		$\dddot{\mathrm{A}}\mathrm{l}$	$\dot{\mathrm{B}}\mathrm{o}$	$\dot{\mathrm{F}}\mathrm{e}$
1.	Brazil	78·10	17·94	4·47=100·51 Avdejef; G.=3·7387.
2	"	78·71	18·06	3·47=100·24 "
3.	Ural	78·92	18·02	3·12, $\dddot{\mathrm{C}}\mathrm{r}$ 0·36, $\dot{\mathrm{C}}\mathrm{u}$ and $\dot{\mathrm{P}}\mathrm{b}$ 0·29=100·71 Avdejef.
4.	Haddam, Ct.	76·02	18·41	——, $\dddot{\mathrm{F}}\mathrm{e}$ 4·51, quartz 0·49=99·43 Damour.
5.	"	75·43	17·93	——, " 4·06, " 0·96=98·38 "

Pyr., etc.—B.B. alone unaltered; with soda, the surface is merely rendered dull. With bo or salt of phosphorus fuses with great difficulty. With cobalt solution, the powdered min gives a bluish color. G. hardly changed by heating; before 3·84, after 3·833. No action with acids.

Obs.—In Brazil and also Ceylon, in rolled pebbles, in the alluvial deposits of rivers: at Marchendorf in Moravia; in the Ural, 85 versts from Katherinenburg, in mica slate with beryl and plenacite, the variety *Alexandrite*, of emerald-green color, columbine-red by transmitted light; in the Orenberg district, S. Ural, yellow; in the Mourne Mts., Ireland; at Haddam, Ct., in granite traversing gneiss, with tourmaline, garnet, beryl, automolite, and columbite; in the same rock at Greenfield near Saratoga, N. Y., with tourmaline, garnet, and apatite; Orange Summit, N. H., in granite at the deep cut of the northern railroad; Norway, Me., in granite with garnet (Verrill).

When transparent, and of sufficient size, chrysoberyl is cut with facets, and forms a beautiful yellowish-green gem. If opalescent, it is usually cut *en cabochon*.

Chrysoberyl is from χρυσός, *golden*, βήρυλλος, *beryl*. *Cymophane*, from κῦμα, *wave*, and φαίνω, *appear*, alludes to a peculiar opalescence the crystal sometimes exhibits. *Alexandrite* is after the Czar of Russia, Alexander I.

On Cryst., see B. & M.; Kokscharof, Min. Russl., iv.; Hessenb., Min. Not., iv. Fig. 152 is natural size, from a crystal belonging to A. E Verrill. Chrysoberyl has very distinct cleavage parallel to 1-ĭ, which appears to show that 1-ĭ is the true vertical prism as made in the last edition of this work, although 3-ĭ is the twinning-plane. But, for the sake of the simpler notation, the position given the crystals by other authors is here adopted.

Artif.—Formed in crystals by exposing to a high heat a mixture of 6 of alumina, 1·62 glucina, and 5·0 boric acid (Ebelmen); by putting a mixture of fluorid of glucinum and fluorid of aluminum, in the proportions of their equivalents, in a carbon crucible, and at the centre of the fluorids a small carbon crucible with a little fused boric acid, and heating for some hours (Deville and Caron), the process yielding fine crystals easily.

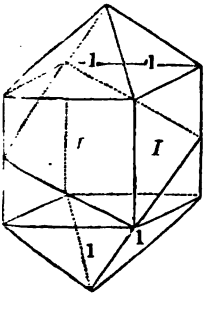
---

4. DEUTOXYDS.

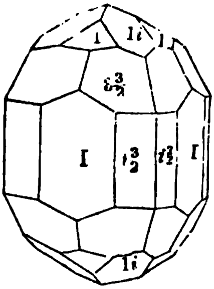
192. CASSITERITE. Ore of the Κασσίτερος *of the Greeks* (*Herod.*, etc.), and of the Plumbum album of *Plin.*, xxxiv., 47, etc.; not of the Stannum [=a pewter-like alloy] of *Plin.* Zinnstein, Stannum ferro et arsenico min., *Wall.*, Min., 303, 1747. Mine d'Etain, *Fr. Trl.* Wall., 1753. Tin Ore, Tin Stone. Zinnstein, Zinnerz, *Germ.* Stannum calciforme (Oxyd of Tin) *Bergm.*, Opusc., ii. 436, 1780; *Klapr.*, Beitr., ii. 245, 1797. Etain oxydé *Fr.* Cassiterite *Beud.*, ii. 618, 1832. Kassiterit *Germ.*

Tetragonal. $O \wedge 1\text{-}i = 146° 5'$; $a = 0·6724$. Observed planes: vertical, I, $i\text{-}\frac{4}{3}$, $i\text{-}\frac{3}{2}$, $i\text{-}2$; octahedrons, $\frac{2}{5}$, 1, $\frac{5}{2}$; zirconoids, $3\text{-}\frac{3}{2}$, $1\text{-}3$, $7\text{-}\frac{7}{6}$.

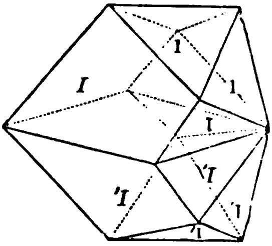
156



157



158



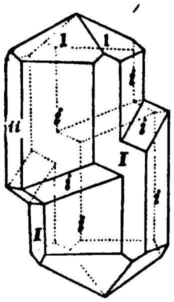
$O \wedge 1 = 136° 26'$
$O \wedge \frac{5}{2} = 112\ 49$
$O \wedge 1\text{-}3 = 144\ 40$

$O \wedge 3\text{-}\frac{3}{2} = 112° 25'$
$1 \wedge 1$, pyr., $= 121\ 40$
$1 \wedge 1$, bas., $= 87\ 7$

$I \wedge 1 = 133° 34'$
$1\text{-}i \wedge 1\text{-}i$, pyr., $= 133\ 31$
$I \wedge i\text{-}\frac{3}{2} = 168\ 42$

Cleavage: *I* and *i-i* hardly distinct. Twins: f. 158, composition-face 1-*i*; producing often complex forms through the many modifying planes; sometimes repeated parallel to all the eight planes 1-*i*; also f. 159, a metagenic twin. Often in reniform shapes, structure fibrous divergent; also massive, granular or impalpable.

159



H.=6–7. G.=6·4–7·1. Lustre adamantine, and crystals usually splendent. Color brown or black; sometimes red, gray, white, or yellow. Streak white, grayish, brownish. Nearly transparent—opaque. Fracture subconchoidal, uneven. Brittle.

Var.—1. *Ordinary*, Tin-stone. In crystals and massive. G. of ordinary cryst. 6·96; of colorless, from Tipuani R., Bolivia, 6·832, Forbes; of honey-yellow, from Oruro, 6·704, id.; of very pure crystals from Carabuco, 6·4, id.; of black cryst. fr. Tipuani, 7·021, id.

2. *Wood Tin* (Holz-Zinn *Germ.*). In botryoidal and reniform shapes, concentric in structure, and radiated fibrous internally, although very compact, with the color brownish, of mixed shades, looking somewhat like dry wood in its colors. *Toad's-eye* tin is the same, on a smaller scale. G. of one variety 6·514. Excellent figs. in Rashleigh's Brit. Min., 1797.

Stream tin is nothing but the ore in the state of sand, as it occurs along the beds of streams or in the gravel of the adjoining region. It has been derived from tin veins or rocks, through the wear and decomposition of the rocks and transportation by water.

Comp.—$\ddot{\text{Sn}}$=Tin 78·67, oxygen 21·33=100. Analyses: 1, Berzelius (Afh., iv. 164); 2, Mallet (J. G. Soc. Dubl., iv. 272); 3, Bergemann (Jahrb. Min., 1857, 395); 4, 5, D. Forbes (Phil. Mag., IV. **xxx.** 140):

	$\ddot{\text{Sn}}$	$\ddot{\bar{\text{Ta}}}$	$\bar{\text{Fe}}$	$\bar{\text{Mn}}$	$\ddot{\text{Si}}$	$\bar{\text{Al}}$	
1. Finbo	93·6	2·4	1·4	0·8	—	—	=98·2 Berzelius.
2. Wicklow, Ireland	95·26	—	2·41	—	0·84	—	Mallet. G.=6·753.
3. Xeres, Mexico	89·43	—	6·63	—	2·21	1·20	Bergem. G.=6·862.
4. Tipuani, Bolivia, *bnh.*	91·81	—	1·02		6·48	0·73	=100·04 Forbes.
5. " " *black*	91·80	—	2·69	—	5·51		=100 Forbes. G =7·021.

Crystals from Carabuco, Bolivia, afforded Kroeber (Phil. Mag., IV. **xxx.** 141) 76·805 p. c. of tin (equivalent to 97·8 p. c. of oxyd), with iron 2·18, silver 0·015, tungstic acid 0·02, lead 0·25, and 1·74 of water. (The analysis is stated to have afforded 19·584 of oxygen, which is not enough for the tin alone found.) The Tenebra ore contains from 2 to 5 p. c. of columbic and tantalic acids. Vauquelin obtained 9 p. c. of sesquioxyd of iron from wood tin.

Pyr., etc.—B.B. alone unaltered. On charcoal with soda reduced to metallic tin, and gives a white coating. With the fluxes sometimes gives reactions for iron and manganese, and more rarely for tantalic acid. Only slightly acted upon by acids.

Obs.—Tin ore is met with in veins traversing granite, gneiss, mica schist, chlorite or clay schist, and porphyry.

Occurs in remarkable crystals in Cornwall, associated with fluor, apatite, topaz, blende, wolfram, etc., and also the *wood-tin* and *stream-tin;* in Devonshire, near Tavistock and elsewhere; County of Wicklow, Ireland; in pseudomorphs after feldspar at Wheal Coates, near St. Agnes, Cornwall; singular compound crystals in Bohemia and Saxony, the twin forms from Zinnwald and Schlackenwald often weighing several pounds; at Limoges in splendid crystals; also in Gallicia; Greenland, with cryolite at Evigtok; Sweden, at Finbo; Finland, at Pitkaranta.

In the E. Indies, on Malacca, Banca, Blitong near Borneo; in the Ovens district, and in some gullies of the Strathbogie ranges in Victoria, Australia.

In Bolivia, S. A., in the gold region along the Tipuani R.; at Oruro tin mines; and at Carabuco, Bolivia; in Mexico, at Xeres and Durango.

In the United States, in *Maine*, sparingly at Paris and Hebron; in *Mass.*, at Chesterfield and Goshen, a few crystals, with albite and tourmaline; in *N. Hamp.*, at Lyme, and somewhat more abundantly on the estate of Mr. Eastman, in the town of Jackson; in *Virginia*, sparingly in some gold mines, imbedded in a talco-micaceous slate; in *California*, in San Bernardino Co., in Temescal region; in *Idaho*, on Jordan creek, near Boonville.

Stannite Breith. (Handb. 772, 1847), an amorphous, pale yellowish-white substance, from Cornwall, with H.=6·5, G.=3·545, has been regarded as a pseudomorph after feldspar, containing much oxyd of tin as a mixture with the other ingredients. Bischof obtained (Chem. G., ii. 2026) S̈i 51·57, S̈n 38·91, Ä̶l 4·53, F̶e 3·55, Ċa 0·16, ign. 0·43=99·15.

On cryst., Hessenberg, Min. Not., vi.; A. E. Nordenskiöld and Gadolin, Pogg., ci. 637. Nordenskiöld makes the angle 1 ∧ 1=121° 42′, whence *a*=0·6720. According to Mr. Gadolin, Finland crystals afford also the planes $\frac{2}{3}$, 7, $\frac{19}{7}$-$\frac{19}{6}$, $\frac{17}{6}$-$\frac{17}{3}$, $\frac{7}{2}$-$\frac{7}{4}$, $\frac{9}{2}$-$\frac{9}{4}$, $\frac{7}{6}$-$\frac{3}{2}$, 1-3, *i*-$\frac{7}{5}$, *i*-$\frac{11}{8}$, *i*-$\frac{9}{7}$, *i*-$\frac{5}{4}$, *i*-$\frac{6}{5}$, *i*-$\frac{7}{6}$, *i*-$\frac{8}{7}$, *i*-$\frac{11}{10}$, *i*-$\frac{14}{13}$, *i*-$\frac{32}{31}$; but there is doubt as to some at least of these planes, as these unusual ratios were determined from measured angles alone and not through zones.

Artif.—Formed in crystals by the action of a stream of muriatic acid gas on Sn O^2 (Deville); by action of steam on chlorid or fluorid of tin (Daubrée).

192A. AINALITE *A. E. Nordenskiöld* (Finl. Min., 162, 1855, 26, 1863). A cassiterite containing nearly 9 p. c. of tantalic acid. Isomorphous with cassiterite, and presenting the planes 1, 1-*i*. H.=6—6·5; G.=6·6—6·8. Lustre vitreous to adamantine; color black to grayish-black; streak light-brown; opaque. Analysis by Nordenskiöld:

S̈n 88·95 T⃛a 8·78 F̶e 2·04 Ċu 0·78=100·55

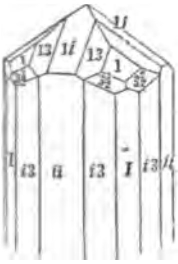
From Fennikoja in Somero, Finland, with tantalite and beryl in albite.

193. RUTILE. Schorl rouge *de Lisle*, Crist., ii. 421, 1783; *v. Born.* Cat. de Raab, i. 168, 1790. Rother Schorl pt., Titankalk, *Klapr.*, Beitr., i. 233, 1795 (discov. of metal Titanium). Red Schorl *Kirw.*, Min., i. 271, 1794; Titanite, id., ii. 329, 1796 [not Titanite *Klapr.*, 1794=Sphene]. Schorl rouge, Sagenite, *Saussure*, Alpes, iv. § 1894, 1796. Crispite (fr. Crispalt. St. Gothard) *Delameth.*, T. T., ii. 333, 1797. Rutil *Wern.*, 1800, Ludwig's Wern, i. 55, 1803. Titane oxydé *H.*, Tr., 1801.

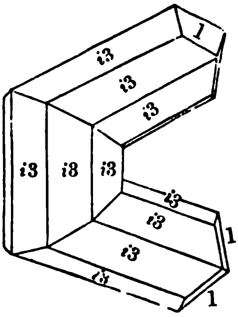
Schwarzer Granat *Lampadius*, Samml., ii. 119, 1797. Eisenhaltiges Titanerz (fr. Ohlapian) *Klapr.*, Beitr., ii., 235, 1797=Nigrin *Karst.*, Tab., 56, 79, 1800. Ilmenorutile *Kokscharof*, Min. Russl., ii. 352, 1854.

Tetragonal. *O* ∧ 1-*i*=147° 12½′, *a*=0·6442. Observed planes: vertical prisms, *I*, *i*-$\frac{3}{2}$, *i*-2, *i*-3, *i*-4, *i*-7, *i*-*i*; octahedrons, 1, 2, $\frac{3}{4}$, 1-*i*, 3-*i*; zirconoids, 1-3, 1-$\frac{3}{2}$, 3-$\frac{3}{2}$; base, *O*, not common.

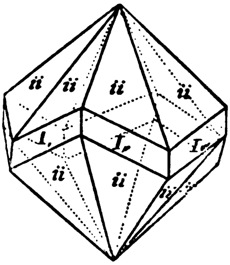
160



161

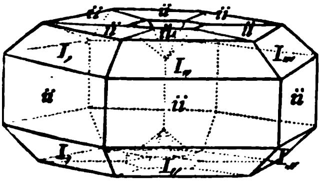


164



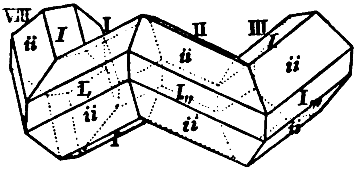
Graves Mtn., Ga.

162



Graves Mtn., Ga.

163



O ∧ 1=137° 40′
O ∧ 3-$\frac{3}{2}$=113 18
O ∧ 1-3=145 49
1 ∧ 1, pyr.,=123 7½

1 ∧ 1, bas.,=84° 40′
I ∧ 1=132 20
I ∧ *i*-$\frac{3}{2}$=168 42
I ∧ *i*-2=161 34

I ∧ *i*-3=153° 26′
i-*i* ∧ *i*-2=153 26
i-*i* ∧ 1-*i*=122 47½
i-*i* ∧ 1=118 26

Cleavage: *1* and *i-i*, distinct; 1, in traces. Vertical planes usually str ated. Crystals often acicular. Twins: 1, composition-face 1-*i*, either (1 having a geniculation at the centre of origin of the crystal (nearly like f. 5(or f. 158 under cassiterite); or (2) having commenced as a simple crysta and afterward become geniculated, as in f. 161. (A) Usually the successiv geniculations take place in a common plane, that is by those faces 1-*i* th lie in the direction of the same diagonal; and (*a*) either the parts at th geniculations, at the opposite extremities, resume alternately a like dire tion, as in f. 159, under cassiterite, p. 157; or the direction changes succe sively (f. 161), the extremities finally bending into one another, and produ ing at times when thus completed an inequilateral hexagonal prism (f. 162 but (B) occasionally the twinned commencement (as I, II, f. 163) is ne geniculated at either end parallel to the *transverse* plane 1-*i*, and a zig-za form is produced, and this in successive alternations, thence resulting, if th twinning begins nearly at, or at, the commencement of the crystal, in th scalenohedral form in f. 164, which consists of 8 united sectors. [Fig. 16 is ideal (from G. Rose), being introduced to illustrate the form in f. 164 2. Composition-face 3-*i*, making a wedge-shaped crystal consisting of tw individuals. 3. Composition-faces 1-*i* and 3-*i* in the same crystal (fr. Ma net Cove, Hessenberg). Occasionally compact, massive.

H.=6–6·5. G.=4·18–4·25. Lustre metallic-adamantine. Color re dish-brown, passing into red; sometimes yellowish, bluish, violet, black rarely grass-green. Streak pale brown. Subtransparent—opaque. Fra ture subconchoidal, uneven. Brittle.

Comp., Var.—Titanic acid, T̈i=Oxygen 39, titanium 61=100. Sometimes a little iron is prese

Var. 1.—*Ordinary.* Brownish-red and other shades, not black. G.=4·18–4·22. Transpare quartz is sometimes penetrated thickly with acicular or capillary crystals, and this variety is t *Sagenite* (fr. σαγηνη, a net), also named *Crispite.* Dark smoky quartz penetrated with the acicul rutile is apparently the *Veneris crinis* of Pliny (xxxvii. 69).

2. *Ferriferous.* (*a*) *Nigrine.* Color black, whence the name. Contains 2 to 3 p. c. of oxyd iron. But as ordinary rutile has 1 to 2 p. c., the distinction is very small. G.=4·249, fr. Oh pian; 4·242 fr. Freiberg. (*b*) *Ilmenorutile.* A black variety from the Ilmen Mts, occurring in tahedrons, containing over 10 p. c. of oxyd of iron, and having G.=5·074–5·133.

3. *Chromiferous* (Titane oxydé chromifère *H.*). A grass-green variety, containing oxyd chrome, which gives the color.

Analyses: 1, Damour (Ann. Ch. Phys., III. x. 417); 2, H. Rose (Gilb. Ann., lxiii. 67, Pogg., 166); 3, Kersten (J. pr. Ch., xxxvii. 170); 4, 5, Demoly (Jahresb., 1849, 728):

1.	St. Yrieix, *reddish*	T̈i 97·60	F̶e 1·55=99·15 Damour.	G.=4·209.
2.	“ “	98·47	1·53=100 H. Rose.	
3.	Freiberg, *nigrine*	96·75	2·40[a]=99·15 Kersten.	G.=4·242.
4.	Loc. unknown	96·41	1 63, M̶n 0·13, S̈i 1·83=100 Demoly.	
5.	“ “	96·45	1·62, “ 0·14, “ 0·79=100 Demoly.	

[a] In part at least *magnetite*, which may be separated by a magnet.

The *Ilmenorutile* consists approximately, according to Hermann (l. c.), of T̈i 89·3, F̶e 10·7.

Pyr., etc.—B.B. infusible. With salt of phosphorus gives a colorless bead, which in R. assumes a violet color on cooling. Most varieties contain iron, and give a brownish-yellow or r bead in R.F., the violet only appearing after treatment of the bead with metallic tin on charco Insoluble in acids; made soluble by fusion with an alkali or alkaline carbonate. The soluti containing an excess of acid, with the addition of tin-foil, gives a beautiful violet-color when co centrated.

Obs.—Rutile occurs in granite, gneiss, mica slate, and syenitic rocks, and sometimes in gra ular limestone and dolomite. It is generally found in imbedded crystals, often in masses of qua or feldspar, and frequently in acicular crystals penetrating quartz. It has also been met with hematite and ilmenite. It is common in grains or fragments in many auriferous sands. Occu in Arendal and Krageröe in Norway; at Horrsjöberg, Finland, with lazulite and kyanite; Saual Carinthia; in the Urals; in the Tyrol; at St. Gothard; at Yrieix, in France; Krummhenne dorf. near Freiberg; in Castile, in geniculated crystals, often large; at Ohlapian in Transylvania, *nigrine* in pebbles; in large crystals in Perthshire, Scotland; at Crianlarick, at Craig Calleach near Killin, and on Benygloe; in Donegal Co., Ireland. A variety from Karingsbricka in Sweden contains according to Ekeberg (Ak. H., Stockh., 1803, 46), 3 p. c. of chrome, and is the *titane oxydé chromifère* of Haüy; *grass-green* needles, supposed to be chromiferous, have been found in the Swiss Alps. The *Ilmenorutile* is from the phenacite and topaz mine of the Ilmen Mts., in the Urals. Rough octahedrons, reticulated within, from Brazil, are supposed to be pseudomorphs after anatase.

In *Maine*, at Warren, along with tremolite and chalcopyrite. In *N. Hamp.*, sparingly at Lyme, with tourmaline; near Hanover, acicular crystals in quartz, only in loose masses. In *Vermont*, at Waterbury, Bristol, Dummerston, and Putney; also in loose boulders in middle and northern Vermont, acicular, some specimens of great beauty in transparent quartz. In *Mass.*, at Barre, in gneiss, crystals occasionally an inch and a half in diameter; at Windsor, in feldspar veins intersecting chlorite slate; at Shelburne, in fine crystals in mica slate; at Leyden, with scapolite; at Conway, with gray epidote. In *Conn.*, at Lane's mine, Monroe, and in the adjoining town of Huntington. In *N. York*, in Orange Co., 1 m. E. of Edenville, with pargasite in limestone boulders, 2 m. E. of Warwick, in granite with zircon; 1 m. E. of Amity, in quartz with brown tourmaline, and 2 m. W., with spinel and corundum, and also 2 m. S.W., with red spinel and chondrodite; near Warwick, in slender prisms penetrating quartz; in N. York Co., at Kingsbridge, in veins of quartz, feldspar, and mica traversing granular limestone; in the limestone of Essex Co. In *Penn.*, in fine long crystals, at Sudsbury, Chester Co., and the adjoining district in Lancaster Co.; at Parksburg, Concord, West Bradford, and Newlin, Chester Co.; at the Poor House quarry, Chester Co., in delicate crystals, sometimes iridescent, on dolomite. In *N. Jersey*, at Newton, with spinel. In *N. Car.*, at Crowder's Mountain. In *Georgia*, in Habersham Co.; in Lincoln Co., at Graves' Mountain, with lazulite in large and splendent crystals, some 3½ by 2¾ in. In *Arkansas*, at Magnet Cove.

In *Canada*, small crystals, with specular iron at Sutton, C. E; in the ilmenite of Bay St. Paul, C. E., orange translucent grains, pure T̈i, and probably rutile or brookite.

The oxyd of titanium is employed for a yellow color in painting porcelain, and also for giving the requisite tint to artificial teeth.

Recent art. on cryst., Kokscharof Min. Russl., i. ii. iii. iv.; Pogg., xci. 154 (whence angles given); G. Rose, Pogg, cxv. 643; Hessenberg, Min. Not., I. II. V. Figs. 163–164 by G. Rose.

Artif.—Formed in crystals by heating together to redness titanic acid and protoxyd of tin, and then heating the mass with silica to a cherry red heat (Deville); by the action of steam on fluorid or chlorid of titanium (Daubrée, Hautefeuille). Hautefeuille observes that in this process crystals of *rutile* are formed when the heat used is red heat; of *brookite*, when it is between that required for volatilizing cadmium and zinc; and of *anatase*, when the heat is a little below that required for the volat. of cadmium.

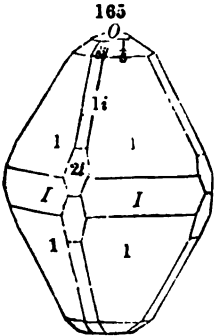
Has been observed in crystals as a furnace product by Scheerer.

194. OCTAHEDRITE. Schorl bleu indigo (fr. Oisans) *Bourn.*, de Lisle's Crist., ii. 406, 1783; Schorl octaèdre rectangulaire *id.*, J. de Phys., xxx. 386, 1787. Octaédrite *Sauss.*, Alpes, § 1901, 1796. Oktaëdrit *Wern.*, 1803, Ludwig's Wern., ii. 218, 1804. Oisanite *Delameth.*, T. T., ii. 269, 1797; *H.*, J. d. M., v. 273, 1799. Anatase *H.*, Tr., iii. 1801. Dauphinit.

Tetragonal. $O \wedge 1\text{-}i = 119° \ 22'$; $a = 1{\cdot}77771$. Commonly octahedral or tabular. Observed planes: O; prisms, I, $i\text{-}i$; octahedrons, 1, $\frac{1}{3}$, $\frac{3}{7}$, $\frac{1}{2}$, $\frac{1}{5}$, $\frac{1}{7}$, $3\text{-}i$, $2\text{-}i$, $1\text{-}i$, $\frac{1}{5}\text{-}i$, $\frac{1}{7}\text{-}i$; zirconoid, $\frac{5}{19}\text{-}5$.

$O \wedge \frac{1}{5} = 153° \ 19'$ $\qquad$ $1 \wedge 1$, bas., $= 136° \ 36'$
$O \wedge \frac{1}{7} = 160 \ 15$ $\qquad$ $2\text{-}i \wedge 2\text{-}i$ " $= 148 \ 28$
$O \wedge 1 = 111 \ 42$ $\qquad$ $1\text{-}i \wedge 1\text{-}i$ " $= 121 \ 16$
$O \wedge 2\text{-}i = 105 \ 46$ $\qquad$ $O \wedge I = 90.$
$1 \wedge 1$, pyr., $= 97 \ 51$ $\qquad$ $I \wedge 1 = 158 \ 18$

165



Cleavage: 1 and O, perfect.

H.=5·5–6. G.=3·82–3·95; sometimes 4·11—4·16 after heating. Lustre metallic-adamantine. Color various shades of brown, passing into indigo-blue, and black; greenish-yellow by transmitted light. Streak uncolored. Fracture subconchoidal. Brittle.

Comp.—Like rutile and brookite, pure titanic acid.

Rose found in crystals from Brazil 1·25 per cent. sesquioxyd of iron (Pogg., lxi. 516); and Damour obtained in an analysis (Ann. Ch. Phys., III. x. 417), $\ddot{\mathrm{Ti}}$ 98·36, $\ddot{\bar{\mathrm{Fe}}}$ 1·11, $\ddot{\mathrm{Sn}}$ 0·20=99·67

Pyr., etc.—Same as for rutile.

Obs.—Most abundant at Bourg d'Oisans, in Dauphiny, with feldspar, axinite, and ilmenite Found in mica slate in the Grisons; in Bavaria; near Hof in the Fichtelgebirge; Norway; th Urals; in chlorite in Devonshire, near Tavistock; with brookite at Tremadoc, in North Wales in Cornwall, near Liskeard and at Tintagel Cliffs; in Brazil in quartz, and in detached crystals s splendent as to be sometimes mistaken for diamonds.

In the U. States, at the Dexter lime rock, Smithfield, R. I., in dolomite.

De Saussure's name *octahedrite* has the priority, and is particularly appropriate, the crystal being usually octahedrons. Haüy's *anatase* is No. 3 in order of time, and was brought forwar after he had once adopted for a while Delametherie's name *oisanite;* it is from ἀνάτασις, *erection* and was intended to signify, as Haüy says, that the common octahedron was longer than that o other tetragonal species; but *length* is not in the meaning of the Greek word.

Artif.—Formed in crystals by the action of steam on chlorid or fluorid of titanium (Daubrée) by the action of a stream of muriatic acid gas on Ti O^2 (Deville); by fusing titanic acid with sal of phosphorus B.B. in R.F., and then exposing the bead to the point of the blue flame, whe minute transparent crystals of octahedrite separate (G. Rose).

195. HAUSMANNITE. Schwarz Braunsteinerz pt. *Wern.*, Bergm. J., 386, 1789. Schwar Manganerz pt. *Karst.*, Tab. 72, 100, 1808. Black Manganese. Blättricher Schwarz-Braunstei *Hausm.*, Handb., 293, 1813. Manganése oxydé hydraté *H.*, Tr., 1822. Pyramidal Manganes Ore *Haid.*, Mohs, Min., ii 416, 1824. Hausmannite *Haid.*, Trans. R. Soc. Ed., 1827. Glan braunstein *Hausm.*, Handb., 405, 1847.

Tetragonal. $O \wedge 1\text{-}i$=130° 25′; a=1·1743. Observed planes: 1, $\frac{1}{3}$, 1- Forms octahedral.

$O \wedge 1$=121° 3′	$\frac{1}{3} \wedge \frac{1}{3}$, pyr.,=139° 57′
$1 \wedge 1$, pyr.,=105 25	$1\text{-}i \wedge 1\text{-}i$, " =114 52
$O \wedge \frac{1}{3}$=151 2	$1 \wedge 1\text{-}i$=142 42

Cleavage: basal, nearly perfect. Twins, parallel to $1\text{-}i$; the same kind o composition sometimes between four individuals, nearly like 93, p. 65. Als granular massive, particles strongly coherent.

H.=5–5·5. G.=4·722. Lustre submetallic. Color brownish-black Streak chestnut-brown. Opaque. Fracture uneven.

Comp.—$\dot{\mathrm{Mn}}^2\,\ddot{\mathrm{Mn}}$=Manganese 72·1, oxygen 27·9=$\ddot{\bar{\mathrm{Mn}}}$ 69, $\dot{\mathrm{Mn}}$ 31=100. Formula usuall written $\dot{\mathrm{Mn}}\,\ddot{\bar{\mathrm{Mn}}}$. Analyses: 1, Turner (Trans. Roy. Soc. Edinb., xi.); 2, Rammelsberg (Pogg xiv. 222); 3, id. (ib., cxxiv. 523); 4, L. J. Igelström (Œfv. Ak. Stockh., 1865, 606):

	$\dot{\mathrm{Mn}}$	$\ddot{\bar{\mathrm{Mn}}}$	O	$\dot{\bar{\mathrm{Ba}}}$	$\ddot{\mathrm{Si}}$	$\dot{\mathrm{H}}$
1. Ilefeld	98·902		0·215	0·111	0·337	0·435=100 Turner.
2. Ilmenau	92·487	——	7·004	1·150	——	——=99·641 Ramm.
3. Filipstad	92·12	——	6·95	0·13	——	0·34, $\dot{\mathrm{Ca}}$ 0·14, $\dot{\mathrm{Mg}}$ 0·41=100·09 Ramm.
4. Jakobsberg	28·78	71·27	——	——	——	——=100 Igelström.

Rammelsberg, in later examinations of the Ilmenau mineral (Pogg., cxxiv. 522), found $\ddot{\mathrm{Si}}$ 0·1 0·91, 0·60, and $\dot{\bar{\mathrm{Ba}}}$ 0·15, 0·60, 0 14, with ign. 0·5, and O 7·10.

Pyr., etc.—B.B. like manganite. Dissolves in heated muriatic acid, affording chlorine.

Obs.—Occurs with porphyry, along with other manganese ores, in fine crystals, near Ilmen in Thuringia; Ilefeld in the Harz; Filipstad in Wermland. Reported also from Framont Alsace. Observed at Lebanon, Penn.

Dauber found for crystals from Ilmenau $1 \wedge 1$=105° 30′, and $\frac{1}{3} \wedge \frac{1}{3}$=140° 31′ (Pogg., xciv. 40

The formula $\dot{\mathrm{Mn}}^2\,\ddot{\mathrm{Mn}}$, which makes the two members each to contain *two of oxygen*, accor with the approximate isomorphism of the species with octahedrite and rutile, the angle $O \wedge 1$ it differing hardly 2° from $O \wedge 1\text{-}i$ in octahedrite, and about 2½° from $O \wedge 1$ in rutile.

Artif.—Formed in crystals by subjecting $\ddot{\bar{\mathrm{Mn}}}$ and Mg to heated muriatic acid gas (Deville).

196. BRAUNITE. Braunite, Brachytypous Manganese-Ore, *Haid.*, Ed. J. Sci., iv. 48, 1826. Hartbraunstein *Hausm.*, Handb., 222, 1847. Marceline *Beud.*, ii. 188, 1832. Heteroklin *Breith.*, Pogg., xlix. 204, 1840 (in art. by Evreinoff), Handb., 801, 1847.

Tetragonal. $O \wedge 1\text{-}i = 135° \, 26'$; $a = 0{\cdot}98525$. Observed planes: O, 1, 2, 2-2:

$O \wedge 1 = 125° \, 40'$	$2 \wedge 2$, pyr., $= 96° \, 33'$
$O \wedge 2 = 109 \;\; 45$	$2 \wedge 2$, basal, $= 140 \;\; 30$
$1 \wedge 1$, pyr., $= 109 \;\; 53$	$2\text{-}2 \wedge 2\text{-}2$, pyr. axial, $= 128 \;\; 17$
$1 \wedge 1$, bas., $= 108 \;\; 40$	$2\text{-}2 \wedge 2\text{-}2$, pyr. diag., $= 144 \;\; 4$

$1 \wedge 1 = 109° \, 46'$ and $108° \, 53'$, Descloizeaux. Twins: forms consisting of three crystals, Kenngott. Also massive.

H.=6—6·5. G.=4·75—4·82; 4·752, fr. Elgersburg, Ramm.; 4·818, ib., Haid.; 4·77, fr. St. Marcel, Damour. Lustre submetallic. Streak and color dark brownish-black. Fracture uneven. Brittle.

Comp.—$2\,\dot{\mathrm{M}}\mathrm{n}^2\,\overline{\mathrm{M}}\mathrm{n}+\overline{\mathrm{M}}\mathrm{n}\,\ddot{\mathrm{S}}\mathrm{i}$ (see p. 133). Turner obtained no silica, and made the mineral simply $\overline{\mathrm{M}}\mathrm{n}$. Analyses: 1, Turner (Edinb. Trans., xi); 2–4, Rammelsberg (Pogg., cxxiv. 515):

			$\dot{\mathrm{M}}\mathrm{n}$	O	$\dot{\mathrm{B}}\mathrm{a}$	$\ddot{\mathrm{S}}\mathrm{i}$	$\dot{\mathrm{H}}$
1. Elgersburg			86·95	9·85	2·25	*tr.*	0·95=100 Turner.
2. "	cryst.	(⅔)	*undet.*		0·24	7·98	—— Ramm.
3. "	massive	(⅓)	"		0·54	8·32	—— Ramm.
4. "			[80·94]	8·08	0·44	8·63	1·00, $\dot{\mathrm{C}}\mathrm{a}$ 0·91=100 Ramm.

The *marceline* (or heterocline) from St. Marcel in Piedmont, shown chemically by Damour, and crystallographically by Descloizeaux, to be impure braunite, was found by Damour (Ann. d. M., IV. i. 400) to consist of

$\overline{\mathrm{M}}\mathrm{n}$ 66·68, $\overline{\mathrm{F}}\mathrm{e}$ 10·04, $\dot{\mathrm{M}}\mathrm{n}$ 8·79, $\dot{\mathrm{F}}\mathrm{e}$ 1·30, $\dot{\mathrm{C}}\mathrm{a}$ 1·14, $\dot{\mathrm{M}}\mathrm{g}$ 0·26, $\ddot{\mathrm{S}}\mathrm{i}$ 10·24=98·45

Analyses of impure ore from Elba, by Bechi, in Am. J. Sci., II. xiv. 62; from Engadin, in serpentine, by Bukeisen, in Ber. Ak. Wien, xxiv. 287.

Pyr., etc.—B.B. infusible. With borax and salt of phosphorus gives an amethystine bead in O.F., becoming colorless in R.F. With soda gives a bluish-green bead. Treated with muriatic acid evolves chlorine. Marceline gelatinizes with acids.

Obs.—Occurs both crystallized and massive, in veins traversing porphyry, at Oehrenstock, near Ilmenau; at Elgersburg in Thuringia; at Botnedalen, Upper Tellemark, in Norway; near Ilefeld in the Harz; at St. Marcel in Piedmont; at Elba (Bechi, Am. J. Sci., II. xiv. 62); at Vizianagram in India.

Named after Mr. Braun of Gotha.

To exhibit the true relations between the forms of braunite and cassiterite or rutile, the plane 1-*i* above should be 1, $O \wedge 1$ in cassiterite being 136° 26′. Homologically this plane in all these related species is 1-*i*, the plane corresponding to that truncating an edge of a cube which inclines to O 135°.

197. MINIUM. Mennige *Germ.* Plomb oxidé rouge *H.*

Pulverulent, occasionally exhibiting, under the microscope, crystalline scales.

H.=2—3 G.=4·6. Lustre faint greasy, or dull. Color vivid red, mixed with yellow; streak orange-yellow. Opaque.

Comp.—$\mathrm{Pb}^3\,\mathrm{O}^4 = \ddot{\mathrm{P}}\mathrm{b} + 2\,\dot{\mathrm{P}}\mathrm{b}$ = Oxygen 9·34, lead 90·66=100.

Pyr.—In the reduction flame of the blowpipe globules of lead are obtained.

Obs.—Usually associated with galenite, and also with calamine, and sometimes constituting pseudomorphs after galenite and cerussite.

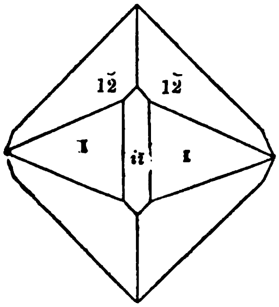
Occurs at Bleialf in the Eifel; in Badenweiler in Baden; Brillon in Westphalia; island of Angl sey; Grussington Moor and Weardale in Yorkshire; Leadhills in Scotland; Schlangenberg i Siberia.

Found at Austin's mine, Wythe Co., Va., along with cerussite.

198. BROOKITE. Jurinite *Soret*, 1822. Brookite *Levy*, Ann. Phil., II. ix. 140, 1825. Arka site *Shep.*, Am. J. Sci., II. ii. 250, 1846. ? Eumanite *Shep.*, ib., xii. 211, 1851.

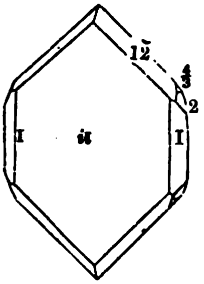
Orthorhombic. $I \wedge I = 99° \ 50'$ ($-100° \ 50'$): $O \wedge 1\text{-}\bar{\imath} = 131° \ 42'$; $a:b:$ $=1·1620:1:1:1·1883$. Observed planes: O; vertical, I, $i\text{-}\bar{\imath}$, $i\text{-}\breve{\imath}$, $i\text{-}\bar{\tfrac{3}{2}}$, i- $i\text{-}4$, $i\text{-}\bar{\tfrac{11}{2}}$, $i\text{-}\underset{\smile}{\tfrac{23}{4}}$, $i\text{-}\breve{2}$; domes, $\tfrac{1}{4}\text{-}\bar{\imath}$, $\tfrac{1}{2}\text{-}\bar{\imath}$, $2\text{-}\breve{\imath}$; octahedral, $\tfrac{1}{2}$, 1, 2, $\tfrac{1}{2}\text{-}\bar{\tfrac{3}{2}}$, $\tfrac{3}{2}\text{-}\bar{\tfrac{3}{2}}$, $1\text{-}\breve{2}$, 2- $\tfrac{7}{3}\text{-}\tfrac{7}{3}$, 5-˘, $5\text{-}\tfrac{10}{3}$, $2\text{-}\breve{\tfrac{8}{7}}$, $2\text{-}\breve{\tfrac{4}{3}}$.

166

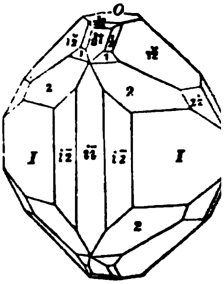


Arkansas.

167

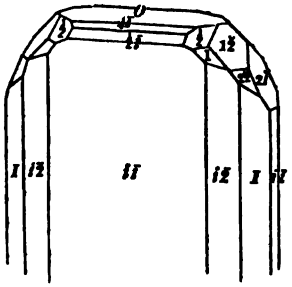


168



Miask, Ural.

169



Ellenville, N. Y.

$O \wedge \tfrac{1}{2}\text{-}\bar{\imath} = 150° \ 42'$
$O \wedge \tfrac{1}{2}\text{-}\bar{\tfrac{3}{2}} = 147 \ \ 14$
$O \wedge 1 = 124 \ \ 17$
$O \wedge \tfrac{1}{2} = 143 \ \ 45$
$O \wedge 2\text{-}\breve{\tfrac{4}{3}} = 111 \ \ 34$
$O \wedge 1\text{-}\breve{2} = 132 \ \ 19$
$O \wedge 5\text{-}\breve{5} = 101 \ \ 38$
$O \wedge 2\text{-}\breve{\imath} = 117 \ \ 54$

$I \wedge i\text{-}\bar{\imath} = 139° \ 55'$
$i\text{-}\bar{\imath} \wedge i\text{-}\breve{2} = 157 \ \ 11$
$i\text{-}\breve{2} \wedge i\text{-}\breve{2}$, mac., $=134 \ \ 2$
$\tfrac{1}{2} \wedge \tfrac{1}{2}$ " $=135 \ \ 1$
$1 \wedge 1$ " $=115 \ \ 4$
$1\text{-}\breve{2} \wedge 1\text{-}\breve{2}$ " $=101$
$1\text{-}\breve{2} \wedge 1\text{-}\breve{2}$, brach., $=135 \ \ 3$
$2\text{-}\breve{\imath} \wedge 2\text{-}\breve{\imath}$, top, $= 55 \ \ 48$

Cleavage: *I*, indistinct; *O*, still more so.

H.=5·5–6. G.=4·12–4·23, brookite; 4· —4·23, trp. Ural cryst.; 4·03–4·085, arkansi Whitney and Damour, 3·86–3·95, Rammelsber 3·81, a variety from the Ural, Hermann. Hair-brown, yellowish, or r dish, with metallic adamantine lustre, and translucent (brookite); also ir black, opaque, and submetallic (arkansite). Streak uncolored—grayis yellowish. Brittle.

Comp.—Pure titanic acid, $\ddot{\rm Ti}$, like rutile. Analyses: 1, Hermann (J. pr. Ch., xlvi. 404) Romanovsky (B. H. Ztg., 1853, No. 26); 3, Damour (Ann. d. M., IV. xv. 447):

	$\ddot{\rm Ti}$	$\overset{\dots}{\overline{\rm Fe}}$	$\overset{\dots}{\overline{\rm Al}}$	ign.
1. Urals	94·09	4·50	*tr.*	1·40=100·00 Hermann.
2. "	94·31	3·28	——	1·31=98·90 Romanovsky.
3. Arkansas	99·36	1·36	0·73	——=101·45 Damour.

Rammelsberg obtained 94·23 p. c. of titanic acid from the arkansite, and a corresponding low specific gravity, while Whitney and Damour found little impurity and a higher specific gravity.

Pyr., etc.—Same as for rutile.

Obs.—Brookite occurs at Bourg d'Oisans in Dauphiny: at St. Gothard, with albite and quartz; in the Urals, district of Slatoust, near Miask; near Makirch in the Vosges, in pseudomorphs after sphene; rarely at Val del Bove, Etna, with rutile; at Fronoleu near Tremadoc, Wales; in thick black crystals (*arkansite*, f. 166) at Magnet Cove, Ozark Mts., Arkansas, along with elæolite, black garnet, and schorlamite; in small crystals from the gold washings of North Carolina; at the lead mine of Ellenville, Ulster Co., N. Y., on quartz (f. 169), with chalcopyrite and galenite; at Paris, Maine.

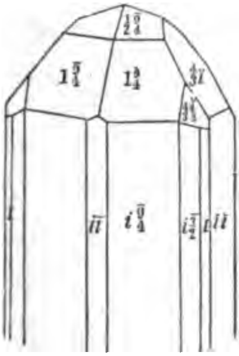
I ∧ *I* in arkansite=100°—100° 30′, 1-2̆ ∧ 1-2̆=101° 30′, and 135° 15′ to 135° 50′. In brookite from the Urals, *I* ∧ *I*=99° 50′, Kokscharof (Min. Russl.).

Named after the English crystallographer and mineralogist, H. J. Brooke.

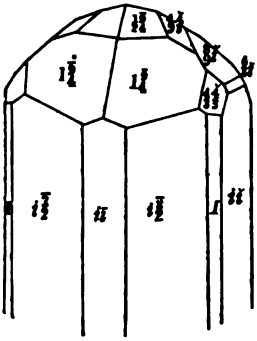
Artif.—Formed in crystals by the action of steam on chlorid or fluorid of titanium (Daubrée).

198A. EUMANITE. Eumanite occurs in minute crystals at the Chesterfield albite vein with rubellite and pyrochlore. Its chemical identity with brookite has not been ascertained. The annexed are figures, by the author, of two of the crystals.

170



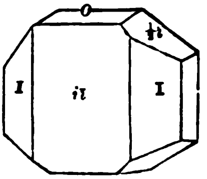
170A



Some of the observed angles are *I* ∧ *I*=100° to 101°, ⅓-ĭ ∧ ⅓-ĭ=77° 49′, *i*-⅗ ∧ *i*-⅗=140°—140° 15′, *i*-ĭ ∧ ⅓-⅓=128° 20′—128° 30′, *i*-ĭ ∧ *i*-⅗=108°. Am. J. Sci., II. xii. 211, 397, xiii. 117.

199. PYROLUSITE. Lapis manganensis pt. *Cæsalp.*, Metall., 1596. Brunsten = Magnesia pt. *Wall.*, 263, 1747; Manganese pt. *Fr. Trl.* Wall., i. 483, 1753. Manganaise grise pt. *Forst.*, Cat., 1772. Grau Braunstein pt. *Wern.*, Bergm. J., 386, 1789; id., *Hausm.*, Handb., 288, 1813. Gray Oxyd of Manganese pt.; Anhydrous Binoxyd of Manganese. Mangan Hyperoxyd *Leonh.*, Handb., 240, 1826. Pyrolusite, Prismatic Manganese-Ore, *Haid.*, Trans. R. Soc. Ed., 1827. Weichbraunstein. Weichmangan, *Germ.* Polianite (fr. Platten) *Breith.*, Pogg., lxi. 191, 1844=Lichtes Graumangan-Erz *id.*, Char., 231, 18.;.

171



Orthorhombic. *I* ∧ *I*=93° 40′, *O* ∧ 1-ĭ=142° 11′; *a* : *b* : *c*=0·776 : 1 : 1·066. Observed planes as in the figure. *O* ∧ ½-ĭ=160°, *I* ∧ *i*-ĭ=136° 50′ *I* ∧ *i*-ĭ=133° 10′, ½-ĭ ∧ ½-ĭ, top,=140°. Cleavage *I* and *i*-ĭ. Also columnar, often divergent; also granular massive, and frequently in reniform coats. Often soils.

H.=2—2·5. G.=4·82, Turner; Lustre metallic. Color iron-black, dark steel-gray, sometimes bluish. Streak black or bluish-black, sometimes submetallic. Opaque. Rather brittle.

Var.—1. *Ordinary.* In (*a*) crystals and (*b*) massive H.=2—2·5; G.=4·819, Turner; 4·84, fr. Andalusia. Angles as above given.

2. *Polianite.* H. above 5. G.=4·838—4·880, fr. Platten, Breith. Color light steel-gray. Angles $I \wedge I = 92° 52'$, $O \wedge 1\text{-}\bar{i} = 147° 43'$. It is a very pure pyrolusite. Pisani states that "polianite" from Cornwall has G.=4·826.

3. *Varvacite* is impure pyrolusite. See under MANGANITE.

Comp.—$\ddot{Mn}$=Manganese 63·3, oxygen 36·7=100. Analyses: 1, Arfvedson (Schw. J., xlii 210); 2, 3, Turner (Edinb. Trans., 1828); 4, Scheffler (Arch. Pharm., xxxv. 260); 5, Plattne (Pogg., lxi. 192):

	$\dot{Mn}\bar{Mn}$	O	$\dot{Ba}$	$\ddot{Si}$	$\dot{H}$
1. Undenaes?	83·56	14·58	——	——	1·86=100 Arfvedson.
2. Elgersberg	84·05	11·78	0·53	0·51	1·12=100 Turner.
3. Ilefeld	85·62	11·60	0·66	0·55	1·57=100 Turner.
4. Ilmenau	87·0	11·6	1·2	0·8	5·8, $\bar{Fe}$ 1·3, $\dot{Ca}$ 0·3, $\bar{Al}$ 0·3 S
5. Platten, *Pol.*	87·27	12·11	——	0·18	0·32, $\bar{Fe}$ $\bar{Al}$ 0·17=100 Platt.

In another specimen Scheffler found 9·7 per cent. of baryta. Specimens from near Battenberg Hesse, afforded Schwarzenberg and Engelhardt 96·45 to 100 per. cent. of pure superoxyd of manganese (Ann. Ch. Pharm., lxi. 262). V. Sevoz and J. Breuilhs find in crystallized ore from Huelv in Andalusia, $\ddot{Mn}$ 97·9, $\bar{Fe}$ 0·5, $\dot{H}$ 1·1=99·5; and in a massive, $\ddot{Mn}$ 96·9, $\bar{Fe}$ 1·0, $\dot{H}$ 0·5, $\ddot{Si}$ 1·0=99·4 (Bull. Soc. de l'Ind. Min., vi. 29, Rev. Geol. par Dolesse, 1860, 57).

Pyr., etc.—B.B. alone infusible; on charcoal loses oxygen. A manganese reaction with borax Affords chlorine with muriatic acid.

Obs.—This ore is extensively worked at Elgersberg near Ilmenau, and other places in Thuringia; at Vorderehrensdorf near Mährish-Trübau, in Moravia, which place annually affords man hundred tons of the ore; at Platten in Bohemia, and elsewhere. Fine crystals occur near Johanngeorgenstadt, and at Hirschberg in Westphalia, and crystalline plates at Matzka, Transylvania also found sparingly in Cornwall; in Timor; in Australia.

Occurs in the United States with psilomelane, abundantly in Vermont, at Brandon, Irasburg Bennington, Monkton, Chittenden, etc., both crystallized (f. 171) and massive; at Conway, Mass. in a vein of quartz; at Plainfield and West Stockbridge, Mass.; at Winchester, N. H.; at Salisbury and Kent, Conn., forming velvet-like coatings on limonite. In California, on Red island, ba of San Francisco. In New Brunswick, 7 m. fr. Bathurst, in fine cryst.; in Shepody Mtn. an elsewhere; near Upham in King's Co. In Nova Scotia, at Teny cape, cryst. and massive; als at Walton, abundant; near Kentville; Pictou; Amherst; Musquodobit.

Pyrolusite and manganite are the most important of the ores of manganese. Pyrolusite part with its oxygen at a red heat, and is extensively employed for discharging the brown and gree tints of glass. It hence received its name from πῦρ, *fire*, and λύω, *to wash;* and for the same reaso it is whimsically entitled by the French *le savon de verriers.* It is easily distinguished from psilomelane by its inferior hardness, and usually by being crystalline.

200. CREDNERITE. Kupferhaltiges Manganerz *Credner*, Jahrb. Min., 5, 1847. Mangankupferoxyd *Hausm.*, Handb., 1582, 1847. Mangankupfererz, Crednerit, *Ramm.*, Pogg., lxxii. 559.

Monoclinic. Foliated crystalline. Cleavage: basal very perfect; les distinct in two other directions obliquely inclined to one another.

H.=4·5. G.=4·9—5·1. Lustre metallic. Color iron-black to steel gray. Streak black, brownish.

Comp.—$\dot{Cu}^3\bar{Mn}^2$=Oxyd of copper 42·9, oxyd of manganese 57·1=100; but often mixed wit oxyd of manganese. Analyses: 1, Credner (Pogg., lxxiv. 555); 2–4, Rammelsberg (l. c., an Min. Ch., 178):

	$\dot{Mn}$	$\bar{Mn}$	$\dot{Cu}$	$\dot{Ba}$	$\dot{Ca}$	$\dot{H}$	O
1. Friederichsrode	22·96	31·25	42·13	0·52	0·63	0·25	——, gangue 0·63=98·37 Cred.
2. "	52·55	——	40·65	1·48	——	——	5·78=100·46 Ramm.
3. "	56·29	——	32·35	3·08	0·76	——	8·58=99·06 Ramm.
4. "	64·24	——	23·73	2·01	——	——	8·83=98·81 Ramm.

Pyr., etc.—B.B. fusible only on thin edges. With borax in O.F. gives a dark violet colo (manganese); with salt of phosphorus a green glass, which on cooling is blue, and in R.F. becomes red (copper). Soluble in muriatic acid with evolution of chlorine.

Obs.—From Friederichsrode, with volborthite, malachite, and manganese ores. Rammelsber observes that this ore is undoubtedly the source of the cupreous manganese, a secondary product

201 **PLATTNERITE.** Schwerbleierz *Breith.*, J. pr. Ch., x. 508, 1837. Plattnerit *Haid.*, Handb. 504, 1845. Braunbleioxyd *Hausm.*, Handb., 202, 1847.

In hexagonal prisms with replaced basal edges, planes *O*, *I*, 1, but pseudomorphous after pyromorphite (Greg); cleavage indistinct. G.=9·39—9·45. Lustre metallic adamantine. Color iron black. Streak brown. Opaque.

COMP.—According to Plattner (J. pr. Ch., x. 508), $\text{Pb}\,\text{O}^2$=Lead 86·6, oxygen 13·4=100. Probably from Leadhills, Scotland. A doubtful species. The specific gravity given is as high as that of the protoxyd of lead.

201A. VANADIC OCHRE.—(Vanadic acid *Teschemacher*, Am. J. Sci., II. xi. 233, 1851.) A yellow pulverulent substance, encrusting masses of native copper, along with quartz, at the Cliff mine, Lake Superior, according to J. E. Teschemacher (l. c.). The color before the blowpipe changed to black; also the powder, boiled in nitric acid, afforded an apple-green solution, from which, on partial evaporation, after standing some weeks, red crystalline globules formed on the surface, which, as they enlarged, fell to the bottom; by means of these crystalline masses the vanadates of silver and lead were made. As no metal was found in the first solution, the yellow mineral was inferred to be probably vanadic acid ($\text{V}\,\text{O}^3$).

B. HYDROUS OXYDS.

1. Oxygen ratio for $\dddot{\text{R}}$, $\dot{\text{H}}=1:\frac{1}{6}$.

202. TURGITE $\dddot{\text{Fe}}^2\,\dot{\text{H}}$

2. O. ratio for $\dddot{\text{R}}$, $\dot{\text{H}}=1:\frac{1}{3}$.

203. DIASPORE $\dddot{\text{Al}}\,\dot{\text{H}}$

204. GÖTHITE $\dddot{\text{Fe}}\,\dot{\text{H}}$

205. MANGANITE $\dddot{\text{Mn}}\,\dot{\text{H}}$

3. O. ratio for $\dddot{\text{R}}$, $\dot{\text{H}}=1:\frac{1}{2}$.

206. LIMONITE $\dddot{\text{Fe}}^2\,\dot{\text{H}}^3$

4. O. ratio for $\dddot{\text{R}}$, $\dot{\text{H}}=1:\frac{2}{3}$.

207. XANTHOSIDERITE $\dddot{\text{Fe}}\,\dot{\text{H}}^2$

208. BEAUXITE $(\dddot{\text{Al}}, \dddot{\text{Fe}})\,\dot{\text{H}}^2$

209. ELIASITE $(\dddot{\text{U}}, \dddot{\text{Fe}})\,\dot{\text{H}}^2$

5. O. ratio for $\dddot{\text{R}}$, $\dot{\text{H}}=1:1$.

210. BRUCITE $\dot{\text{Mg}}\,\dot{\text{H}}$ (or $\dot{\text{Mg}}^3\,\dot{\text{H}}^3$)

211. PYROCHROITE $\dot{\text{Mn}}\,\dot{\text{H}}$ (or $\dot{\text{Mn}}^3\,\dot{\text{H}}^3$)

212. GIBBSITE $\dddot{\text{Al}}\,\dot{\text{H}}^3$

213. LIMNITE $\dddot{\text{Fe}}\,\dot{\text{H}}^3$

214. HYDROTALCITE $(\frac{1}{3}\,\dddot{\text{Al}}+\frac{2}{3}\,\dot{\text{Mg}}^3)\,\dot{\text{H}}^3+2\,\dot{\text{H}}$

215. PYROAURITE $(\frac{1}{3}\,\dddot{\text{Fe}}+\frac{2}{3}\,\dot{\text{Mg}}^3)\,\dot{\text{H}}^3+2\,\dot{\text{H}}$

216. GUMMITE $(\dddot{\text{U}}, \dddot{\text{Fe}})\,\dot{\text{H}}^3$

Appendix.—217. PSILOMELANE. 218. WAD: A, BOG MANGANESE; B, ASBOLITE; C, LAMPADITE

202. **TURGITE.** Hematite pt. Red Ochre pt. Turgit *Herm.*, Bull. Soc. Nat. Moscow, i. 252, 1845. Hydrohæmatit *Breith.*, Handb., 846, 1847.

Compact fibrous and divergent, to massive; often botryoidal and stalactitic like limonite. Also earthy, as red ochre.

H.=5—6; 5·5, Brush. G.=3·56—3·74, from Ural, Herm.; 4·29—4·49, fr. Hof, Breith.; 4·681, fr. Horhausen, Bergemann; 4·14, fr. Salisbury, Brush. Lustre submetallic and somewhat satin-like in the direction of the fibrous structure; also dull earthy. Color reddish-black, to dark red; bright-red when earthy; botryoidal surface often lustrous, like much limonite. Streak red. Opaque.

Comp.—$\dddot{Fe}\dot{H}$=Sesquioxyd of iron 94·7, water 5·3=100. Analyses: 1, Hermann (l. c.); 2, F. W. Fritzsche (Breith. Handb., l. c.); 3, 4, Bergemann and Pfeifier (Ramm. Min. Ch., 989); 5, Rodman (Am. J. Sci., II. xliv. 219):

	$\dddot{Fe}$	$\dddot{Mn}$	$\dot{H}$	Insol.
1. Ural	85·34	——	5·31	7·50, $\dot{C}u$, $\dot{P}b$ 1·85=100 Herm.
2. Hof	93·49	——	4·61	1·91, $\dddot{S}$ 0·09=100·10 Fritzsche.
3. Horhausen	89·64	1·40	5·64	2·79=99·47 Bergemann.
4. "	92·93	——	5·31	0·93, $\dot{C}a$ 1·10=100·27 Pfeiffer.
5. Salisbury	$\frac{3}{4}$ 91·36	0·61	5·20, $\ddot{S}i$ 2·06, $\dddot{A}l$ 0·75, $\dddot{P}$, $\dddot{S}$, $\dot{C}o$ *tr.*=99·98 Rodman.	

In other determinations for No. 5, $\dot{H}$=5·02 and 5·09 p. c.; for specimens from Lehigh valley, Pa., 5·34 Rœpper.

Pyr., etc.—Heated in a closed tube, flies to pieces in a remarkable manner, and in this distinct from hematite and limonite; yields water. Otherwise like hematite.

Obs.—A very common ore of iron, often taken for limonite, with which it is frequently associated, and which it resembles, except in its superior hardness, streak, and decrepitation. It also looks very much like fibrous hematite. Hermann's mineral was from the Turginsk copper mine near Bosgolovsk, in the Ural, and from the Kolyvan district, in the Altai; that of Breithaupt, from near Hof in Bavaria, and Siegen in Prussia; found also with limonite at Dusseldorf in Prussia; at the Louisa mine, Horhausen. In the United States it occurs abundantly, and very large botryoidal massive, at the limonite ore bed of Salisbury, Ct., as detected by Prof. Brush (Am. J. Sci., II. xliv. 219), usually constituting the exterior layer of the limonite, sometimes an inch or more thick. The line of demarcation between it and the limonite is very distinct, and separation along it is often easy.

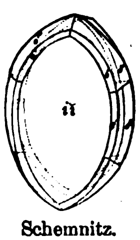
Artif.—E. Davies has shown that the ordinary precipitate of hydrate of iron, on being boiled in water, may have its water reduced to 3·52 p. c. (J. Ch. Soc., II. iv. 69); and Rodman (l. c.) has, by the same method, reduced it to 2 p. c., showing that the water varies with the temperature of origin; and, as Davies observes, no great heat is needed to make thus anhydrous hematite.

203. DIASPORE. Diaspore *Haüy*, Tr., iv. 1801. Blättricher Hydrargillit *Hausm.*, Handb., 442, 1813. Hydrate of alumine.

Orthorhombic. $I \wedge I = 93° \ 42\frac{3}{4}'$, $O \wedge 1\text{-}\bar{i} = 147° \ 12\frac{1}{2}'$; $a : b : c = 0·64425 : 1 : 1·067$. Observed planes: vertical, I, $i\text{-}\breve{i}$, $i\text{-}\bar{i}$, $i\text{-}\breve{\tfrac{3}{2}}$, $i\text{-}2$, $i\text{-}3$, $i\text{-}\breve{5}$, $i\text{-}\bar{\tfrac{5}{3}}$, $i\text{-}2$; domes, $1\text{-}\breve{i}$, $\tfrac{1}{2}\text{-}\breve{i}$, $\tfrac{3}{8}\text{-}\breve{i}$; octahedral, 1, $2\text{-}2$, $1\text{-}2$, $\tfrac{5}{2}\text{-}\overline{10}$, $\tfrac{9}{2}\text{-}\bar{\tfrac{9}{2}}$, $1\text{-}3$, $4\text{-}\breve{\tfrac{14}{3}}$.

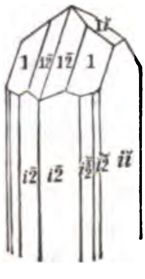
$O \wedge 1\text{-}\breve{i} = 148° \ 52\frac{1}{2}'$ $1\text{-}2 \wedge 1\text{-}2$, basal, $= 70° \ 52'$ $i\text{-}2 \wedge i\text{-}2 = 129° \ 47'$
$i\text{-}\breve{i} \wedge 1\text{-}\breve{i} = 121 \ 7\frac{1}{2}$ $i\text{-}\breve{i} \wedge 1\text{-}2 = 104 \ 14\frac{1}{2}$ $i\text{-}3 \wedge i\text{-}3 = 140 \ 50\frac{1}{2}$
$1\text{-}2 \wedge 1\text{-}2$, mac., $= 116 \ 40$ $i\text{-}\breve{i} \wedge 1 = 116 \ 54\frac{1}{2}$ $1\text{-}\breve{i} \wedge 1\text{-}\breve{i}$, top, $= 117 \ 45$
$1\text{-}2 \wedge 1\text{-}2$, brach., $= 151 \ 31$ $i\text{-}\breve{i} \wedge 1\text{-}3 = 120 \ 33\frac{1}{2}$ $i\text{-}\breve{i} \wedge i\text{-}2 = 115 \ 6\frac{1}{2}$

172



Schemnitz.

173



Crystals usually thin, flattened parallel to $i\text{-}\breve{i}$; sometimes acicular; commonly implanted. Cleavage: $i\text{-}\breve{i}$ eminent; $i\text{-}2$ less perfect. Occurs foliated massive and in thin scales; sometimes stalactitic.

H.=6·5—7. G.=3·3—3·5; 3·4324, Haüy; 3·452, Dufrenoy; 3·30—3·34, fr. Schemnitz. Lustre brilliant and pearly on cleavage-face; elsewhere vitreous. Color whitish, grayish-white, greenish-gray, hair-brown, yellowish, to colorless; sometimes violet-blue in one direction, reddish plumb-blue in another, and pale asparagus-green in a third. When thin, translucent—subtranslucent. Very brittle.

Comp.—$\ddot{\bar{\text{Al}}}\,\dot{\text{H}}$=85·1 alumina, 14·9 water=100. Analyses: 1, 2, Dufrénoy (Ann. d. M., III. x. 577, 1836); 3, Hess (Pogg., xviii. 255); 4, Damour (C. R., xxi. 322); 5, Löwe (Pogg., lxi. 307); 6, 7, J. L. Smith (Am. J. Sci., II. xi. 58); 8, Damour (L'Institut, 1853, 78); 9, C. T. Jackson (Am. J. Sci., II. xlii. 108); 10, S. B. Sharples (Priv. contrib.):

	$\ddot{\bar{\text{Al}}}$	$\dot{\text{H}}$	$\dot{\text{Fe}}$	$\ddot{\text{Si}}$
1. Siberia	74·66	14·58	$\ddot{\bar{\text{Fe}}}$ 4·51	2·90, $\dot{\text{Ca}}$ and $\dot{\text{Mg}}$ 1·64=98·29 Duf.
2. *Id.*	78·93	15·13	" 0·52	1·39, $\dot{\text{Ca}}$ 1·98=97·95 Duf.
3. Miask	85·44	14·56	——	——=100 Hess.
4. Siberia	79·91	14·90	——	——. unattacked 5·80=100·61 Dam.
5. Schemnitz	85·13	15·00	——	——=100·13 Löwe. G.=3·303.
6. Gumuch-dagh	83·12	14·28	0·66	0·82, $\dot{\text{Ca}}$, $\dot{\text{Mg}}$ *tr.*=98·88 S. · G.=3·45.
7. Naxos	82·94	14·81	1·06	0·26, $\dot{\text{Ca}}$ 0·35=99·42 S.
8. Bahia, S. A.	84·02	14·59	$\ddot{\bar{\text{Fe}}}$ 0·68	0·43=99·72 Damour. G.=3·464.
9. Chester, Mass.	83·0	14·8	" 3·0	——=100·8 Jackson. G.=3·39.
10. Newlin, Pa.	80·95	14·84	" 3·12	1·53=100·44 Sharples.

Anal. 2 was made on the mineral of anal. 1 after removing the iron by sulphuric acid.

Pyr., etc.—In the closed tube decrepitates strongly, separating into pearly white scales, and at a high temperature yields water. The variety from Schemnitz does not decrepitate. Infusible; with cobalt solution gives a deep blue color. Some varieties react for iron with the fluxes. Not attacked by acids, but after ignition becomes soluble in sulphuric acid.

Obs.—Commonly found with corundum or emery in dolomite, chlorite schist, and other crystalline rocks, in nests, or as implanted crystals on corundum and other minerals. Occurs near Kossoibrod, district of Katharinenburg in the Ural, in granular limestone with emery; at Schemnitz in veins between dolomite and limestone; at Broddbo near Fahlun; with corundum in dolomite in Campo Longo, near Dazio Grande, in the Canton of Tessin in Switzerland; at Gumuch-dagh and Manser, Asia Minor, and the Grecian islands Naxos, Samos, and Nicaria, with emery, as detected by J. L. Smith; with topaz and margarodite at Trumbull, Ct., but rare; with corundum and margarite at Newlin, Chester Co., Pa.; at the emery mines of Chester, Mass., in large plates and crystals. Exists also as an impurity in some zeolites (Scheerer, Pogg., cviii. 430).

The above angles are from Kokscharof (Min. Russl., iii. 169). Marignac obtained by measurement 1-ī ∧ 1-ī=117° 46′, *i*-2 ∧ *i*-2=130°, 1-2 ∧ 1-2=151° 36′ and 116° 38′; Phillips, *i*-2 ∧ *i*-2=129° 48′; Kenngott, *i*-2 ∧ *i*-2=129° 32′; Haidinger, *i*-2 ∧ *i*-2=129° 54′, 1-2 ∧ 1-2=151° 54′.

Diaspore was named by Haüy from διασπείρειν, to scatter, alluding to the usual decrepitation before the blowpipe. Le Lièvre, as Haüy states, first made known the species, having found it at a mineral-dealer's in Paris, and given it to Vauquelin for analysis. Its original locality is not known, but is supposed to have been the Urals. Vauquelin obtained alumina 80, oxyd of iron 3, water 16 to 18=100 (Haüy, Tr., l. c., and Ann. Ch., xlii. 113, 1802).

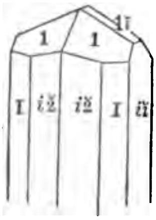
204. GÖTHITE. Dünnschuppiger, linsenformiger, rubinrother, etc. Eisenglimmer (fr. Siegen), *Becher*, Min. Beschr. O.-Nass. Lande, 401, 1789. Kryst. fasriger Brauneisenstein *Mohs*, Null Min. Kab., iii. 403, 1804. Göthit (fr. Eiserfeld near Siegen) *J. G. Lenz*, Tabell. ges. Mineralreich, 46. Jena, 1806, fol., Moll's Efem., iv. 505, 1808, Ullmann's Ueb., 304, 1814. Pyrrhosiderit [not Pyrosiderit] *Ullmann*, Hausm. Handb., 268, 1813, Ullmann's Ueb., 144, 299, 304, 1814 [but given many years before to his class]. Schuppig-fasriger Brauneisenstein (fr. Hollerter Zug)=Lepidokrokit *Ullmann*, Hausm. ib., 269, 1813, Ullmann's Ueb., 148, 316, 1814. Haarförmiger Brauneisenstein *Hausm.* ib., 270, 1813=Nadeleisenerz *Breith.*, Char., 1823. Brown Iron-stone pt., Brown Iron-ore pt., Brown Hematite pt., of *Jameson*, *Phillips*, etc. Sammteisenerz, Sammetblende pt.=Przibramit in Glock. Handb., 549, 1831.

Chileit *Breith.*, J. pr. Ch., xix. 103, 1840. Onegit (fr. L. Onega) *Andre* (of Brünn), Tageblatt, No. 18, 1802, Moll's Efem., ii. 109, 112, 1806=Ore of Titanium *various auth.* for 25 years=Göthite *later auth.*

Orthorhombic. *I* ∧ *I*=94° 52′, B.& M. (95° 14′, Levy; 96°, Yorke); *O* ∧ 1-ĭ =146° 33′; *a* : *b* : *c*=0·66 : 1 : 1·089. Observed planes: vertical, *I*, *i*-ĭ, *i*-2̆, *i*-2̆; domes, 1-ĭ; octahedral, 1, 1-2̆, 3-3̆, $\frac{5}{2}$-$\breve{\frac{5}{2}}$.

O ∧ 3-3̆=115° 44′	*O* ∧ 1-ĭ=148° 48′	1-2̆ ∧ 1-2̆, mac.,=151° 35′
O ∧ 1-2̆=143 55	*O* ∧ $\frac{5}{2}$-$\breve{\frac{5}{2}}$=121 8	*i*-2 ∧ *i*-2 =130 40
O ∧ 1 =138 6	1 ∧ 1, brach.,=121 4	*i*-2̆ ∧ *i*-2̆, ov. *i*-ĭ,=122 52

174



In prisms longitudinally striated, and often flattened int scales or tables parallel to the shorter diagonal. Cleavage brachydiagonal, very perfect. Also fibrous; foliated or i scales; massive; reniform; stalactitic.

H.=5—5·5. G.=4·0—4·4; 4·37, crystals from Lostwithie in Cornwall, Yorke. Lustre imperfect adamantine. Colo yellowish, reddish, and blackish-brown. Often blood-red b transmitted light. Streak brownish-yellow—ochre-yellow.

Var.—1. In thin scale-like or tabular crystals, usually attached by one edge. Such is the original *Göthite* (*Pyrrhosiderite* or *Rubinglimmer*) of Siegen.

2. In acicular or capillary (not flexible) crystals, or slender prisms. often radiately grouped the *Needle-Ironstone* (*Nadeleisenstein*). It passes into (*b*) a variety with a velvety surface: th *Przibramite* (*Sammetblende*) of Przibram is of this kind.

(*c*) *Onegite* is acicular göthite penetrating quartz, like rutile, from an island in L. Onega, Russi where it was found in loose stones, in 1800, by Mr. Armstrong, an Englishman. It has als been called *Fullonite*, after Mr. Fullon, a brother-in-law of Mr. A., who also possessed specimens.

3. Columnar or fibrous.

4. Scaly-fibrous, or feathery columnar, the lines consisting of more or less distinct scales, some what like plumose mica; the *Lepidocrocite* (fr. λεπίς, *scale*, and κρόκις, *fiber*).

5. According to Hausmann, compact massive, with a flat conchoidal fracture, liver-brown t blackish-brown and rust-brown color; and sometimes reniform or stalactitic.

6. Disseminated microscopic crystals of göthite are one source of the frequent *aventurine* an opalescent character of specimens of different feldspars (see p.

Comp.—$\bar{\mathrm{F}}\mathrm{e}\ \dot{\mathrm{H}}$=Sesquioxyd of iron 89·9, water 10·1=100. Analyses: 1–3, v. Kobell (J. pr. Ch. i. 181, 319); 4, Brandes (Nögg. Geb. in Rheinl. Westph., i. 358); 5, 6, v. Kobell (l. c.); 7, Plattne (J. pr. Ch., xix. 108); 8, Yorke (Phil. Mag., III. xxvii. 264):

	$\bar{\mathrm{F}}\mathrm{e}$	$\ddot{\bar{\mathrm{M}}}\mathrm{n}$	$\dot{\mathrm{H}}$	$\ddot{\mathrm{S}}\mathrm{i}$
1. Eiserfeld, *Göthite*	86·35	0·51	11·38	0·85, $\dot{\mathrm{C}}\mathrm{u}$ 0·90=99·99 Kobell.
2. H. Zug, *Lepid.*	90·53	——	9·47	——=100 Kobell.
3. " "	85·65	2 50	11·50	0·35=100 Kobell.
4. " "	88·00	0 50	10·75	0·50=99·75 Brandes.
5. Amberg, *mass.*	86·24	——	10·68	2·00, $\dot{\mathrm{P}}\mathrm{b}$ 1·08=100 Kobell.
6. Maryland, "	86·32	——	10·80	2·88=100 Kobell.
7. Chili, *Chileite*	83·5	——	10·3	4·3, $\dot{\mathrm{C}}\mathrm{u}$ 1·9=100 Plattner.
8. Lostwithiel, *cryst.*	89·55	0·16	10·07	0·28=100·06 Yorke.

Göthite from near Marquette gave G. J. Brush 10·47 $\dot{\mathrm{H}}$ (Am. J. Sci., II. xxxvii. 271). Th Amberg mineral (anal. 5) has been called *stilpnosiderite;* but Ullmann, who gave this name, foun for his mineral the composition of limonite (q. v.)

Pyr., etc.—In the closed tube gives off water and is converted into red sesquioxyd of iron With the fluxes like hematite; most varieties give a manganese reaction, and some, treated in th forceps in O.F., after moistening in sulphuric acid, impart a bluish-green color to the flame (phosphoric acid). Soluble in muriatic acid.

Obs.—Found with the other oxyds of iron, especially hematite or limonite. Occurs at Eiserfel near Siegen, in Nassau, in lamelliform and foliated crystallizations of a hyacinth-red color, wit limonite; at Zwickau in Saxony; Oberkirchen in Westerwald, etc.; near Clifton in Gloucester shire, near Bristol, England; in Cornwall, near Botallack and Lostwithiel, some of the crystals 1 —2 in. long and $\frac{1}{8}$ in. across; in Somersetshire, at the Providence iron mines.

In the U. States, at the Jackson Iron Mtn., near Marquette, L. Superior, in lamelliform crystals in Penn., near Easton, the var. lepidocrocite with limonite; in California, at Burns Creek, Maripos Co., in quartz; in Oregon, 16 m. from Portland.

Named *Göthite* after the poet philosopher Göthe; and *Pyrrhosiderite* from πυῤῥός, *fire-red*, an σίδηρος, *iron*. The name *Onegite* has priority, but it was given without a proper description, and fo 25 years the nature of the mineral was unknown.

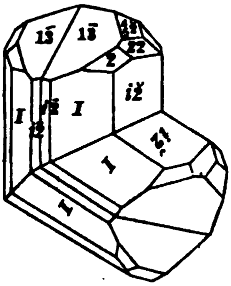
205. MANGANITE. Manganaise cristallisé *de Lisle*, Crist., 330, 1772, iii. 101, 1783. Manganèse oxydé metalloïde *H.*, Tr., iv. 1801 (with figs.). Grau-Braunsteinerz pt. *Wern.*, 1789, *Karsten*, Tab., 1800. Graumanganerz pt. *Karsten*, Tab., 1808. Grau-Braunstein pt. *Hausm.*

Handb., 288, 1813, 390, 1847. Gray Oxyd of Manganese pt. Prismatoidisches Mangan-Erz *Mohs*, Grundr., 488, 1824. Manganite *Haid.*, Trans. R. Soc. Edinb., 1827. Acerdèse *Beud.*, Tr., ii. 678, 1832. Newkirkite *Thom.*, Min., i. 509, 1836.

Orthorhombic. *I* ∧ *I*=99° 40′, *O* ∧ 1-ī=147° 9½′; *a* : *b* : *c*=0·6455 : 1 : 1·185. Hemihedral, in plane $\frac{6}{5}$-2̆. Observed planes, *O* (uncommon); vertical, *I*, *i*-ĭ, *i*-ī, *i*-2̆, *i*-$\frac{5}{2}$, *i*-3̆, *i*-$\frac{4}{3}$, *i*-2̄; domes, 1-ĭ, 1-ī, 2-ī; octahedral, 1, 2, 1-2̆; 1-3̄, 2-2̄, $\frac{6}{5}$-2̆.

O ∧ 2-ī=127° 46′ 1 ∧ 1, mac.,=130° 49′
O ∧ 1-3̄=146 9 1 ∧ 1, brach.,=120 54
O ∧ 1-2̆=144 59 1-3̄ ∧ 1-3̄, mac.,=162 39
O ∧ 1=139 49 *i*-2̆ ∧ *i*-2̆, mac.,=134 14
O ∧ 2-2̄=128 18 *i*-2̆ ∧ *i*-2̆, br.,=118 48
O ∧ 1-ĭ=151 25 *i*-3̆ ∧ *i*-3̆, br.,=136 54

175.



Twins: composition-face 1-ĭ. Cleavage: *i*-ĭ very perfect, *I* perfect. Crystals longitudinally striated, and often grouped in bundles. Also columnar; seldom granular; stalactitic.

H.=4. G.=4·2—4·4. Lustre submetallic. Color dark steel-gray—iron-black. Streak reddish-brown, sometimes nearly black. Opaque; minute splinters, sometimes brown by transmitted light. Fracture uneven.

Comp.—M̶n Ḣ=Sesquioxyd of manganese 89·8 (=Mn 62·5, O 27·3), water 10·2=100. Analyses: 1, Arfvedson (Schw. J., xxvi. 262); 2, Gmelin (ib., xlii. 208); 3, 4, Turner (Edinb. Trans., 1828); 5, How (Phil. Mag., IV. xxxi. 166):

	Mn	O	Ḣ
1. West Gothland	89·92		10·08 Arfvedson.
2. Ilefeld	62·86	27·64	9·50 Gmelin.
3. "	62·68	27·22	[10 10] Turner.
4. "	62·77	27·13	[10·10] Turner.
5. Cheverie	86·81		10·00, gangue 1·14, F̶e, Ḃa, loss 2·05 How.

Pyr., etc.—In the closed tube yields water; otherwise like braunite.

Obs.—Occurs in veins traversing porphyry, associated with calcite and barite, at Ilefeld in the Harz; Ilmenau and Oehrenstock in Thuringia; Undenaes in Sweden; Christiansand in Norway; Cornwall, at various places, occurring crystallized at Botallack mine, St. Just; Callington and at the Royal iron mines; also in Cumberland, Devonshire, Somerset; Aberdeenshire, Scotland: near Ross and elsewhere in Ireland.

In Nova Scotia, at Cheverie, Hants Co., and Walton; also 10 m. W. of Walton, where it forms a bed of conglomerate, along with quartz pebbles. In New Brunswick, at Shepody mountain, Albert Co.; Tattagouche R., Gloucester Co.; Upham, King's Co.; and Dalhousie, Restigouche Co.

Newkirkite of Thomson, from Newkirchen in Alsace, according to Lettsom, is nothing but manganite.

Alt.—By loss of water changes to pyrolusite, hausmannite, or braunite. *Varvacite* of R. Phillips, from Warwickshire, is considered an altered manganite, consisting largely of pyrolusite. Breithaupt observed a crystal with nearly the angles of manganite, giving *I* ∧ *I*=80° 24′ and 99° 36′. H.=2·5—3. G.=4·283—4·623.

205. LIMONITE. Σχιστὸς λίθος (fr. Iberia) *Diosc.* Schistus, Hæmatites, *Plin.*, xxxvi. 37 38. Hæmatites pt., Blodsten pt. [rest *red* hematite], *Wall.*, 260, 1747, *Cronst.*, 178, 1758 Hématite pt., *Fr. Trl.* Wall., 469, 1753. Braun-Eisenstein (incl. Eisenrahm, Brauner Glaskopf, *Wern.*, Bergm. J., 383, 1789. Brauneisenstein pt. [rest Göthite] *Hausm.*, Handb., 268, 1813. Braun-Eisenstein, Stilpnosiderit, *Ullmann*, Ueb., 146, 305, 148, 313, 1814. Brown Iron Stone pt., Brown Hematite, Brown Ochre, *Jameson*, Min., 253, 261, 1816. Limonite pt. [rest Göthite, Bog Ore] *Beud.*, Tr., ii. 702, 1832 [not Limonit *Hausm.*, 1813 (=Bog Ore only)].

Ὤχρα [yellow and brown] *Theophr.* ? Sil *Plin.*, xxxiii. 56. Ochra nativa, *Germ.* Berggeel, *Agric.*, 466, 1546. O. nativa, Sil, Berggelb, Ockergelb, *Gesner*, Foss., 8, 1565. Ochriger Brauneisenstein *Wern.*, *Karst.* Brown Ochre pt., Yellow Ochre pt.

Minera Ferri subaquosa, Min. F. lacustris, v. palustris, Sjoemalm, Myrmalm, *Wall.*, 263, 1747. Mine de fer limoneuse *Fr. Trl.* Wall., 1753. Ferrum limosum, etc., *Wall.*, ii. 256, 1775. Raseneisenstein (incl. Morasterz, Sumpferz, Wiesenerz) *Wern.*, Bergm. J., 383, 1789. Marsh Ore, Bog Ore, Meadow Ore pt., *Kirwan*, *Jameson*, etc. Limonit (=Raseneisenstein or Bog Ore) *Hausm.*, Handb., 283, 1813 [not Limonite of *Beud.*, wh. incl. *all* hydrous ox. of iron]. Limnit *Glock.*, Syn., 62, 1847.

Usually in stalactitic and botryoidal or mammillary forms, having a fibrous or subfibrous structure; also concretionary, massive; and occasionally earthy.

H.=5–5·5. G.=3·6–4. Lustre silky, often submetallic; sometimes dull and earthy. Color of surface of fracture various shades of brown, commonly dark, and none bright; sometimes with a nearly black varnish-like exterior; when earthy, brownish-yellow, ochre-yellow. Streak yellowish-brown.

Var.—(1) *Compact.* Submetallic to silky in lustre; often stalactitic, botryoidal, etc. (2) *Ochreous* or earthy, brownish-yellow to ochre-yellow, often impure from the presence of clay, sand, etc. (3) *Bog ore.* The ore from marshy places, generally loose or porous in texture, often petrifying leaves, wood, nuts, etc. (4) *Brown clay-ironstone*, in compact masses, often in concretionary nodules, having a brownish-yellow streak, and thus distinguishable from the clay-ironstone of the species hematite and siderite; it is sometimes (*a*) *pisolitic*, or an aggregation of concretions of the size of small peas (Bohnerz *Germ.*); or (*b*) *oolitic.*

Only part of stalactitic limonite, brown or yellow ochre, bog ore, and clay-ironstone belong here, the water present sometimes much exceeding that of limonite, so as to make them of the species *xanthosiderite* or *limnite*. But since in the determinations of the water analysts have not always separately estimated the organic ingredients, it is at present impossible to refer the analyses in all cases to their true places.

Kaliphite of Ivanoff is a mixture of limonite, oxyd of manganese, silicate of zinc and lime, from Hungary.

Comp.—$\bar{\text{Fe}}^2\dot{\text{H}}^3$=Sesquioxyd of iron 85·6, water 14·4=100. In the bog ores and ochres, sand, clay, phosphates, oxyds of manganese, and humic or other acids of organic origin are very common impurities.

Analyses: 1, Ullmann (Ueb., 314, 1814); 2, 3, v. Kobell (J. pr. Ch., i. 181, 319); 4, Beck (Min. N. Y., 33); 5, Amelung (Ramm. Min. Ch., 149); 6, Schönberg (J. pr. Ch., xix., 107); 7, C. Bergemann (Verh. nat. Ver. Bonn, xvi. 127); 8, Litton (Rep. G. Mo., 1855); 9, C. S. Rodman (priv. contrib.); 10–13, Schenck (Ann. Ch. Pharm., xc. 123):

	$\bar{\text{Fe}}$	$\bar{\text{Mn}}$	$\dot{\text{H}}$	$\ddot{\text{Si}}$	$\bar{\text{P}}$	
1. Westerwald, *Stilpn.*	80·50	*tr.*	16·00	2·25	——	=98·75 Ullmann.
2. Perm, *fibrous*	83·38	——	15·01	1·61	——	=100 Kob.
3. Siegen, *pitchy*	82·87	*tr.*	13·46	0·67	3·00,	$\dot{\text{C}}$u, $\dot{\text{C}}$a *tr.*=100 Kob.
4. Amenia, N. Y., *stalact. lim.*	82·90	*tr.*	13·50	3·60[a]	——	=100 Beck.
5. Rubelund, Harz	86·77	——	13·23	——	——	=100 Amelung.
6. Horhausen	82·27	——	13·26	4·50	——	=100·03 Schönberg.
7. " G.=3·908	82·63	2·35	12·33	2·27	——	=99·58 Bergemann.
8. Buffalo, Mo.	84·80	——	11·62	2·88	——,	$\ddot{\bar{\text{A}}}$l 0·64, S 0·12=100·06 Litton
9. Salisbury, Ct.	81·13	0·60	13·81	3·68	*tr.*,	$\ddot{\bar{\text{A}}}$l ·93, $\dot{\text{C}}$o, $\dot{\text{C}}$a, $\bar{\text{S}}$ *tr.*=100·15 R

[a] With alumina.

	F̶e	Ḣ	S̈i	A̶l	
10. Dist. of Kandern, *pisolitic*	71·71	8·23	13·00	6·71,	Ċa 0·60=100·25 Schenck.
11. " "	75·51	12·99	5·80	6·86=101·16 Schenck.	
12. " "	68·70	11·53	11·80	7·47=99·50 Schenck.	
13. " "	70·46	11·12	13·04	5·88=100·50 Schenck.	

A concretionary ore from Staatswald Hardt, Wurtemberg, afforded A. Müller (J. pr. Ch., lvii 124) 0·05 p. c. of chromic acid, and 0·03 of vanadic; and traces of titanium, sulphur, and arsenic have been found in others.

The organic acids sometimes amount to 12—15 p. c., as in the following: 1, T. S. Hunt (Rep. G. Can., 513. 1863); 2, 3, Wiegmann (Preischr. Torfes, 75, 76, 1837):

	F̶e	Ṁn	Ḣ	S̈i	P̶	Humic acid.
1. Pointe du Lac, *Ochre*	59·10	——	21·14	1·15	——	15·01, sand 3·60=100 Hunt.
2. Braunschweig, *Bog ore*	Ḟe 66	——	13	——	7	14=100 Wiegmann.
3. " "	" 68·5	1·5	10·5	——	7·0	12·5=100 Wiegmann.

The ochre analyzed by Hunt was from a bed in the soil having an extent of many acres; the color light brownish-yellow. It may be a mixture of limonite and a hydrous species containing oxyd of iron combined with organic acids. Hunt suggests that it should be made a distinct species; and when the exact nature of the organic acids is determined, this may properly be done.

In other analyses of bog ores from Vaudreuil and other places in Canada, Hunt found 16·50 to 23·65 p. c. of water and organic acids, but the proportion of the two was not determined. For other so-called limonite, bog ores, and ochres, see XANTHOSIDERITE and LIMNITE.

Pyr., etc.—Like göthite. Some varieties give a skeleton of silica when fused with salt of phosphorus, and leave a siliceous residue when attacked by acids.

Obs.—Limonite occurs in secondary or more recent deposits, in beds associated at times with barite, siderite, calcite, aragonite, and quartz; and often with ores of manganese; also as a modern marsh deposit.

It is in all cases a result of the alteration of other ores, through exposure to moisture, air, and carbonic or organic acids; and is derived largely from the change of pyrite, siderite, magnetite, and various mineral species (such as mica, augite, hornblende, etc.), which contain iron in the protoxyd state. It consequently occupies, as a bog ore, marshy places, over most countries of the globe, into which it has been borne by streamlets from the hills around; and in the more compact form it occurs in stalactites as well as in tuberose and other concretionary forms, frequently making beds in the rocks which contain the minerals that have been altered into it. In moist places where a sluggish streamlet flows into a marsh or pool, a rust-yellow or brownish-yellow deposit often covers the bottom, and an iridescent film the surface of the water: the deposit is a growing bed of bog ore. The iron is transported in solution as a protoxyd carbonate in carbonated waters, a sulphate, or as a salt of an organic acid. The limonite beds of the Green Mountain region were shown by Percival (Rep. G. Conn., 132, Am. J. Sci., II. ii. 268) to be altered beds of pyritiferous micaceous and argillaceous schist; and the same is held by Lesley as true also of the other beds of the Atlantic border, from New England and New York, through Pennsylvania (Mt. Alto region and others), to Tennessee and Alabama (Proc. Am. Ac. Philad., 463, 1854, Am. J. Sci., II. xl. 119).

Abundant in the United States. A few only of its localities are here mentioned; reference may be made to the various geological reports for complete lists. Extensive beds exist at Salisbury and Kent, Conn., also in the neighboring towns of Beekman, Fishkill, Dover, and Amenia, N. Y., and in a similar situation north; at Richmond and Lenox, Mass.; at Hinsdale as the cement in a conglomerate quartz rock; in Vermont, at Bennington, Monkton, Pittsford, Putney, and Ripton.

Limonite is one of the most important ores of iron. The pig iron, from the purer varieties, obtained by smelting with charcoal, is of superior quality. That yielded by bog ore is what is termed *cold short*, owing to the phosphorus present, and cannot therefore be employed in the manufacture of wire, or even of sheet iron, but is valuable for casting. The hard and compact nodular varieties are employed in polishing metallic buttons, etc.

Named *Limonite* from λειμών, *meadow*. Ullmann's name, *Stilpnosiderite*, from στιλπνός, *shining*, has priority; but the ore is characteristically not a shining ore, although sometimes with a lustrous, varnish-like exterior. The name *limonite* was first appropriated especially to the *bog* ores by Hausmann in 1813. But most bog ores are of the above species, and Beudant, recognizing this, in 1832 used limonite for the *bog* as well as other limonite.

Alt.—By deoxydation through organic matter, if carbonic acid is present, may form siderite (Ḟe C̈). By losing water becomes hematite (F̶e). Hematite occurs as pseudomorphs after limonite. This species forms numerous pseudomorphs of other species.

207. XANTHOSIDERITE. Gelbeisenstein (fr. Goslar) *Hausm.*, Handb., 279, 1813. Xa thosiderit (fr. Ilmenau) *E. E. Schmid*, Pogg., lxxxiv. 495, 1851. Yellow Ochre pt. B Ore pt.

In fine needles or fibres, stellate and concentric. Also as an ochre.

H.=2·5 when in needles. Lustre silky or greasy; also pitch-like; al earthy. Color in needles golden-yellowish, brown to brownish-red; as a ochre, yellow of different shades, more or less brown, sometimes reddis Streak ochre-yellow.

Comp.—$\dddot{\overline{\mathrm{F}}}\mathrm{e}\,\dot{\mathrm{H}}^3$=Sesquioxyd of iron 81·6, water 18·4=100. Analyses: 1, Hausmann (Gil Ann., v. 21, 1811); 2, 3, Schmid (l. c.); 4, Murray (Ramm. Min. Ch., 150); 5, Haughton (Ph Mag., IV. xxxii. 220):

	$\dddot{\overline{\mathrm{F}}}\mathrm{e}$	$\dddot{\overline{\mathrm{M}}}\mathrm{n}$	$\dddot{\overline{\mathrm{A}}}\mathrm{l}$	$\dot{\mathrm{H}}$	$\ddot{\mathrm{S}}\mathrm{i}$
1. Goslar, Harz	69·00	——	2·50	16·39	4·00, $\dot{\mathrm{F}}\mathrm{e}\,\dddot{\mathrm{S}}$ 8·05=99·84 Haus
2. Ilmenau, *yellow* [a]	74·96	1·82	1·32	15·67	2·51=96·28 Schmid.
3. " *brown* [a]	75·00	1·33	1·51	14·10	5·02=96·96 Schmid.
4. Hüttenrode, *brown*	81·41	——	——	17·96	0·17, $\ddot{\mathrm{C}}$ 0·46=100 Murray.
5. Kilbride. Ireland.	77·15	——	*tr.*	20·43	0·30, $\dddot{\overline{\mathrm{P}}}$ 1·60=99·48 Haughto

[a] Loss due to undetermined lime, magnesia, alkalies, antimony, lead, and bismuth, present as impurities.

Haughton found no organic matter, protoxyd of iron, or sulphur in his analyses. Half th water in Hausmann's analysis must have belonged to the sulphate of iron, or else the miner analyzed by him could not have corresponded to the formula given.

Pyr., etc.—Like those of limonite.

Obs.—Associated with manganese ores at Ilmenau, in silky needles, etc.; as an ochre nea Goslar, Bruchberg, Elbingerode in the Harz; as a pitchy ore at Kilbride, Wicklow Co., Irelan along with limonite and psilomelane.

Several analyses of bog ore apparently accord with those of xanthosiderite. But the amou of water given actually includes whatever was driven off on ignition, and no examination wa made for organic acids. See under LIMONITE.

Artif.—The hydrate, $\dddot{\overline{\mathrm{F}}}\mathrm{e}\,\dot{\mathrm{H}}^3$, is formed when oxyd of iron is precipitated from hot solutions o its salts; and, according to Gmelin, also from cold solutions.

208. BEAUXITE. Alumine hydratée de Beaux *Berthier*, Ann. d. M., vi. 531, 1821. Beauxit *Dufr.*, Min. (ii. 347), iii. 799, 1847. Bauxite *Deville*, Ann. Ch. Phys., III. lxi. 309, 1861. Woche nite *A. Flechner*, ZS. G., xviii. 181, 1866, Jahrb. G. Reichs., 1866.

In round concretionary disseminated grains. Also massive oölitic; an earthy, clay-like.

G.=2·551, fr. Wochein, v. Lill. Color whitish, grayish, to ochre-yellow brown, and red.

Var.—1. In concretionary grains, or oolitic; *beauxite.* 2. Clay-like, *wocheinite*; the purer kin grayish, clay-like, containing very little oxyd of iron; also red from the oxyd of iron present.

Comp.—($\dddot{\overline{\mathrm{A}}}\mathrm{l}$, $\dddot{\overline{\mathrm{F}}}\mathrm{e}$) $\dot{\mathrm{H}}^3$; with $\dddot{\overline{\mathrm{A}}}\mathrm{l}$: $\dddot{\overline{\mathrm{F}}}\mathrm{e}$=3 : 1,=Alumina 50·4, sesquioxyd of iron 26·1, water 23· =100; without $\dddot{\overline{\mathrm{F}}}\mathrm{e}$,=$\dddot{\overline{\mathrm{A}}}\mathrm{l}$ 74·1, water 25·9=100. Berthier considered the iron an impurit Analyses: 1, Berthier (l. c.); 2, Deville (Ann. Ch. Phys., III. lxi. 309); 3, Berthier (l. c., v. 13 1820); 4, v. Lill (Jahrb. G. Reichs, Verh. 1866, 11):

	$\ddot{\mathrm{S}}\mathrm{i}$	$\dddot{\overline{\mathrm{A}}}\mathrm{l}$	$\dddot{\overline{\mathrm{F}}}\mathrm{e}$	$\dot{\mathrm{H}}$	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\mathrm{M}}\mathrm{g}$
1. Beaux	——	52·0	27·6	20·4	——	——=100 Berthier.
2. "	——	55·4	44·6		——	——=100 Deville.
3. Senegal	2·0	40·0	33·60	24·7	——	——, $\dddot{\overline{\mathrm{C}}}\mathrm{r}$ *tr.*=100·3 Berthier.
4. Wochein	6·29	64·24	2·40	25·74	0·85	0·38, $\dddot{\mathrm{S}}$ 0·20, $\dddot{\overline{\mathrm{P}}}$ 0·46, $\dot{\mathrm{K}}$, $\dot{\mathrm{N}}\mathrm{a}$, $\dot{\mathrm{L}}\mathrm{i}$ *tr.*=100·56 Lil

In the last, which has been called *wocheinite* (although at first referred to beauxite), if the 6·2 $\ddot{\mathrm{S}}\mathrm{i}$ are present in the condition of kaolinite, and this and the other ingredients are rejected a impurities, the remainder corresponds approximately to $\dddot{\overline{\mathrm{A}}}\mathrm{l}\,\dot{\mathrm{H}}^3$. But if the $\ddot{\mathrm{S}}\mathrm{i}$ is in the conditio of allophane, it will require 13 p. c. of the water, and the wocheinite remaining would be essen tially identical with *diaspore.* A red variety from Wochein contained 8·8 $\dddot{\overline{\mathrm{F}}}\mathrm{e}$ and 58·02 $\dddot{\overline{\mathrm{A}}}\mathrm{l}$.

The following are analyses by Deville (l. c.) of what he regards as impure varieties of beauxite all but one of which contain only water enough for a species of the diaspore group:

	$\ddot{Si}$	$\bar{Al}$	$\bar{Fe}$	$\dot{H}$	$\ddot{Ti}$	$\dot{Ca}\ddot{C}$
1. Beaux, *white*	21·7	58·1	3·0	[14·0]	8·2	*tr.*=100
2. Revest, *bnh.-red*	2·8	57·6	25·3	10·8	3·1	0·4=100
3. Allauch, *oolitic*	4·8	55·4	24·8	11·6	3·2	0·2=100
4. Beaux	——	30·3	34 9	22·1	——	12·7=100
5. Calabria	2·0	33·2	[48·8]	8·6	1·6	——, corundum 5·8=100.

Obs.—From Beaux (sometimes spelt Baux), near Arles, France, disseminated in grains in compact limestone, and also oolitic; also at Revest, near Toulon, brown to dark-red, and massive, regarded as an iron ore; at Allauch, Dept. of Var, France, massive, oolitic, with a base of like nature, cemented by some carbonate of lime, the most common variety; at Hügel, in the Commune of Beaux, a hard and firm variety; at Calabre, massive. The *wocheinite* occurs in Styria, between Feistritz and Lake Wochein, in a deposit 12 feet thick, the junction of the Trias and Jurassic formations, part of it red from the presence of oxyd of iron. The purest beauxite is used for the manufacture of aluminum, and is called *aluminum ore.*

209. ELIASITE. Uranisches Pittin-Erz, Pittinus inferior, *Breith.*, Handb., 901, 1847. Eliasit *Haid.*, Jahrb. G. Reichs., iii. No. 4, 124, 1852. Pittinit *Herm.*, J. pr. Ch., lxxvi. 322, 1859.

In amorphous masses, more or less resin-like in aspect, or like gum. H.=3·5—4·5. G.=4·0—5·0. Lustre greasy or resinous. Color dull; reddish-brown, with thin edges hyacinth-red; also black. Streak wax-yellow to orange; of the black var., olive-green. Subtranslucent to opaque. Fracture somewhat uneven, slightly conchoidal.

Var.—1. *Eliasite.* Somewhat resin-like in aspect; G.=4·087—4·237, v. Zepharovich. Color dull reddish-brown.

2. *Pittinite.* Color black; streak olive-green; lustre greasy submetallic; G.=4·8—5·0, Breith.; 5·16, Herm.

Comp.—$\bar{R}\dot{H}^2$, with opal silica and other impurities. O ratio for $\dot{R}$, $\bar{R}$, $\ddot{Si}$, $\dot{H}$, as deduced by Hermann, in *eliasite.* 2 : 24 : 5 : 18; in *pittinite*, 2 : 24 : 5 : 16. These numbers correspond very nearly to the above formula, and make the species analogous to xanthosiderite.

Analyses: 1, F. Ragsky (Pogg., IV. Ergonz., 348, 1853); 2, Hermann (J. pr. Ch., lxxvi. 326):

	$\bar{U}$	$\bar{Fe}$	$\dot{Ca}$	$\dot{Mg}$	$\dot{Pb}$	$\ddot{Si}$	$\bar{P}$	$\dot{H}$
1. *Eliasite*	61·33	6·63	3·09	2·20	4·62	5·13	0 84	10·68, $\bar{Al}$ 1·17, $\dot{Fe}$ 1·09, $\ddot{C}$ 2·52, As *tr.* =99·30 Ragsky.
2. *Pittinite*	68·45	4·54	2·26	0·55	2·51	5·00	*tr.*	10·06, $\bar{Bi}$ 2·67, insol. 3·20=99·24 H.

The carbonic acid in anal. 1 may be combined with lime and part of the magnesia, making 5·7 p. c. of impurity.

Pyr., etc.—Nearly as for *gummite.* Eliasite is soluble in muriatic acid.

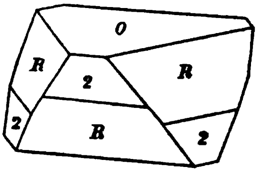
Obs.—*Eliasite* is from the Elias mine, Joachimsthal, where it occurs with fluor, dolomite, pitchblende, etc.; and *pittinite*, from Joachimsthal. This species may not be distinct from gummite.

210. BRUCITE. Native Magnesia (fr. N. Jersey) *A. Bruce*, Bruce's Min. J., i. 26, 1814 (with anal.). Hydrate of Magnesia *A. Aikin*, Min., 236, 1815, *Cleaveland*, Min., 429, 1822, *F. Hall*, Cat. Min., 28, 1824, *S. Robinson*, Cat. Amer. Min., 166, 1825. Brucite, ou Hydrate de magnésie, *Beud.*, Tr., 838 (Index), 1824. Talk-Hydrat, Magnesia-Hydrat, *Germ.* Monoklinoëdrisches Magnesiahydrat oder Texalith (fr. Texas, Pa.) *Herm.*, J. pr. Ch., lxxxii. 368, 1861. Amianthus (fr. Hoboken) *J. Pierce*, Am. J. Sci., i. 54, 1818=Amianthoid Magnesite, Nemalite, *T. Nuttall*, ib., iv. 18, 1821=Brucite (Talk-hydrat, "hierher zu gehören scheint"), *Leonh.*, Handb., 245, 1826; *J. D. Whitney*, J. Soc. N. H., Boston, 36, 1849 (with anal.).

Rhombohedral. $R \wedge R = 82° 22\frac{1}{2}'$, $O \wedge R = 119° 39\frac{1}{2}'$; $a = 1·52078$, Hessenberg. Observed planes: O; R, $2R$, $-4R$, $-\frac{7}{6}R$, $-\frac{1}{2}R$, $-\frac{1}{8}R$.

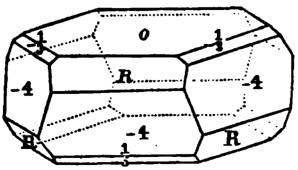
$O \wedge 2\,R = 105°\ 53\tfrac{1}{2}'$, $O \wedge \tfrac{1}{3}\,R = 149°\ 39\tfrac{1}{2}'$, $O \wedge 4\,R = 98°\ 6'$, $O \wedge \tfrac{7}{5}\,R = 112°\ 8'$ Hessenberg. Crystals often broad tabular. Cleavage: basal, eminent, folia easily separable, nearly as in gypsum. Usually foliated massive. Also fibrous, fibres separable and elastic.

176



Low's mine, Texas.

177



Wood's mine, Texas.

H.=2·5. G.=2·35, Haidinger; 2·40—2·46 fr. Wermland, Igelström: 2·376, fr. Orenburg, Beck; 2·44, nemalite, Nuttall. Lustre pearly on a cleavage-face, elsewhere between waxy and vitreous; the fibrous silky. Color white, inclining to gray, blue, or green. Streak white. Translucent —subtranslucent. Sectile. Thin laminæ flexible.

Var.—1. Foliated. 2. Fibrous; called *nemalite*.

Comp.—$\dot{\mathrm{Mg}}\dot{\mathrm{H}}$=Magnesia 68·97, water 31·03=100. Analyses: 1, Bruce (Bruce's J., i. 26): 2, Fyfe; 3, Stromeyer (Unters., 467); 4, Wurtz (This Min., 682, 1850): 5, Fyfe (Ed. N. Phil. J., viii. 352); 6, Thomson (Min., i. 157); 7, Stromeyer (l. c.); 8, Hermann (J. pr. Ch., lxxxii. 368); 9, Smith & Brush (Am. J. Sci., ii. xv. 214); 10, Beck (Verh. Min. St. Pet., 1862, 87); 11, Igelström (Ak. H. Stockh., 1858, 187); 12, J. D. Whitney (J. Soc. N. H., Bost., vi. 36, 1849); 13, Wurtz (l. c.); 14, Rammelsberg (Pogg., lxxx. 284):

		$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Mn}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{H}}$	$\ddot{\mathrm{C}}$	
1.	Hoboken	70	——	——	——	30	——	=100 Bruce.
2.	"	68·57	——	——	——	31·43	——	=100 Fyfe.
3.	"	68·35	0·12	0·64	——	30·90	——	=100 Stromeyer.
4.	"	69·11	0·47	——	——	30·42	——	=100 Wurtz.
5.	Swinaness	69·75	——	——	——	30·25	——	=100 Fyfe.
6.	"	67·98	1·57		——	30·96	——	=100·51 Thomson.
7.	"	66·67	1·18	1·57	0·19	30·39	——	=100 Stromeyer.
8.	Wood's mine, Texas,	68·87	——	0·80	——	30·33	——	=100 Hermann.
9.	Low's mine "	66·30	0·50	*tr.*	——	[31·93]	1·27	=100 S & B.
10.	Orenburg (⅓)	67·24	2·03	——	——	30·29	0·62	=99·98 Beck.
11.	Wermland (⅔)	68·04	3·59	——	——	28·66	——	=190·29 Igelström.
12.	Hoboken, *Nemalite*	62·89	4·65	——	——	28·36	4·10	=100 Whitney.
13.	" "	66·05	5·63	——	——	30·13	——	=101·81 Wurtz.
14.	" "	64·86	4·05	——	——	29·48, $\ddot{\mathrm{Si}}$ 0·27		=98·65 Ramm.

Pyr., etc.—In the closed tube gives off water, becoming opaque and friable, sometimes turning gray to brown. B.B. infusible, glows with a bright light, and the ignited mineral reacts alkaline to test paper. With cobalt solution gives the violet-red color of magnesia. The pure mineral is soluble in acids without effervescence.

Obs.—Brucite accompanies other magnesian minerals in serpentine, and has also been found in limestone. Occurs in considerable veins traversing serpentine, at Swinaness in Unst, one of the Shetland Isles, where it is sometimes found in regular crystals; at Pyschminsk in the Urals; at Goujot in France; near Filipstadt in Wermland, in Sweden, in roundish masses in limestone. It occurs at Hoboken, N. J., opposite the city of New York, in seams in serpentine; in Richmond Co., N. Y.; on the peninsula east of New Rochelle, Westchester Co., N. Y.; at Wood's mine. Texas, Pa., in large plates or masses, and often crystallizations several inches across; at Low's mine, with hydromagnesite.

The angles and f. 177 given above are from Texas crystals, as measured by Hessenberg (Min. Not., iv. 42). G. Rose obtained from the same, $O \wedge R = 120°$, $O \wedge \tfrac{1}{3}R = 149°\ 40' - 150°\ 51$, $R \wedge -\tfrac{1}{3}R = 90°$. The author gave the following measurements of a minute crystal from Low's mine (f. 176) in his last edit.: $O \wedge R = 119° - 119°\ 55'$, $O \wedge 2\,R = 105°\ 30'$, $R \wedge R$ (by calc.)$= 82°\ 15$.

The fibrous variety (nemalite) occurs at Hoboken, and Xettes in the Vosges.

Named after A. Bruce, an early American mineralogist, who first described the species.

Alt.—Becomes white, pulverulent, and carbonated on exposure, and also crystallized, constituting then the mineral hydromagnesite; the latter is sometimes in pseudomorphous crystals after brucite.

211. PYROCHROITE. Pyrochroit *L. J. Igelström*, Pogg., cxxii. 181, 1864, Œfv. Ak. Stockh., 1864, 205, 1865.

Foliated, like brucite.

H.=2·5. Lustre pearly. Color white; but changing on exposure to bronze, and then to black. In thin pieces transparent, and having a flesh-red color by transmitted candle-light.

Comp.—$\dot{\mathrm{Mn}}\,\dot{\mathrm{H}}$, or $(\dot{\mathrm{Mn}}, \dot{\mathrm{Mg}})\,\dot{\mathrm{H}}$. $\dot{\mathrm{Mn}}\,\dot{\mathrm{H}}$=Protoxyd of manganese 79·8, water 20·2=100. Analysis: Igelström (l. c.):

$\dot{\mathrm{Mn}}$ 76·40 $\dot{\mathrm{Mg}}$ 3·14 $\dot{\mathrm{Ca}}$ 1·27 $\dot{\mathrm{Fe}}$ 0·01 $\dot{\mathrm{H}}$ 15·35 $\ddot{\mathrm{C}}$ [3·834]

Pyr., etc.—In a matrass a small piece becomes at surface verdigris-green, then dirty green, and finally brownish-black. Yields water. B.B. reactions of manganese. In muriatic acid forms easily a clear colorless solution.

Obs.—Occurs in veins 1 to 2 lines broad in magnetite at Paisberg in Filipstadt, Sweden.

Kenngott refers here (Jahrb. Min., 1866, 440) a mineral which Wiser had announced as a hydrous carbonate of manganese (Wasserhaltiges Kohlensaures Mangan), and which Haidinger (Handb., 493, 1845) named *Wiserite*. It is described as yellowish-white to gray in color, pearly to silky in lustre, fibrous in structure, and as coming from Gonzen near Sarganz, the Canton of St. Gall, in Switzerland, where it is found in seams in a granulitic hausmannite, with rhodochrosite. Even if identical with pyrochroite in composition, it was so imperfectly and incorrectly described that Igelström's name should stand for the species.

212. GIBBSITE. Wavellite (fr. Richmond) *C. Dewey*, Am. J. Sci., ii. 249, 1820; =Water and Alumina, *id.*, ib, iii. 239, 1821. Gibbsite *J. Torrey*, N. Y. Med. Phys. J., i. No. 1, 68, April, 1822. Hydrargillite, Gibbsite of Torrey, *Cleavel.*, 224, 782, 1822. Hydrargillite (fr. Ural) *G. Rose*, Pogg., xlviii. 564, 1839.

Hexagonal, Koksch.; monoclinic, Descl. In small hexagonal crystals with replaced lateral edges. $O \wedge R = 92° 28'$, $O \wedge \frac{1}{2}R = 97° 22'$, $O \wedge -\frac{1}{2}R = 94° 55'$, Koksch. Planes vertically striate. Cleavage: basal or O eminent. Occasionally in lamello-radiate spheroidal concretions. Usually stalactitic, or small mammillary and incrusting, with smooth surface, and often a faint fibrous structure within.

H.=2·5–3·5. G.=2·3–2·4; 2·385, fr. Richmond, B. Silliman, Jr.; 2·287, Ural, Hermann. Color white, grayish, greenish, or reddish-white; also reddish-yellow when impure. Lustre of O pearly; of other faces vitreous; of surface of stalactites faint. Translucent; sometimes transparent in crystals. A strong argillaceous odor when breathed on. Tough.

Var.—1. In crystals; the original *hydrargillite*. 2. Stalactitic; *gibbsite*.

Comp.—$\bar{\dddot{\mathrm{Al}}}\,\dot{\mathrm{H}}^3$=Alumina 65·6, water 34·4=100. Analyses: 1, Torrey (l. c.); 2, B. Silliman, Jr. (Am. J. Sci., II. vii. 411); 3, 4, Smith & Brush (Am. J. Sci., II. xvi. 51, 1853); 5, Hermann (J. pr. Ch., xl. 11); 6, v Kobell (J. pr. Ch., xli., and l. 491); 7, v. Hauer (Jahrb. G. Reichs., iv. 397):

		$\bar{\dddot{\mathrm{Al}}}$	$\bar{\dddot{\mathrm{Fe}}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{H}}$	$\dddot{\mathrm{Si}}$	$\bar{\mathrm{P}}$	
1.	**Richmond,** *Gibbs.*	64·8	——	——	34·7	——	——	=99·5 Torrey.
2.	" "	(?) 64·19	——	0·30	34·23	0·59,	insol. 1·16	=100·27 Silliman.
3.	" "	64·24	*tr.*	0·10	33·76	1·33	0·57	=100 S. & B.
4.	" "	63·48	*tr.*	0·05	34·68	1·09	*tr.*	=99·30 S. & B.
5.	**Ural,** *Hydrarg.*	64·03	——	——	34·54	——	1·43	=100 Hermann.
6.	**Villa Rica,** "	65·6	——	——	34·4	——	——	=100 Kobell.
7.	" "	64·35	——	——	35·65	——	*tr.*	=100 Hauer.

Dewey found (l. c.) 33–36 p. c. of water, with "little besides alumine left."

Hermann states (J. pr. Ch., xl. 32, xlii. 1) that a "gibbsite" from Richmond, Mass., afforc him $\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\text{P}}}$ 37·62, $\dddot{\bar{\text{Al}}}$ 26·66, $\dot{\bar{\text{H}}}$ 35·72=100. But the true gibbsite has since been analyzed anew Silliman, Jr., and by Smith & Brush, without finding more than a trace of phosphoric acid, susta ing the original analysis of Torrey. This at least is certain, that gibbsite is a hydrate, and i phosphate occurs also at Richmond, that phosphate is *not* gibbsite. Rose's hydrargillite (fou crystallized in the Urals) is identical in composition with gibbsite.

Pyr., etc.—In the closed tube becomes white and opaque, and yields water. B.B. infusil whitens, and does not impart a green color to the flame. With cobalt solution gives a deep-b color. Soluble in concentrated sulphuric acid.

Obs.—The crystallized gibbsite was discovered by Lissenko in the Schischimskian mounta near Slatoust in the Ural; it occurs, according to Kokscharof, in cavities in a talcose schist c taining much magnetite. The larger crystals were 1 to 2 in. long. With corundum at Gumu dagh, Asia Minor; also on corundum at Unionville, Pa.; in Brazil, resembling wavellite. 1 stalactitic occurs at Richmond. Mass., in a bed of limonite; also at Lenox, Mass.; at the Cl mine, Union Vale, Duchess Co., N. Y., on limonite; in Orange Co., N. Y.

Named after Col. George Gibbs, the original owner (after extensive foreign travel) of the la Gibbs' cabinet of Yale College. Cleaveland calls the Richmond mineral *hydrargillite* on p. 221 his mineralogy, but on p. 732 adopts Torrey's name *gibbsite.*

Kokscharof states that the Ural crystals are optically uniaxial, and hence rhombohedral (B Ac. St. Pet., v. 372); Descloizeaux that they are optically monoclinic (C. R., lxii. 987).

213. LIMNITE. Limonite pt. Yellow Ochre pt. Bog Ore pt. Brown Iron Ore (Brauneis stein) pt. Quellerz *Herm.*, J. pr. Ch., xxvii. 53.

Massive. In stalactites or tuberose, resembling limonite. Also as earthy yellow ochre.

H., G., and other physical characters same nearly as for limonite. T darker colored kinds usually more yellowish-brown, the lighter rust-yello

Var.—1. Submetallic or pitch-like in lustre, brownish-black in color. 2. Ochreous, yellow.

Comp.—$\dddot{\bar{\text{Fe}}}\,\dot{\bar{\text{H}}}^3$=Oxyd of iron 74·8, water 25·2=100. Analyses: 1, A. H. Church (J. Soc., II. iii. 214); 2, 3, Hermann (l. c.); 4, Karsten (Karst. Arch., xv. 1):

	$\dddot{\bar{\text{Fe}}}$	$\dddot{\bar{\text{Mn}}}$	$\dot{\bar{\text{H}}}$	$\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\text{P}}}$	Humic acid
1. Cornwall, *stalact.*	73·73	——	24·40	——	——, loss, etc., 1·87=100 Churc
2. Novgorod, *bog ore* [a]	62·08	1·90	24·64	6·64	4·74=100 Herm.
3. " " [b]	61·14	3·10	27·74	5·86	2·16=100 Herm.
4. New York "	66·33	0·75	26·40 [c]	0·12	——, $\dot{\text{Fe}}$ 3·6, $\dddot{\text{Si}}$ 2·80=100 Kars

[a] After excl. 47·50 sand. [b] After excl. 50·28 sand. [c] Including humic acid.

As the amount of organic acids in Karsten's analysis was not determined, its right to included here is not certain.

Obs.—The Cornwall mineral is from the Botallack mine, and was stalactitic and of a rust-yell color; G.=2·69. That of Novgorod, Russia, was a bog ore.

Named *limnite* from λιμνη, *marsh.* Glocker proposed this name as a substitute for limonite, the alleged ground that the word limonite was of French extraction. As his limonite, or limni was bog ore exclusively, the name is appropriately used here. Hermann's name Quellerz allu to its water or marsh origin.

214. HYDROTALCITE. Hydrotalkit *Hochstetter.*, J. pr. Ch., xxvii. 376, 1842. Völkner *Herm.*, J. pr. Ch., xl. 11, 1847, xlvi. 257, 1849.

Hexagonal. Cleavage: basal, eminent; lateral, distinct. Also lamell massive, or foliated, and somewhat fibrous.

H.=2. G.=2·04. Color white. Lustre pearly, and feel greas Translucent, or in thin folia transparent.

Comp.—$\dddot{\bar{\text{Al}}}\,\dot{\bar{\text{H}}}^3+6\,\dot{\text{Mg}}\,\dot{\bar{\text{H}}}+6\,\dot{\bar{\text{H}}}=(\frac{1}{3}\,\dddot{\bar{\text{Al}}}+\frac{2}{3}\,\dot{\text{Mg}}^3)\,\dot{\bar{\text{H}}}^3+2\,\dot{\bar{\text{H}}}$=Alumina 16·8, magnesia 39·2, wa 44·0=100. Corresponds to 1 of *gibbsite*+6 of *brucite*, with 6 $\dot{\bar{\text{H}}}$ in addition.

Analyses: 1, Hermann (l. c.); 2, Hochstetter (l. c.); 3–6, Rammelsberg (Pogg., xcvii. 296):

	$\bar{\text{Al}}$	$\bar{\text{Fe}}$	$\dot{\text{Mg}}$	$\dot{\text{H}}$	$\ddot{\text{C}}$
1. Schischimsk	16·95	——	37·07	46·87	——=100 Hermann.
2. Snarum	12·00	6·90	36·30	32·06	10·54, insol. 1·20=99·60 Hochst.
3. "	19·25	——	37·27	.41·59 .	2·61=100·72 Ramm.
4. "	17·78	——	38·18	[37·99]	6·05=100 Ramm.
5. "	18·00	——	37·30	[37·38]	7·32=100 Ramm.
6. "	18·87	——	37·04	37·38	7·30=100·59 Ramm.

Pyr., etc.—In the closed tube yields much water. B.B. infusible, but exfoliates somewhat, and gives out light. A weak rose-red with cobalt solution. With the fluxes intumesces and affords a clear colorless glass. The Snarum mineral reacts for iron.

Obs.—Occurs at the mines of Schischimsk, district of Slatoust, implanted on talc schist; at Snarum, Norway, in serpentine.

188

Named *hydrotalcite* in allusion to its resembling talc, but containing much more water, and *völknerite*, after Captain Völkner.

Houghite of Shepard (Am. J. Sci., II. xii. 210), from near Oxbow, and near Somerville in Rossie, St. Lawrence Co., New York, is hydrotalcite, derived from the alteration of spinel. The color is white; lustre faint, pearly. H.=2·5. G.=2·0—2·1. The crystals are in all conditions, from the pure spinel to octahedrons with rounded edges and pitted or irregular surfaces, and it also occurs in flattened nodules. The surfaces are sometimes soft and altered, when the edges or angles have the hardness of spinel. S. W. Johnson, who has redescribed the mineral, obtained in one analysis (Am. J. Sci., II. xii. 361), $\bar{\text{Al}}$ 19·743, $\dot{\text{Mg}}$ 36·292, $\ddot{\text{C}}$ 8·458, insoluble spinel, etc., 8·264, silica 3·020, water (by diff.) 24·223. The whole loss by ignition in one trial was 40·86 p. c.; which would give 33 to 34 p. c. of water. It is associated with dolomite, spinel, phlogopite, graphite, and serpentine.

215. PYROAURITE. Pyroaurit *Igelström*, Œfv. Ak. Stockh., xxii. 608, 1865.

Hexagonal. In six-sided tables.
Color submetallic, gold-like. Subtranslucent.

Comp.—$\bar{\text{Fe}}\,\dot{\text{H}}^3 + 6\,\dot{\text{Mg}}\,\dot{\text{H}} + 6\,\dot{\text{H}} = (\frac{1}{3}\,\bar{\text{Fe}} + \frac{3}{3}\,\dot{\text{Mg}}^3)\,\dot{\text{H}}^3 + 2\,\dot{\text{H}}$=Sesquioxyd of iron 23·9, magnesia 35·8, water 40·3=100. Corresponds to 1 of *limnite*+6 of *brucite*, with 6 $\dot{\text{H}}$ in addition, differing from hydrotalcite in the presence of iron in place of aluminum. **Analysis**: Igelström (l. c.):

$\bar{\text{Fe}}$ 23·92 $\dot{\text{Mg}}$ 34·04 $\dot{\text{H}}$ 34·56 $\ddot{\text{C}}$ 7·24.

Pyr., etc.—Yields water. B.B. infusible. Perfectly soluble in muriatic acid.
Obs.—From the Longban iron-mine in Wermland.

216. GUMMITE. Feste Uranokker pt. *Wern.*, Min. Syst., 26, 1817, Hoffm. Min., iv. a, 279. Lichtes Uranpecherz *Freiesleben.* Uranisches Gummi-Erz *Breith.*, Uib., 60, 1830, Char., 218, 1832. Urangummi *Breith.*, Handb., 903, 1847. Phosphor-Gummit *Herm.*, J. pr. Ch., lxxvi. 327, 1859.

Amorphous. In rounded or flattened pieces, looking much like gum. H.=2·5—3. G.=3·9—4·20, Breith. Lustre greasy. Color reddish-yellow to hyacinth-red, reddish-brown. Streak yellow. Feebly translucent.

Comp.—($\bar{\text{U}}$, $\bar{\text{Fe}}$) $\dot{\text{H}}^3$, with some opal silica, phosphate of lime, and other impurities. Hermann deduced the O ratio for $\dot{\text{R}}^3$, $\bar{\text{R}}$, $\ddot{\text{Si}}$, $\dot{\text{H}}$, 2 : 24 : 5 : 26, or 1 : 1 for oxyds and water. Hence analogous to *limnite*, and sustaining the supposed close relation of uranium and iron. Analysis: Kersten (Schw. J., lxvi. 18):

$\bar{\text{U}}$	$\bar{\text{Mn}}$	$\dot{\text{Ca}}$	$\ddot{\text{Si}}$	$\bar{\text{P}}$	$\dot{\text{H}}$	F, As
72·00	0·05	6·00	4·26	2·30	14·75	tr.=99·36.

Some specimens contain traces of vanadic acid.

Pyr., etc.—Yields much water and a bituminous odor. With salt of phosphorus in O.F. gi a yellow bead, becoming green in R.F. (due to uranium), leaving an undissolved skeleton silica.

Obs.—From Johanngeorgenstadt, with uraninite.

217. PSILOMELANE. Derb Brunsten pt. *Wall.*, Min., 268, 1747. Magnesia indurata *Cronst.*, Min., 106, 1758. Schwarz Braunsteinerz pt. *Wern.*, Bergm. J., 1789, 386. Verhärte Schwarz-Braunsteinerz pt. *Emmerling*, Min., 'v. 532, *Karsten*, Tab., 54, 1800. Verh. Schw: Manganerz pt. *Karst.*, Tab., 72, 1808. Schwarz-Eisenstein pt. *Wern.*, *v. Leonh.*, etc. Bl Hematite, Black Iron Ore, Compact Black Manganese Ore. Hartmanganerz. Psilomelane *Ha* Trans. R. Soc. Edinb., 1827.

Massive and botryoidal. Reniform. Stalactitic.

H.=5—6. G.=3·7—4·7. Lustre submetallic. Streak brownish-bla shining. Color iron-black, passing into dark steel-gray. Opaque.

Comp.—$(\dot{\bar{\mathrm{B}}}\mathrm{a}, \dot{\mathrm{M}}\mathrm{n})\ \ddot{\mathrm{M}}\mathrm{n}+\dddot{\bar{\mathrm{M}}}\mathrm{n}+n\,\dot{\mathrm{H}}\,\ddot{\mathrm{M}}\mathrm{n}$ [+aq]; or, for the anhydrous kinds, $(\dot{\bar{\mathrm{B}}}\mathrm{a}, \dot{\mathrm{M}}\mathrm{n})\ \ddot{\mathrm{M}}\mathrm{n}+$ Each of these formulas is equivalent to simply $\mathrm{R}^2\,\mathrm{O}^3$. Rammelsberg writes for the mineral ($\dot{\mathrm{M}}\mathrm{n}$) $\ddot{\mathrm{M}}\mathrm{n}^2+\dot{\mathrm{H}}$, with some $\dddot{\bar{\mathrm{M}}}\mathrm{n}$ as mixture. For the Elgersburg ore (anal. 7) Schmid deduces formula $(\dot{\bar{\mathrm{B}}}\mathrm{a}\ \dot{\mathrm{M}}\mathrm{n})\ \ddot{\mathrm{M}}\mathrm{n}^4+6\,\dot{\mathrm{H}}$, which may be written $(\dot{\bar{\mathrm{B}}}\mathrm{a}, \dot{\mathrm{M}}\mathrm{n})\ \ddot{\mathrm{M}}\mathrm{n}+3\,\dot{\mathrm{H}}\,\ddot{\mathrm{M}}\mathrm{n}+3\dot{\mathrm{H}}$, equivalen $\dot{\mathrm{R}}^2\,\mathrm{O}^3+3\,\dot{\mathrm{R}}^2\,\mathrm{O}^3+3\,\dot{\mathrm{H}}=\dot{\mathrm{R}}^2\,\mathrm{O}^3+\frac{3}{4}\,\dot{\mathrm{H}}$ As the mineral occurs only massive, the true nature of species is doubtful.

Analyses: 1, 2, Turner (Edinb. Trans., xi.); 3, Fuchs (Schw. J, lxii. 255); 4, Rammelsb (Handw., ii. 73); 5, K. List (J. pr. Ch., lxxxiv. 60); 6, Scheffler (Arch. d. Pharm., xxxv. 260); 7 Schmid (Pogg., cxxvi. 151):

		$\ddot{\bar{\mathrm{M}}}\mathrm{n}\ \dot{\mathrm{M}}\mathrm{n}$	O	$\dot{\bar{\mathrm{B}}}\mathrm{a}$	$\dot{\mathrm{K}}$	$\dot{\mathrm{H}}$
1. Schneeberg		69·80	7·36	16·36	——	6·22, $\ddot{\mathrm{S}}\mathrm{i}$ 0·26=100 Turner.
2. Romanêche		70·97	7·26	16·69	——	4·13, $\ddot{\mathrm{S}}\mathrm{i}$ 0·95=100 Turner.
3. Baireuth		81·8	9·5	——	4·5	4·2=100 Fuchs.
4. Horhausen		81·36	9·18	——	3·04	3·39, $\ddot{\mathrm{S}}\mathrm{i}$ 0·53, $\dot{\mathrm{C}}\mathrm{u}$ 0·96, $\dddot{\bar{\mathrm{F}}}\mathrm{e}$ 1·43, $\dot{\mathrm{C}}\mathrm{a}$ 0 $\dot{\mathrm{N}}\mathrm{a}$, $\dot{\mathrm{M}}\mathrm{g}$ 0·32=100·61 Ra
5. Olpe		85·17	4·49	——	1·36	4·02, $\dot{\mathrm{C}}\mathrm{u}$ 1·28, $\dot{\mathrm{C}}\mathrm{o}$ 0·31, $\dot{\mathrm{C}}\mathrm{a}$ 0·37, in 2·51 I
6. Ilmenau		83·3	9·8	5·8	——	4·3, $\dot{\mathrm{C}}\mathrm{a}$ 1·8, $\dddot{\bar{\mathrm{A}}}\mathrm{l}$ 2·1, $\dddot{\bar{\mathrm{F}}}\mathrm{e}$ 0·3, $\ddot{\mathrm{S}}\mathrm{i}$ 1·1 99·1 Schef
7. Elgersburg	(G.=4·307)	68·27	8·15	17·27	——	4·84, $\ddot{\mathrm{S}}\mathrm{i}$ 0·51, $\dddot{\bar{\mathrm{F}}}\mathrm{e}$ 0·10, $\dddot{\bar{\mathrm{A}}}\mathrm{l}$ 0·31, $\dot{\bar{\mathrm{P}}}\mathrm{b}$ 0 $\dot{\mathrm{M}}\mathrm{g}$ 0·02, $\dot{\mathrm{C}}\mathrm{a}$ 0·16, $\dot{\mathrm{N}}\mathrm{a}$ 0·08=99·82 Schı
8. Oehrenstock	(G.=4·134)	70·54	10·09	10·92	0·21	5·86, $\ddot{\mathrm{S}}\mathrm{i}$ 0·32, $\dddot{\bar{\mathrm{F}}}\mathrm{e}$ 0·17, $\dddot{\bar{\mathrm{A}}}\mathrm{l}$ 0·21, $\dot{\mathrm{C}}\mathrm{u}$ 0 $\dot{\mathrm{M}}\mathrm{g}$ 0·13, $\dot{\mathrm{C}}\mathrm{a}$ 1·26, $\dot{\mathrm{N}}\mathrm{a}$ 0·25=100·21 Schı
9. Nadabula	(G.=4·332)	82·46	9·87	0·01	3·05	3·21, $\dddot{\bar{\mathrm{F}}}\mathrm{e}$ 0·30, $\dddot{\bar{\mathrm{A}}}\mathrm{l}$ 0·08, $\dddot{\bar{\mathrm{C}}}\mathrm{o}$ 0·29, $\dot{\mathrm{C}}\mathrm{u}$ 0 $\dot{\mathrm{M}}\mathrm{g}$ 0·03, $\dot{\mathrm{C}}\mathrm{a}$ 0·20, $\dot{\mathrm{N}}\mathrm{a}$ 0·22=99·74 Schı

Other varieties of the so-called psilomelane contain little or no water. Analyses: 10, Cl bruch (Ramm. 1st Suppl., 121); 11, Ebelmen (Ann. d. M., III. xix. 155); 12, Rammelsberg (Po lxviii. 72); 13, Schultz (Ramm. Min. Ch., 1006):

	$\dot{\mathrm{M}}\mathrm{n}$	O	$\dot{\bar{\mathrm{B}}}\mathrm{a}$	$\dot{\mathrm{K}}$	$\dot{\mathrm{M}}\mathrm{g}$	$\dot{\mathrm{H}}$
10. Ilmenau	77·28	15·82	0·12	5·29	——	——, $\dot{\mathrm{C}}\mathrm{a}$ 0·91, $\dot{\mathrm{C}}\mathrm{u}$ 0·40, $\ddot{\mathrm{S}}\mathrm{i}$ 0·52=100·2
11. Gy. Haute Saone	70·60	14·18	6·55	4·05	1·05	1·67, $\dddot{\bar{\mathrm{F}}}\mathrm{e}$ 0·77, $\ddot{\mathrm{S}}\mathrm{i}$ 0·60=99·47 Ebelmer
12. Heidelberg	70·17	15·16	8·08	2·62	0·21	[1·43], $\dot{\mathrm{C}}\mathrm{a}$ 0·60, $\dot{\mathrm{C}}\mathrm{u}$ 0·30, $\dot{\mathrm{C}}\mathrm{o}$ 0·54, $\ddot{\mathrm{S}}\mathrm{i}$ 0 100 Ra
13. Schneeberg	80·27	14·10	——	4·35	——	[0·23], $\dot{\mathrm{C}}\mathrm{a}$ 1·05=100 Schultz.

Pyr., etc.—In the closed tube most varieties yield water, and all lose oxygen on ignition; the fluxes reacts for manganese. Soluble in muriatic acid, with evolution of chlorine.

Obs.—This is a common ore of manganese. It is frequently in alternating layers with pyr site. It occurs in botryoidal and stalactitic shapes, in Devonshire and Cornwall; at Ilefeld in Harz; also at Johanngeorgenstadt, Schneeberg, Ilmenau, Siegen, etc.; at Elgersburg and Oeh stock, Thuringia, and Nadabula, Hungary.

It forms mammillary masses at Chittenden, Irasburg, and Brandon, Vt.

Named from ψιλός, *smooth* or *naked*, and μέλας, *black*.

218. **WAD.** (A) BOG MANGANESE. Magnesia friabilis terriformis *Cronst.*, Min., 105, 1758 Earthy Ochre of Mang., Black Wad pt., *Kirwan*, Min., 1784, 1796. Schwarz Braunsteiners Manganschaum, *Karst.*, Tab., 1808. Brauner Eisenrahm *Wern.* Bog Manganese. Ouatite *Huot.*, Min., 241, 1841. Groroilite *Berth.*, Ann. Ch. Phys., li. 19, 1832, Reissacherit *Haid.* Jahrb. G. Reichs., vii. 609, 1856.

(B) ASBOLITE. ? Cobaltum nigrum *Agric.*, Bermann., 459, 1529. Svart Kobolt-Jord, Min Cob. terrea fuliginea, *Wall.*, Min., 285, 1747. Kobalt-Mulm, Ochra Cob. nigra, *Cronst.*, Min., 211, 1758. Kobolt-Erde, Schwarzer Erdkobalt, Russkobalt, Kobaltmanganerz, *Germ.* Earthy Cobalt, Black Cobalt Ochre. Cobalt oxydé noir *H.*, Tr., iv. 1801. Kakochlor (fr. Lausitz) *Breith.*, Char., 240, 1832, Handb., 896, 1847. Asbolan (fr. Kamsdorf, etc.) *Breith.*, Handb., 332, 1847.

(C) LAMPADITE. Kupfermangan *Lampadius*, Neue Erfahr. im Gebiete der Ch., etc., ii. 70. Kupfermanganerz *Breith.*, in Hoffm. Min., iv. b, 201, 1818. Cupreous Manganese. Pelokonit *G. F. Richter*, Pogg., xxi. 591, 1831. Lampadite *Huot.*, Min., 238, 1841.

The manganese ores here included occur in amorphous and reniform masses, either earthy or compact, and sometimes incrusting or as stains. They are mixtures of different oxyds, and cannot be considered chemical compounds or distinct mineral species.

H.=0·5—6. G.=3—4·26; often loosely aggregated, and feeling very light to the hands. Color dull black, bluish or brownish-black.

Comp., Var.—Rammelsberg considers them related essentially to psilomelane under the formula $\dot{\mathrm{R}}\,\ddot{\mathrm{M}}\mathrm{n}+\dot{\mathrm{H}}$ (or 2 $\dot{\mathrm{H}}$), but mixed with other ingredients.

Varieties: (A) Manganesian; (B) Cobaltiferous; (C) Cupriferous.

A. BOG MANGANESE. Consists mainly of oxyd of manganese and water, with some oxyd of iron, and often silica, alumina, baryta. The Derbyshire wad sometimes gives the angle of barite, 101° 42′, with which mineral it is in part impregnated. The wad of Leadhills is pseudomorphous after calcite. *Groroilite* occurs in roundish masses of a brownish-black color, and reddish-brown streak; with H. sometimes 6—6·5; it is from Groroi in Mayenne, Vicdessos, and Cautern, in France. *Reissacherite* is the ore analyzed by Hornig (anal. 14), which is remarkable for the amount of water. Huot's name *ouatite* is from the French spelling of wad. *Wad* is of English origin. The *wad* of the Cumberland miners is graphite, a wrong use of the word, says Mawe in his Mineralogy of Derbyshire.

B. ASBOLITE, or Earthy Cobalt, is wad containing oxyd of cobalt, which sometimes amounts to 32 p. c. Named from ἀσβόλη, *soot* (or *Asbolan* from ἀσβολαίνω, to soil like soot). For anal. 15–17, Rammelsberg writes the formula $(\dot{\mathrm{C}}\mathrm{o}, \dot{\mathrm{C}}\mathrm{u})\,\ddot{\mathrm{M}}\mathrm{n}^2+4\,\dot{\mathrm{H}}$. Breithaupt's *cucochlor* includes the ore from Rengersdorf in Lausitz (anal. 15), having H.=2—2·5, G.=3·15—3·29.

C. LAMPADITE, or Cupreous Manganese. A wad containing 4 to 18 p. c. of oxyd of copper, and often oxyd of cobalt also. It graduates into black copper (Melaconite or Kupferschwärze). G.=3·1—3·2. *Peloconite* is a brownish-black variety, having a liver-brown streak; H.=3; G.=2·509—2·567; from Remolinos in Chili.

Special formulas have been written for several of the following analyses; but these bog minerals are not simple species.

Analyses: 1, Klaproth (Beitr., iii. 311); 2, 3, Turner (Edinb. J. Sci. N. S., ii. 213); 4, 5, Berthier (Ann. Ch. Phys., li. 19); 6, Wackenroder (Kastn. Archiv., xiii. 302, xiv. 257); 7, Scheffler (Arch. d. Pharm., xxxv. 260); 8, Rammelsberg (Pogg., lxii. 157); 9, Igelström (Jahresb., xxv. 342); 10, 11, Beck (Rep. Min. N. Y., 55); 12, Berthier; 13, Bahr (J. pr. Ch., liii. 308, fr. Oefv. Ak. Stockh., 240, 1850); 14, E. Hornig (Jahrb. G. Reichs., vii. 312); 15, Klaproth (Beitr., ii. 308); 16, Döbereiner (Gilb. Ann., lxvii. 333); 17, Rammelsberg (Pogg., liv. 551); 18, Kersten (Schw. J., lxvi. 1); 19, Rammelsberg (Pogg., liv. 545); 20, Böttger (ib.):

I. *Wad.*

	$\dot{\mathrm{M}}\mathrm{n}$	$\bar{\mathrm{M}}\mathrm{n}$	O	$\bar{\mathrm{F}}\mathrm{e}$	$\dot{\mathrm{B}}\mathrm{a}$	$\dot{\mathrm{C}}\mathrm{u}$	$\dot{\mathrm{H}}$
1. Clausthal	68·		——	6·5	1·0	——	17·5, $\dddot{\mathrm{S}}\mathrm{i}$ 8·0, C 1·0 Klaproth.
2. Devonshire	79·12		8·82	——	1·4	——	10·66=100 Turner.
3. Derbyshire	——	38·59	——	52·34	5·4	——	10·29, insol. 2·74=109·36 T

	$\dot{Mn}$	$\overline{Mn}$	O	$\overline{Fe}$	$\dot{Ba}$	$\dot{Cu}$	$\dot{H}$
4. Vicdessos	69·8	——	11·7	——	——	——	12·4, $\overline{\dddot{Al}}$ 7·0=100·9 Berthier.
5. *Groroilite*	62·4	——	12·8	6·0	——	——	15·8, clay 3·0=100 Berthier.
6. Baden	——	32·73	——	9·33	——	4·0	31·33, $\dot{Pb}$ 12·33, $\dot{Pb}$ 8·0, $\overline{Ce}$ 0·33, $\dddot{Si}$ 0·1 quartz 2·60 W
7. Ilmenau	66·5	——	12·1	1·0	8·1	——	9·8, $\dddot{Si}$ 2·5=100 Scheffler.
8. Rübeland	67·50	——	13·48	1·01	0·36	——	10·30, $\dddot{Si}$ 0·47, $\dot{Ca}$ 4·22, $\dot{K}$ 3·66=100
9. Westgothland	——	82·51	——	0·77	——	——	5·58, $\dddot{Si}$ 1·43, $\overline{\dddot{Al}}$ 6·30, $\dot{Ca}$ 1·91, 0·69=99·21 Igls
10. Hillsdale, N. Y.	——	68·50	——	16·75	——	——	11·50, insol. 3·25=100 Beck.
11. Austerlitz, "	——	58·50	——	22·00	——	——	17·00, insol. 2·50=100 Beck.
12. Siegen	58·5	——	10·4	5·7	——	——	12·9 (with loss), $\overline{\dddot{Al}}$ 10·7, quartz 1·8
13. Skidberg	66·16		——	2·70	15·34	$\dot{Co}$ 0·02	12·07, $\dddot{Si}$ 0·92, $\overline{\dddot{Al}}$ 0·75, $\dot{Ca}$ 0·59, 0·28, $\dot{K}$ 0·28=99·11 Bah
14. Gastein	——	34·16	——	14·16	——	——	16·90, $\dot{Ca}\ddot{C}$ 7·59, sand 27·27 Hornig.

II. *Earthy Cobalt*; Asbolite.

	$\dot{Mn}$	$\overline{Mn}$	O	$\overline{Fe}$	$\dot{Ba}$	$\dot{Co}$	$\dot{Cu}$	$\dot{H}$
15. Lausitz	——	16·0	——	——	——	19·4[a]	0·2	17·0, $\dddot{Si}$ 24·8, $\overline{\dddot{Al}}$ 20·4=97·8 Kl
16. Kamsdorf	31·21	——	6·78	——	——	32·05	——	22·90=92·94 D.
17. "	40·05	——	9·47	4·56	0·50	19·45	4·35	21·24, $\dot{K}$ 0·37=99·94 Ramm.

III. *Cupreous Manganese*; Lampadite; Kupferschwärze, or Black Copper, *in part.*

	$\dot{Mn}$	$\overline{Mn}$	O	$\overline{Fe}$	$\dot{Ba}$	$\dot{Co}$	$\dot{Cu}$	$\dot{H}$
18. Schlackenwald	——	74·10	——	0·12	——	——	4·80	20·10, $\dddot{Si}$ 0·3, gypsum 1·05 100·47 Kerste
19. Kamsdorf	49·99	——	8·91	4·70	1·64	0·49[b]	14·67	14·46, $\dot{Mg}$ 0·69, $\dot{K}$ 0·52, $\dddot{Si}$ 2·7 $\dot{Ca}$ 2·25=101·06
20. "	53·22	——	9·14	1·88	1·70	0·14[b]	16·85	16·94, $\dot{K}$ 0·65, $\dot{Ca}$ 2·85=103·44

[a] With oxyd of manganese. [b] With oxyd of nickel.

Pyr., etc.—*Wad* reacts like psilomelane. *Earthy cobalt* gives a blue bead with salt of pho phorus, and when heated in R.F. on charcoal with tin, some specimens yield a red opaque be (copper). *Cupreous manganese* gives similar reactions, and three varieties give a strong ma ganese reaction with soda, and evolve chlorine when treated with muriatic acid.

Obs.—The above ores are results of the decomposition of other ores—partly of oxyds, a partly of manganesian carbonates. They occur at the localities above mentioned, and ma other places. Wad or bog manganese is abundant in the counties of Columbia and Duches N. Y., at Austerlitz, Canaan Centre, and elsewhere, where it occurs as a marsh deposit, a according to Mather, has proceeded from the alteration of brown spar; also in the south-we part of Martinsburg, Lewis Co., in a swamp. There are large deposits of bog manganese at Bl Hill Bay, Dover, and other places in Maine.

Earthy cobalt occurs with cobalt pyrites at Riechelsdorf in Hesse; Saalfeld in Thuringia: Nertschinsk in Siberia; at Alderly Edge in Cheshire. An earthy cobalt occurs at Mine la Mott Missouri, which contains 10 or 11 p. c. of oxyd of nickel, besides oxyd of cobalt and copper, wi iron, lead, and sulphur; also near Silver Bluff, South Carolina, affording 24 p. c. of oxyd of cob to 76 of oxyd of manganese.

Cupreous manganese is found at Schlackenwald, and at Kamsdorf near Saalfeld; at Lauterbe in the Harz. *Peloconite* is from Remolinos, Chili, where it occurs with chrysocolla, or malachit

VARVACITE. Varvacite, referred to on p. 171 as an altered manganite, approaches a wad composition. Phillips obtained (Phil. Mag., vi. 281, vii. 284) Mn 63·3, O 31·7, $\dot{H}$ 5·0; or $\overline{M}$ 81·7, O 13·3, $\dot{H}$ 5·0. A similar compound from Ilefeld in the Harz (in part pseudomorphous af calcite) afforded Turner $\overline{Mn}$ 80·79, O 14·23, $\dot{H}$ 4·98=100, and Duflos (Schw. J., lxiv. 81) $\overline{M}$ 81·40, O 13·47, $\dot{H}$ 5·13=100.

II. OXYDS OF ELEMENTS OF THE ARSENIC AND SULPHUR GROUPS, SERIES II.

1. **ARSENOLITE GROUP.** Comp. R O^3. Isometric.

219. Arsenolite	As O^3	220. Senarmontite	Sb O^3

2. **VALENTINITE GROUP.** Comp. R O^3. Orthorhombic.

221. Valentinite	Sb O^3	224. Molybdite	Mo O^3
222. (?) Bismite	Bi O^3	225. Tungstite	W O^3
223. (?) Karelinite	Bi $O^3+[\frac{1}{n}$Bi S]		

3. **KERMESITE GROUP.** Comp. R O^3, with S replacing part of O. Monoclinic.

226. Kermesite Sb $(O, S)^3$

4. **CERVANTITE GROUP.** Comp. R O^3 + R O^5.

227. Cervantite Sb O^3 + Sb O^5.

Appendix.—228. Stibiconite Sb O^4+aq. 229. Volgerite Sb O^5+aq.

219. ARSENOLITE. Arsenicum nativum farinaceum, A. n. crystallinum, *Wall.*, 224, 1747. A. calciforme *Cronst.*, 207, 1758. A. cubicum, etc., *Linn.*, 1768. White Arsenic *Hill*, 1771. Arsenic blanc natif *Fr.* Naturlichor Arsenikkalk. Arsenikblüthe *Karst.*, Tab., 79, 1800. Arsenic oxidé *H.* Acide arsenieux *Fr.* Oxyd of Arsenic, Arsenous acid. Arsenige Säure *Germ.* Arsenit *Haid.*, Handb., 487, 1845. Arsenolite *Dana*, Min., 139, 1854.

Isometric. In octahedrons (f. 2). Usually in minute capillary crystals, stellarly aggregated, or crusts investing other substances. Also botryoidal, stalactitic; earthy.

H.=1·5. G.=3·698, Roget & Dumas. Lustre vitreous or silky. Color white, occasionally with a yellowish or reddish tinge. Streak white, pale yellowish. Transparent—opaque. Taste astringent, sweetish.

Comp.—$\ddot{\overline{\mathrm{As}}}$=Oxygen 24·24, arsenic 75·76=100.

Pyr., etc.—Sublimes in the closed tube, condensing above in minute octahedrons. B.B. on charcoal volatilizes in white fumes, giving a white coating and an alliaceous odor. Slightly soluble in hot water.

Obs.—Accompanies ores of silver, lead, arsenical iron, cobalt, nickel, antimony, etc., as a result of the decomposition of arsenical ores. Occurs at Andreasberg in the Harz; at Wheal Sparnon in Cornwall; Joachimsthal in Bohemia; Kapnik in Hungary; tho old mines of Biber in Hanau; the Ophir mine, Nevada; the Armagosa mine, Great Basin, Cal.

Arsenolite has been observed as a furnace product in *orthorhombic* crystals, probably isomorphous with valentinite. $\ddot{\overline{\mathrm{As}}}$ and $\ddot{\overline{\mathrm{Sb}}}$ are known to be isodimorphous. The prismatic form is obtained from sublimation at a temperature above 200° C., and the isometric at one much lower.

As the name *arsenite* is used in chemistry for compounds of arsenous acid, the author in 1854 changed it to *arsenolite*.

Alt.—Native arsenic is often covered by a blackish crust or powder, which has been considered a suboxyd (Ȧs); but according to Suckow, it is a mixture of metallic arsenic and arsenous acid.

220. SENARMONTITE. Antimoine oxydé octaédrique *H. de Senarmont*, Ann. Ch. Phys., III. xxxi. 504, 1851. Senarmontite *Dana*, Am. J. Sci., II. xii. 209, 1851.

Isometric; in octahedrons (f. 2). Cleavage: octahedral, in traces. Also granular massive; in crusts.

H.=2—2·5. G.=5·22—5·3. Lustre resinous, inclining to subadamantine. Transparent—translucent. Colorless or grayish. Streak white.

Comp.—S̈b (like valentinite)=Oxygen 16·44, antimony 83·56=100, with sometimes 1 p. c. of lead and 1 to 3 p. c. of grayish clay, Rivot (l. c.).

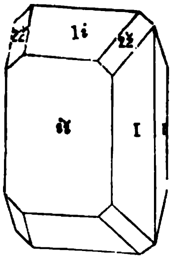
Pyr., etc.—In the closed tube fuses and partially sublimes. B.B. on charcoal fuses easily, and gives a white coating; this treated in R.F. colors the outer flame greenish-blue. Soluble in muriatic acid.

Obs.—A result of the decomposition of stibnite and other ores of antimony. First found in the district of Haraclas in Algeria; occurs also at Perneck near Malaczka in Hungary; Endellion in Cornwall; the antimony mine of S. Ham, Canada. The octahedrons from Algeria are sometimes nearly $\frac{1}{2}$ in. in diameter.

Named after H. de Senarmont, who first described the species.

221. VALENTINITE. Chaux d'antimoine native (fr. Chalanches) *Mongez*, J. de Phys., xxiii. 66, 1783; (fr. Przibram) *Rössler*, Crell's Ann., 1787, i. 334. Antimonium spatosum album *Hacquet*, ib., 1788, i. 523. Weiss-Spiesglaserz *Wern.*, *Hoffm.*, Bergm. J., 385, 398, 1789. Weiss-Spiessglanzerz *Klapr.*, Crell's Ann., 1789, i. 9; *Beitr.*, iii. 183, 1802. Antimoine oxydé *H.*, Tr., iv. 1801. White Antimonial Ore *Kirwan*, i. 251, 1796. White Antimony, Oxyd of Antimony. Antimonblüthe *v. Leonh.*, Handb., 160, 1821. Exitèle *Beud.*, Min., 615, 1832. Exitelite *Chapman*, Min., 39, 1843. Valentinit *Haid.*, Handb., 506, 1845.

179



Orthorhombic. $I \wedge I = 136° 58'$; $O \wedge 1\text{-}\bar{i} = 105° 35'$; $a : b : c = 3·5868 : 1 : 2·5365$. Observed planes: I, $i\text{-}\breve{i}$, $\frac{1}{3}\text{-}\breve{i}$, $1\text{-}\breve{i}$, $4\text{-}\breve{i}$,, $2\text{-}\breve{2}$. $1\text{-}\breve{i} \wedge 1\text{-}\breve{i}$, adj.,$= 70° 32'$, $\frac{1}{3}\text{-}\breve{i} \wedge \frac{1}{3}\text{-}\breve{i} = 129° 32'$, $I \wedge i\text{-}\breve{i} = 111° 31'$. Often in rectangular plates with the lateral edges bevelled, and in acicular rhombic prisms. Cleavage: I, highly perfect, easily obtained, Twins: composition-plane, $i\text{-}\breve{i}$, producing an aggregation of thin plates. Also massive; structure lamellar, columnar, granular.

H. = 2·5—3. G. = 5·566, crystals from Bräunsdorf. Lustre adamantine, $i\text{-}\breve{i}$ often pearly; shining. Color snow-white, occasionally peach-blossom red, and ash-gray to brownish. Streak white. Translucent—subtransparent.

Comp.—S̈b=Oxygen 16·44, antimony 83·56=100. Analysis: 1, Vauquelin (Haüy's Min., iv 274); 2, Suckow (Jahresb., 1849, 733):

1. Allemont	Oxyd of antimony 86	Ibid. with F̈e 3	Silica 8=97.	
2. Wolfach	" " 91·7	" F̈e 1·2	" 0·8,	Sb 6·3=100.

Mongez, who makes the first mention of this mineral from a discovery of the acicular variety at Allemont, correctly regarded it as native oxyd of antimony, as afterward confirmed by Vauquelin, and by Rössler (l. c.) for the Bohemian variety. Prof. Hacquet and Klaproth announced in 1788, 1789, the probable presence in the latter of muriatic acid; but in 1802 Klaproth pronounced this also pure oxyd of antimony.

Pyr., etc.—Same as for senarmontite.

Obs.—Occurs with other antimonial ores, and results from their alteration. Found at Przibram in Bohemia, in veins traversing metamorphic rocks; at Felsobanya in Hungary, with stibnite and arsenopyrite; Malaczka in Hungary; Bräunsdorf near Freiberg in Saxony; Allemont in Dauphiny. Also at the antimony mine of South Ham, Canada East.

Antimonophyllite of Breithaupt, of unknown locality, occurring in thin angular six-sided prisms, is probably valentinite.

The *prismatic* form of $\bar{S}b$ is obtained from solutions at a temperature above 100°C.

Named after Basil Valentine, an alchemist of the 15th century, who discovered the properties of antimony.

222. BISMITE. Oxyd of Bismuth, Bismuth Ochre. Wismuthocker *Germ.* Bismuth oxydé *Fr.* Bismite *Dana.*

Crystalline form not observed. Occurs massive and disseminated, pulverulent, earthy; also passing into foliated.

G.=4·3611, Büsson. Lustre adamantine—dull, earthy. Color greenish-yellow, straw-yellow, grayish-white. Fracture conchoidal—earthy.

Comp.—$\dddot{\bar{B}}i$=Oxygen 10·35, bismuth 89·65=100, along with some iron and other impurities. Analysis by Lampadius (Handb. ch. Anal., 286):

Oxyd of bismuth 86·4, oxyd of iron 5·1, carbonic acid 4·1, water 3·4=99.

Suckow obtained for another from Fichtelgebirge, derived from the decomposition of aikinite (Die Verwitt. im Min., 14), $\dddot{\bar{B}}i$ 96·5, $\ddot{\bar{A}}s$ 1·5, $\dddot{\bar{F}}e^2\dot{H}^3$ 2·0=100.

Pyr., etc.—In the closed tube most specimens give off water. B.B. on charcoal fuses, and is easily reduced to metallic bismuth, which in O.F. gives a yellow coating of oxyd. Soluble in nitric acid.

Obs.—Occurs pulverulent at Schneeberg in Saxony, at Joachimsthal in Bohemia; with native gold at Beresof in Siberia; in Cornwall, in St. Roach, and near Lostwithiel.

Dr. Jackson reports an oxyd of bismuth not carbonated, as occurring with the tetradymite of Virginia.

See further, BISMUTITE, p 716.

223. KARELINITE. Karelinit *Hermann*, J. pr. Ch., lxxv. 448, 1858.

Massive. Structure crystalline. Cleavage in one direction rather distinct.

H.=2. G.=6·60, Herm. Lustre strongly metallic within. Color lead-gray.

Comp.—$\dddot{\bar{B}}i$ with Bi S. Analysis: Hermann (l. c.):

O [5·21] S 3·53 Bi 91·26=100

Pyr., etc.—In tube gives sulphurous acid but no sulphur, yielding a gray slag with globules of bismuth.

Obs.—From the Savodinsk mine in the Altai, along with hessite (telluric silver). The mineral is not homogeneous, containing along with the metallic substance a gray, earthy mass of bismutite. By treating the powdered mass with muriatic acid, a metallic powder remains, which, examined with a lens, and washed, proves to be entirely free from any native bismuth, and is the mineral karelinite.

Named after Mr. Karelin, the discoverer.

224. MOLYBDITE. Molybdena or Molybdic Ochre, Molybdic Acid. Molybdänocker *Germ* Molybdine *Greg & Lettsom*, This Min., 144, 1854, Brit. Min., 348, 1858. Molybdite *Breith.*, B. H. Ztg., xvii. 125, 1858.

Orthorhombic. $I \wedge I$=136° 48′, and isomorphous with valentinite, Breith (fr. artif. cryst.). In capillary crystallizations tufted and radiated; also subfibrous massive; and as an earthy powder or incrustation.

H.=1–2. G.=4·49–4·50, Weisbach. Lustre of crystals silky to adamantine; earthy. Color straw-yellow, yellowish-white.

Comp.—$\dddot{\mathrm{M}}\mathrm{o}$=Oxygen 34·29, molybdenum 65·71=100.

Pyr., etc.—B.B. on charcoal fuses and coats the charcoal with minute yellowish crystals of molybdic acid near the assay, becoming white near the outer edge of the coating. This coating treated for an instant in R.F. assumes a deep blue color, which changes to dark red on continued heating. With borax gives in O.F. a yellow bead while hot, becoming colorless on cooling: in R.F. a saturated bead becomes brown or black and opaque. With salt of phosphorus gives a yellowish bead in O.F., becoming green when treated in R.F. and allowed to cool.

Obs.—Occurs with molybdenite, from which it is probably derived, at the foreign localities of that species; at Adun Tschilon in Dauria, and at Pitkäranta on L. Ladoga, in silky tufts of capillary crystals.

In N. Hamp., at Westmoreland, earthy; in Penn., at Chester, Delaware Co.; Georgia, Heard Co., in silky fibrous tufts; in the gold region, a few miles north of Virginia City, Nevada, in subfibrous masses, and tufted crystallizations of a deep yellow color (called *molybdate of iron* by D. D. Owen, in Proc. Ac. Philad., vi. 108, but shown by Genth to be this species mixed with limonite).

Artificial crystals of molybdite afforded A. E. Nordenskiöld the planes O, $i\text{-}\bar{i}$, $i\text{-}\breve{i}$, $i\text{-}\bar{\tfrac{1}{3}}$, $\tfrac{2}{3}\text{-}\bar{i}$, $\tfrac{1}{2}\text{-}\breve{i}$, $\tfrac{1}{3}\text{-}\bar{i}$, and the following angles: $O\wedge\tfrac{1}{3}\text{-}\bar{i}=157°\ 7'$, $O\wedge\tfrac{1}{2}\text{-}\bar{i}=148°\ 5'$, $O\wedge\tfrac{2}{3}\text{-}\bar{i}=140°\ 3'$, $i\text{-}\breve{i}\wedge i\text{-}\tfrac{1}{3}=106°\ 12'$; and gave $a:b:c$=0·4792 : 1 : 0·3872. Doubling the vertical axis, $a:b:c$=0·9584 : 1 : 0·3872, which is very closely the relation in the corresponding acid of vanadium, which has $a:b:c$=0·9590 : 1 : 0·3832. The above dimensions correspond to $I\wedge I=137°\ 40'$.

225. TUNGSTITE. Tungstic Ochre *B. Silliman*, Am. J. Sci., iv. 52, 1822. Wolframocker, Scheelsaure *Germ.* Wolframine *Lettsom & Greg*, This Min., 1854, Brit. Min., 349, 1858.

Pulverulent and earthy.
Color bright-yellow, or yellowish-green.

Comp.—$\dddot{\mathrm{W}}$, or pure tungstic acid=Oxygen 20·7, tungsten 79·3=100.

Pyr., etc.—B.B. on charcoal becomes black in the inner flame, but infusible. With salt of phosphorus gives in O.F. a colorless or yellowish bead, which treated in R.F. gives a blue glass on cooling. Soluble in alkalies, but not in acids.

Obs.—Occurs with wolfram in Cumberland, and Cornwall, England; at Lane's mine, Monroe, Ct., filling small cavities in other ores of tungsten, or coating them, and has resulted from their decomposition; in Cabarrus Co., N. C.; at St. Leonard, near Limoges, rarely in distinct cubes of a sulphur-yellow color on wolfram and quartz, a fine specimen of which is contained in the cabinet of Mr. Adam of Paris.

Artificial crystals, according to A. E. Nordenskiöld (Pogg., cxiv., 223), are orthorhombic, with $I\wedge I=110°$, and $a:b:c$=0·4026 : 1 : 0·6966; G.=6·302–6·384. These axes approximate to those of molybdite, if for c, $\tfrac{2}{3}c$ is substituted, and then this axis is made the vertical; the axes becoming 0·4644 : 1 : 0·4026.

The name *Wolframine* is changed to *Tungstite* in order to get rid of the chemical termination *ine*. *Wolframite* has been used for another species.

226. KERMESITE. Röd Spitsglasmalm, Antimonium Sul. et Ars. mineralisatum, Minera Ant. colorata, *Wall.*, 239, 1747 (fr. Bräunsdorf), *Cronst.*, 203, 1758. Antimonium plumosum *v. Born*, Lithoph., i. 137, 1772. Mine d'antimoine en plumes, ib. granuleuse,=Kermes mineral natif, *Sage*, Min., ii. 251, 1779, *de Lisle*, Crist., iii. 56, 60, 1783. Roth-Spiesglaserz *Wern.*, 1789. Rothspiessglanzerz *Emmerling*, Min., 1793; *Klapr.*, Beitr., iii. 182, 1802 (with anal., making it an oxysulphid). Antimoine oxydé sulfuré *H.*, Tabl., 1809. Red Antimony. Spiessglanzblende pt. *Hausm.* Handb., 225, 1813. Antimony Blende *Jameson*, Min. iii. 421, 1820. Antimonblende *Leonh.*, Handb., 157, 1821. Kermès *Beud.*, Tr., ii. 617, 1832. Kermesite *Chapman*, Min., 61, 1843. Pyrostibit *Glock.*, Syn., 16, 1847. Pyrantimonite *Breith.*

Monoclinic. $C=77°\ 51'$; $O\wedge i\text{-}i=102°\ 9'$, $O\wedge 1\text{-}i$, plane on acute edge, =115° 36′, $O \wedge \frac{1}{2}\text{-}\dot{i}$=149° 57′. Cleavage: basal. Usually in tufts of capillary crystals, consisting of elongated, slender, six-sided prisms.

H.=1—1·5. G.=4·5—4·6. Lustre adamantine, inclining to metallic. Color cherry-red. Streak brownish-red. Feebly translucent. Sectile. Thin leaves slightly flexible.

Comp.—$\mathrm{Sb\,O^3 + 2\,Sb\,S^3}$=Antimony 75·3, sulphur 19·8, oxygen 4·9=100. Analyses: H. Rose (Pogg., iii. 453, the sulphur separately determined):

1. Bräunsdorf	Antimony	74·45	Oxygen	5·29	Sulphur	20·49
2. "	"	75·66	"	4·27	"	20·49

Pyr., etc.—In the closed tube blackens, fuses, and at first gives a white sublimate of oxyd of antimony; with strong heat gives a black or dark-red sublimate. In the open tube and on charcoal reacts like stibnite.

Obs.—Results from the change of gray antimony. Occurs in veins in quartz, accompanying stibnite and valentinite, at Malaczka near Posing in Hungary; at Bräunsdorf near Freiberg in Saxony; at Allemont in Dauphiny; at New Cumnock in Ayrshire, Scotland; at South Ham, Canada East.

The *tinder ore* (*Zundererz*) has been shown to be wholly distinct from red antimony.

Artif.—This species is the compound long known in chemistry under the name of *kermes*.

227. CERVANTITE. Spiesglanzokker pt. *Karst.*, Mus. Lesk., i. 534, 1789, Tab., 54, 78, 1800. Antimony Ochre pt. Antimonocher pt. *Germ.* Gelbantimonerz (from Hungary) *Breith.*, Char., 98, 1823, 224, 1832. Acide autimonieux *Dufr.*, Min., ii. 654, 1845. Antimonous Acid, Antimonoso-antimonic Oxyd. Cervantite *Dana*, Min., 1854.

Orthorhombic. In acicular crystallizations. Also massive; as a crust, or a powder.

H.=4—5. G.=4·084. Lustre greasy or pearly, bright or earthy. Color isabella-yellow, sulphur-yellow, or nearly white, sometimes reddish-white. Streak yellowish-white to white.

Comp.—$\mathrm{Sb\,O^4}$, or $\mathrm{Sb\,O^3 + Sb\,O^5}$=Oxygen 20·8, antimony 79·2=100. Analyses: 1, Dufrenoy (l. c.); 2, Bechi (Am. J. Sci., II. xiv. 61); 3, Phipson (C. R., lii. 752):

	O	Sb	$\dot{\mathrm{C}}\mathrm{a}\,\ddot{\mathrm{C}}$	$\ddot{\bar{\mathrm{F}}}\mathrm{e}$
1. Cervantes	16·85	67·50	11·45	1·50, gangue 2·70=99·80 Dufrenoy.
2. Pereta, Tusc.	19·47	78·83	——	1·25, gangue 0·75=100·30 Bechi.
3. Borneo	65·00		——	$\ddot{\bar{\mathrm{F}}}\mathrm{e}$, $\ddot{\bar{\mathrm{A}}}\mathrm{l}$ 10·00, $\ddot{\mathrm{S}}\mathrm{i}$, etc., 21·25, $\dot{\mathrm{H}}$ 3·75=100 Phipson.

The compound $\mathrm{Sb\,O^3 + Sb\,O^5}$, free of water, is formed by different methods in chemistry, as by the roasting of stibnite, or of valentinite, etc.; and when pure it is white.

Pyr., etc.—B.B. infusible and unaltered; on charcoal easily reduced. Soluble in muriatic acid.

Obs.—Occurs at various mines of stibnite, and results from the alteration of this and other antimonial ores. Found at Cervantes in Galicia, Spain; Chazelles in Auvergne; Felsobanya, Kremnitz, and elsewhere in Hungary; Pereta in Tuscany (anal. 2); near St. Minvers, at Wheal Lea, at Wheal Kine, and at Endellion, in Cornwall; in Ayrshire, Scotland, at Hare Hill; in Borneo, in rhombic prisms half an inch long, terminating in two planes, and also massive; at the Carmen mine at Zacualpan in Mexico; at South Ham, Canada East; in California, Tulare Co., at Pass of San Amedio, with stibnite.

Phipson makes the Borneo mineral a hydrate, with the formula $\mathrm{Sb\,O^4 + \dot{H}}$. But, as Brush observes (Am. J. Sci., II. xxxiv. 207), the oxyd of iron and silicate of alumina present as impurities in a pale yellowish or reddish-white mineral, would have had, in combination, at least 3 p. c. of the water, if in the states of limonite and kaolin. Moreover, the fact which Phipson states, that the mineral is unaltered when heated, is further evidence that it is not a hydrate.

228. **STIBICONITE.** Antimony Ochre pt. (Syn. under Cervantite). Stibiconise *Beud.*, Tr., ii 616, 1832. Stiblith *Blum & Delffs*, J. pr. Ch., xl. 318. Stibiconite *Brush*, Am. J. Sci., II. xxxiv. 207, 1862.

Massive, compact. Also as a powder and in crusts.

H.=4—5·5. G.=5·28, B. & D. Lustre pearly to earthy. Color pale yellow to yellowish-white, reddish-white.

Formula given, $\text{Sb O}^4+\dot{\text{H}}$=Oxygen 19·6, antimony 74·9, water 5·5=100.

Analysis: Blum & Delffs (l. c.):

	O	Sb	As	$\dot{\text{H}}$
Goldkronach	19·54	75·83	*tr.*	4·63=100 B. & D.

Beudant states that stibiconite yields water, and he makes it in his formula antimonious acid with $x\dot{\text{H}}$. Blum & Delffs say that the water they obtained was probably mechanically mixed, but no reason for this conclusion is given. Volger states (Entw. Min., 72, 1854) that the stibiconite is a mixture of the following hydrous species with cervantite and valentinite. The compound $\text{Sb O}^4+\dot{\text{H}}$ has been formed artificially; but its existence in nature appears still to be doubtful Beudant mentions no particular locality. Blum & Delffs enumerate others besides Goldkronach in Bavaria, but evidently aim to include all localities of antimony ochre.

Partzite of A. Arents (Am. J Sci., II. xliii. 362) appears to be a hydrous oxyd of antimony mixed with various metallic oxyds, as pronounced by Blake (ib., xliv. 119). It varies in color from yellowish-green to blackish-green and black; has G.=3·8; H.=3—4; and an even conchoidal fracture.

An analysis afforded Arents $\ddot{\text{Sb}}$ 47·65, $\dot{\text{Cu}}$ 32·11, $\dot{\text{Ag}}$ 6·12, $\dot{\text{Pb}}$ 2·01, $\dot{\text{Fe}}$ 2·33, $\dot{\text{H}}$ 8·29=98·51. It occurs in the Blind Spring Mts., Mono Co., California, with argentiferous galenite, and antimonial ores of lead and silver, from whose decomposition it has probably proceeded.

Stetefeldtite of E. Riotte (B. H. Ztg., xxvi. 253, July, 1866) appears to be very similar to the partzite. It occurs massive; blackish and brown in color; H.=3·5—4·5; G.=4·12—4·24, with a shining streak.

Stetefeldt found as a mean of two analyses: Sb O^4 43·77, S 4·7, Ag 23·74, Cu 12·78, Fe 1·82, $\dot{\text{H}}$ 7·9; and thence deduces Sb O^5 46 47, S 4·59, Ag 23·23, Cu 2·27, $\dot{\text{Fe}}$ 2·41, $\dot{\text{Cu}}$ 13·28, $\dot{\text{H}}$ 7·75=100.

It comes from South-eastern Nevada, in the Empire district; also in the Philadelphia district.

229. **VOLGERITE.** Antimony Ochre pt. Hydrous Antimonic Acid.

Massive, or as a powder.
Color white.

Comp.—$\text{Sb O}^5+5\,\dot{\text{H}}$=Oxygen 19·3, antimony 58·9, water 21·8=100, Volger (Entwickl. Min., 77). The analysis of Cumenge corresponds to $\text{Sb O}^5+4\,\dot{\text{H}}$.

Analysis. Cumenge (Ann. d. M., IV., xx. 80):

O	Sb	$\dot{\text{H}}$	$\dot{\text{Fe}}$	gangue
17	62	15	1	3=98.

$\text{Sb O}^5+5\,\dot{\text{H}}$ is easily obtained artificially. It is tasteless, insoluble in water and acids, and has G.=6·6, Boullay It gives off its water at a heat below redness, and oxygen at a red heat. There is also a compound $\text{Sb O}^5+4\,\dot{\text{H}}$; but this is much less stable (Watt's Dict. Chem.).

Obs.—The mineral analyzed by Cumenge was from the province of Constantine, Algeria. Volger remarks that this white antimony ochre is a common result of the alteration of stibnite.

230. Tellurite. (Tellurige Säure *Petz*, Pogg., lvii. 478, 1842; Tellurite *Nicol*, Min., 429.) Small yellowish or whitish spherical masses, radiated in structure, and a yellowish, earthy incrustation, occurring with the native tellurium of Facebay and Zalathna; is said to afford the reactions of *tellurous acid.*

230A. Tantalic Ochre. A tantalic ochre occurs on crystals of tantalite at Pennikoja in Somero Finland; color brownish, lustre vitreous. *A. E. Nordenskiöld*, Finl. Min., 27, 1855.

III. OXYDS OF THE CARBON-SILICON GROUP, SERIES II.

231. QUARTZ. Κρύσταλλος *Theophr.*, etc. Crystallus (with allusion to its hexagonal form and pyramidal terminations) *Plin.*, xxxvii. 9, 10; Silex *Plin.*, xxxvi. 371. Crystallus, Quartzum candidissimum [auriferous], *Germ.* Quertze, Kiselstein, *Agric.*, 276, etc., 444, 459, 465, 1546, 1529. Quartz, Kisel, *Wall.*, 102, 1747. Quartz, Kiesel, *Germ.*

Rhombohedral, and for the most part hemihedral to the rhombohedron (or tetartohedral to the hexagonal prism). $R \wedge R = 94° 15'$, $O \wedge R = 128° 13'$; $a = 1{\cdot}0999$. Observed planes: (*a*) R, $-R$ (or -1), i, most frequent, as in f. 180–182, R and -1 making up the ordinary pyramidal terminations, and the latter often distinguishable from R in being the smaller planes, and sometimes in having feebler lustre or less smoothness; the pyramid sometimes consisting of R alone (f. 183); (*b*) planes 2-2, very common, but only hemihedrally, as in f. 186, and thus corresponding to the faces of a double three-sided pyramid; (*c*) various rhombohedrons replacing the basal edges of the hexagonal pyramid (as 4 in f. 185, $\frac{3}{2}$, 3, and -7, -1, in f. 191, others in f. 192), 3, 4, being the most common; also the rhombohedron $-\frac{1}{2}$ replacing the edges R/R (f. 191, 193, a rough plane, as usual); also, among other rhombohedrons, $\frac{2}{3}$, $\frac{4}{3}$, $\frac{5}{3}$, 2, 6, 7, 10, and the same in the negative series, besides 50 others; (*d*) various trapezohedral forms, situated obliquely about the angles of the pyramids, like 6-$\frac{6}{5}$ in f. 190, and others in f. 192, 193, the planes *gyroidal* or *plagihedral* in position, and inclining upward toward the right or left, and thus being either *right-handed* as in f. 192, or *left-handed* as in f. 190; and again occurring occasionally on each solid angle (as in f. 190), in which case they are *hemihedral* (12 out of the normal 24); or, as is generally the fact, only on the alternate solid angles (as in f. 192), when they are *tetartohedral*; or, more rarely, right-handed on one solid angle, and left-handed on the next, another kind of hemihedral form; among them, in the zone R : 2-2 : i, or -1 : 2-2 : i, there are *below* 2-2 (f. 192) the forms 3-$\frac{3}{2}$, 4-$\frac{4}{3}$ (o' f. 192), 6-$\frac{6}{5}$ (f. 190, and o''' f. 192), 12-$\frac{12}{11}$, etc., and many others; *above* 2-2, $\frac{3}{2}$-$\frac{3}{2}$, $\frac{4}{3}$-$\frac{4}{3}$, $\frac{6}{5}$-$\frac{6}{5}$, $\frac{8}{7}$-$\frac{8}{7}$, $\frac{9}{8}$-$\frac{9}{8}$ (f. 193), etc.; (*e*) other trapezohedrons bevelling the obtuse edges of the rhombohedron R, as $\frac{1}{5}$-3, $\frac{1}{4}$-3, $\frac{1}{2}$-$\frac{5}{3}$, 1-5, etc.; also (*f*) many trapezohedrons in other positions; the total number of different forms over 175.

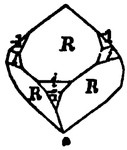
$i \wedge R = 141° 47'$
$i \wedge \frac{3}{2} = 154$ 43
$i \wedge 2 = 158$ 31
$i \wedge 3 = 165$ 18
$i \wedge$ 2-2 $= 142$ 2
$i \wedge$ 3-$\frac{3}{2} = 154$
$i \wedge$ 4-$\frac{4}{3} = 161$ 31

$i \wedge$ 6-$\frac{6}{5} = 167° 59'$
$i \wedge$ 8-$\frac{8}{7} = 171$ 8
$i \wedge$ 13-$\frac{13}{12} = 174$ 39
$i \wedge \frac{4}{3}$-$\frac{4}{3}$, ov. 2-2, $= 125$ 28
$i \wedge \frac{9}{8}$-$\frac{9}{8}$, ov. 2-2, $= 118$ 7
$i \wedge i = 120$
$i \wedge i$-$\frac{6}{5} = 171$ 33

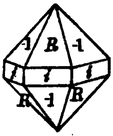
$R \wedge -1$, ov. i, $= 103° 34'$.
$R \wedge -1$, adj., $= 133$ 44.
$R \wedge i$, ov. 2-2, $= 113$ 8.
$R \wedge$ 2-2 $= 151$ 6.
$R \wedge 3 = 155$ 59.
$R \wedge 4 = 152$ 55.
$R \wedge \frac{9}{8}$-$\frac{9}{8} = 175$ 1.

Cleavage: R, -1, and i very indistinct: sometimes effected by plunging a heated crystal in cold water. Crystals either very short, or very much

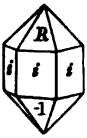
180



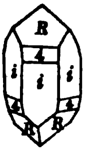
181



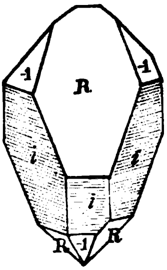
182



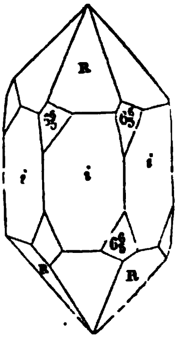
185



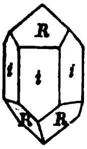
189



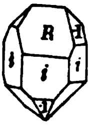
190



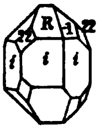
183



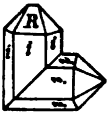
184



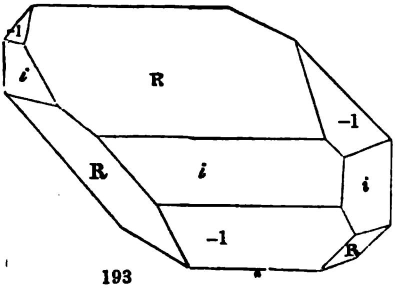
186



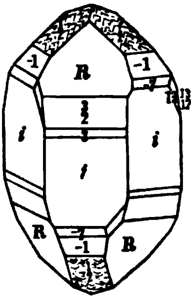
187



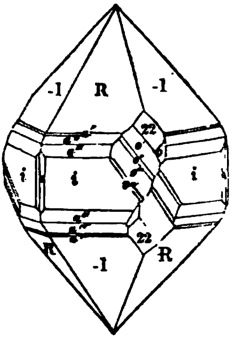
188



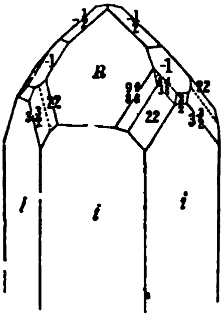
191



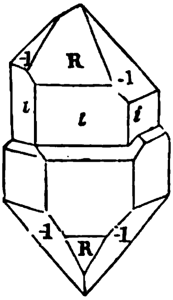
192



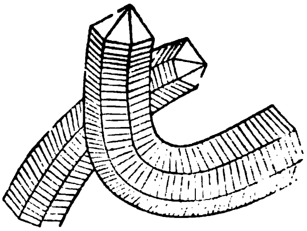
193



194



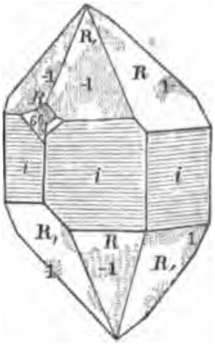
195



elongated, sometimes fine acicular; usually implanted by one extremity of the prism; occasionally twisted or bent (f. 195). Prismatic faces *i* commonly striated horizontally (f. 189, 195, 196), and thus distinguishable, in distorted crystals, from the pyramidal. Crystals often grouped by juxtaposition, not proper twins. Frequently in radiated masses with a surface of pyramids, or in druses having a surface of pyramids or short crystals.

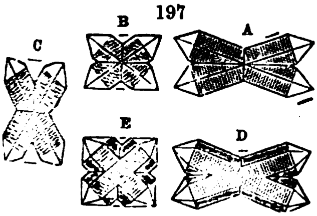
Twins: 1. Composition-face, the basal plane *O*; sometimes (*a*) revolution-twins, or such as correspond to a simple revolution of one-half (made by section parallel to the base), 60° or 180° to the right or left, bringing *R* above into the same vertical line with *R* below, and revolving other planes in a like manner (in f. 192 it would carry half the gyroidal planes to the next edge of the prism, and half the bevelled edge to the place of these planes). Very generally (*b*) *penetration-twins*, the forms not corresponding to a regular revolution, but to an irregular interpenetration of unlike parts of the crystal, making –1 to be distributed in irregular areas over *R*, and so also *R* over –1, with a similar irregular distribution of other planes, as illustrated in f. 196, in which the unshaded parts of the pyramidal faces are *R*, and the shaded parts are –1; crystals of quartz not thus compounded in some part are of very rare occurrence.

196

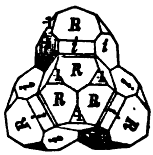


Other twins, mostly geniculating, as in f. 187, and very rarely cruciform (represented cruciform in f. 197, in order to exhibit the divergence of the vertical axes [axes *a*] of the combined crystals, and other relative characteristics): 2. C.-face *R*, or –1, f. 197B; divergence of axes $a = 76° 26'$ (because the angle between axis *R*, and *a* or –1, is 38° 13′); (*a*) simply geniculating, like either half of 197B; (*b*) a three-rayed twin, consisting of a central crystal twinned to three others by each *R* of one extremity, f. 198A, B. 3. Composition between *R* (or –1) and a face of the prism, *i*, f. 197A; divergence of axes $a = 33° 13'$. 4. C.-face $\frac{1}{2}R$, f. 197C; divergence of axes 115° 10′ (angle between axis *a* and face of $\frac{1}{2}R$ being 57° 35′; observed only in simple twins. 5. C.-face 1-2, or plane truncating edge of pyramid between *R* and –1 (a mode of twinning that belongs rather to the true hexagonal system than to the rhombohedral, and showing that the rhombohedral character is often crystallogenically but feebly dominant in the species), illustrated in f. 187 and 197E; divergence of axes $a = 84° 44'$ (because the angle between axis *a* and the pyramidal edge is 42° 17′); observed in geniculating or juxtaposition twins like f. 187, and either half of 195E; there are two kinds, one (*a*) in which faces *R* are correspondent in position in the two parts; (*b*) in which they are not so. 6. Composition between the plane truncating edge of pyramid (or 1-2) and that truncating edge of prism (or *i*-2), f. 197D; angle of divergence 42° 17′.

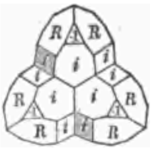
197



198A



198B

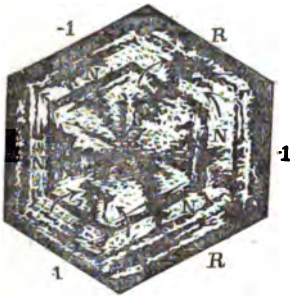


Massive; coarse or fine granular to flint-like or crypto-crystalline. Sometimes mammillary, stalactitic, and in concretionary forms.

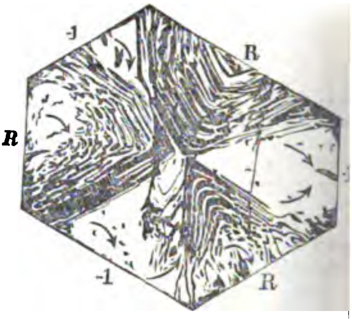
H.=7. G.=2·5–2·8; 2·6413–2·6541, Beudant; 2·663, Deville. Lustre vitreous, sometimes inclining to resinous; splendent—nearly dull. Colorless when pure; often various shades of yellow, red, brown, green, blue, black. Streak white, of pure varieties; if impure, often the same as the color, but much paler. Transparent—opaque. Fracture perfect conchoidal—subconchoidal. Tough—brittle—friable. Polarization circular, ther being a colored centre instead of a central cross, and the rings of colo around enlarging as the analyzer is turned to the right in right-handed crystals (f. 192), or left in left-handed (f. 190); and colored spirals are seen which rotate to the right or left, when the incident light and emergen light are polarized, one circularly and the other plane.

For observing the polarization, plates of the crystal are cut at right angles to the axis. I twins the component parts may be both right-handed or both left-handed (as in those of Dauphin and the Swiss Alps); or one may be of one kind and the other of the other. Moreover, successive layers of deposition (made as the crystal went on enlarging, and often exceedingly thin) ar sometimes alternately right and left-handed, showing a constant oscillation of polarity in the cours of its formation; and, when this is the case, and the layers are *regular*, cross-sections, examine by polarized light, exhibit a division, more or less perfect, into sectors of 120°, parallel to th plane *R*, or into sectors of 60°. If the layers are of unequal thickness, there are broad areas o colors without sectors. In f. 199 (by Descloizeaux, from a crystal from the Dept. of the Aude). hal of each sector of 60° is right-handed, and the other half left (as shown by the arrows), and the dar radii are neutral bands produced by the overlapping of layers of the two kinds. In f. 200, from

199



200



crystal of amethyst (also by Descloizeaux), the alternate white and black lines in each banded secto are due to alternate right and left-handed layers, parallel to *R*. The fact of a structure in layer is easily made manifest by means of fluoric acid, it corroding successive layers unequally. Th asteriated internal structure is often apparent in an asteriated arrangement of shades of color c of degrees of transparency. *Biaxial polarization* is sometimes a consequence of the composit structure (as in crystals from Euba, near Schemnitz).

In crystals, the planes *R* and -1, when not distinguishable by different degrees of lustr smoothness, or striation, may be by etching with fluoric acid, this process going on unequally i the two directions and producing a difference of surface, besides often developing the layers tha were superimposed in the growth of the crystal, alluded to above.

For papers on cryst. of quartz, see Weiss, Mag. Ges. nat. Fr., Berlin. vii. 163; Haidinge Brewster's J, i. 322, 1824; G. Rose, Ber. Ak. München, 1844. Pogg., lxii. 325. Descloizeau Mem. Crist. Quartz. Ann. Ch. Phys., xlv. 129, 1855, and Mem. Acad. Sci., xv. 404, 4to, 185 ; Sella, R. Acad. Sci. Torino, 8vo, 1856, and Studii Min. Sarda, 4to, Torino, 1856; Websky, Pogg xcix. 296, 1856, ZS. G., xvii. 348, 1865; Lang, Pogg., c. 351, 1857; Hessenberg, Min. Not., i. 1 ii 3. Jenzsch, Pogg., cxxx. 597, from whom figs. 195A—F are taken. F. Leydolt on the stru ture of quartz crystals as developed by means of fluoric acid, Ber. Ak. Wien, xv. 59, 1855.

Comp.—Pure silica, or $\ddot{\mathrm{Si}}$ = Oxygen 53·33, silicon 46·67 = 100. In massive varieties. Ofte mixed with a little opal-silica. Impure varieties contain oxyd of iron, carbonate of lime, clay sand and various minerals. Quartz-silica has been supposed to be insoluble in a hot solution o potash, and to be thus distinguishable from opal-silica. But since the investigations of Rammels berg (Pogg., cxii. 177) it has been questioned whether in a very finely divided state, and espec such as constitutes the compact (cryptocrystalline) chalcedony or flint, it is not more or l soluble. Rammelsberg subjected a number of kinds of quartz to the action of a hot pot solution, and the following are part of his results; under ign. and $\ddot{S}$ the *total* loss is give then, in brackets, the part from drying over sulphuric acid:

	Loss by ign. and $\bar{S}$.		Dissolved by potash.	
Vitreous massive quartz, Querbach	0·27		5 — 7 75	p. c
Gray hornstone, Schneeberg	2·35	[0·45]	12·82—15	"
Agate, Saxony, G. 2·661	0·39	[0·13]	2 43	"
Chalcedony, Faroe, G. 2 624	0·59	[0·21]	7·2 —20·1	"
" Hungary, G. 2·503	2·60	[1·17]	22 —93 88	"
Chrysoprase, Silesia, G. 2·635	1·83	[0·59]	7·36—50·59	"
Flint, G. 2·62, 2·63	1·40	[0·20]	20 2 —73·4	"

From the high specific gravity of kinds affording a large percentage of soluble silica, it appears that the soluble silica is not all amorphous or opal-silica. Jenzsch has announced (Pogg., cxxvi. 497) that there is a second modification of amorphous silica, distinct from opal, and hitherto unrecognized (see under Opal), having G.=2·6, like quartz. This suggests an explanation of the above. But the hyalite variety of opal, having G.=2·185, gave Rammelsberg 9·6 to 19·9 p. c of *insoluble* silica. To explain this fact by the same method still another modification of silica would be required—an insoluble kind, having the low specific gravity of opal.

Pyr., etc.—B.B. alone unaltered. With soda dissolves with effervescence; unacted upon by salt of phosphorus. Soluble only in fluohydric acid.

Var.—1. Crystallized (phenocrystalline), vitreous in lustre. 2. Flint-like massive, or cryptocrystalline. The first division includes all ordinary vitreous quartz, whether having crystalline faces or not. The varieties under the second are in general acted upon somewhat more by attrition, and by chemical agents, as fluoric acid, than those of the first. In all kinds made up of layers, as agate, successive layers are unequally eroded.

A. PHENOCRYSTALLINE OR VITREOUS VARIETIES.

1. *Ordinary Crystallized; Rock Crystal.* Colorless quartz, or nearly so, whether in distinct crystals or not. (*a*) Regular crystals, or limpid quartz; (*b*) right-handed crystals; (*c*) left-handed; (*d*) cavernous crystals, having deep cavities parallel to the faces—occasioned by the interference of impurities during their formation; (*e*) cap-quartz, made up of separable layers or caps, due to the deposit of a little clayey material at intervals in the progress of the crystal; (*f*) drusy quartz, a crust of small or minute quartz crystals; (*g*) radiated quartz, often separable into radiated parts having pyramidal terminations; (*h*) fibrous, rarely delicately so, as a kind from Orange river, near Cape of Good Hope.

2. *Asteriated; Star-quartz* (Stern-quartz *Germ.*). Containing within the crystal whitish or colored radiations along the diametral planes. Part if not all asteriated quartz is asteriated in polarization, as above described.

3. *Amethystine; Amethyst* (Ἀμέθυστον *Theophr.*, etc.). Clear purple, or bluish-violet. The color is supposed to be due to manganese. But Heintz obtained in an analysis of a Brazilian specimen, besides silica, 0·0187 oxyd of iron, 0·6236 lime, 0·0133 magnesia, and 0·0418 soda; and he considers the color owing to a compound of iron and soda. The structure is composite, as illustrated in f. 199, 200, and the shade of violet is usually deepest parallel to the planes *R*.

4. *Rose.* Rose-red or pink, but becoming paler on exposure. Common massive, and then usually much cracked. Lustre sometimes a little greasy. Fuchs states that the color is due to titanic acid; he found 1 to 1½ p. c. in specimens from Rabenstein, near Bodenmais. It may come in part from manganese.

5. *Yellow; False Topaz.* Yellow and pellucid, or nearly so; resembling somewhat yellow topaz, but very different in crystallization and in absence of cleavage.

6. *Smoky, Cairngorm Stone* (Mormorion *Plin.*, xxxvii. 63). Smoky-yellow to smoky-brown, and often transparent; but varying to brownish-black, and then nearly opaque in thick crystals. The color is probably due to titanic acid, as crystals containing rutile are usually smoky. Called *cairngorms* from the locality at Cairngorum, S.W. of Banff, in Scotland.

7. *Milky.* Milk-white and nearly opaque. Lustre often greasy, and then called *greasy* quartz.

8. *Siderite*, or *Sapphire-quartz.* Of indigo or Berlin-blue color; a variety occurring in an impure limestone at Golling in Saltzburg.

9. *Sagenitic.* Containing within acicular crystals of other minerals. These acicular crystals are most commonly (*a*) *rutile*, the mineral called from such specimens *sagenite* (fr. σαγήνη, *a net*) by de Saussure (see under Rutile). They may also be (*b*) black tourmaline; (*c*) göthite; (*d*) stibnite; (*e*) asbestus; (*f*) actinolite; (*g*) hornblende; (*h*) epidote.

10. *Cat's Eye* (Katzenauge *Germ.*, Œil de Chat *Fr.*). Exhibiting opalescence, but without prismatic colors, especially when cut *en cabochon*, an effect due to fibres of asbestus.

11. *Aventurine.* Spangled with scales of mica or other mineral.

12. *Impure from the presence of distinct minerals* distributed densely through the mass. The more common kinds are those in which the impurities are: (*a*) *ferruginous*, either red or yellow oxyd of iron; (*b*) *chloritic*, some kind of chlorite; (*c*) *actinolitic*; (*d*) *micaceous*; (*e*) *arenaceous*, or sand.

Quartz crystals also occur penetrated by various minerals, as topaz, corundum, chrysober garnet, different species of the hornblende and pyroxene groups, kyanite, zeolites, calcite a other carbonates, rutile, stibnite, hematite, göthite, magnetite, fluorite, gold, silver, anthrac etc. As quartz has been crystallized through the aid of hot waters or of steam in all ages do to the present, and is the most common ingredient of rocks, there is good reason why it shou be found thus the enveloper of other crystals.

13. *Containing liquids in cavities.* These liquids are seen to move with the change of posit of the crystal, provided an air-bubble be present in the cavity; they may be detected also by refraction of light. The liquid is either water (pure, or a mineral solution), or some petroleum-l or other compound. (See p. 761.)

B. Cryptocrystalline Varieties.

1. *Chalcedony* (Murrhina *Plin.*, xxxvii. 7. Ἴασπις pt. *Theophr.* Iaspis pt. *Plin.*, xxxvii. Murrhina, *Germ.* Chalcedonius, *Agric.*, 466, 1546, Chalcedon, Achates vix pellucida, nebul colore griseo mixta, *Wall.*, 83, 1747. Calcedoine *Fr.*). Having the lustre nearly of wax, either transparent or translucent. Color white, grayish, pale-brown to dark-brown, bla tendon-color common; sometimes delicate blue. Also of other shades, and then having ot names.

Often mammillary, botryoidal, stalactitic, and occurring lining or filling cavities in rocks. is true quartz, with some disseminated opal-quartz. A gray chalcedony from Hungary affor Redtenbacher (Ramm. Min. Ch., 1007) $\mathrm{\ddot{S}i}$ 98·87, $\mathrm{\bar{F}e}$ 0·53, $\mathrm{\dot{C}a\,\ddot{C}}$ 0·62=100·02.

2. *Carnelian* (Σάρδιον *Theophr.* Sarda *Plin.*, xxxvii. 23, id.=*Germ.* Carneol, *Agric.*, 468, 1 Carneol, Agates fere pellucida, colore rubescente, *Wall.*, 82, 1747. Cornaline *Fr.*). A clear chalcedony, pale to deep in shade; also brownish-red to brown, the latter kind (Sardoine reddish-brown by transmitted light.

Heintz found that the red color was due to oxyd of iron, obtaining in an analysis $\mathrm{\bar{F}e}$ 0·050 p $\mathrm{\bar{A}l}$ 0·081, $\mathrm{\dot{M}g}$ 0·028, $\mathrm{\dot{K}}$ 0·0043, $\mathrm{\dot{N}a}$ 0·075. It has been supposed to be of organic origin.

3. *Chrysoprase* (not Chrysoprasus *antiq.*). An apple-green chalcedony, the color due to presence of oxyd of nickel. Klaproth found in that of Silesia (Beitr., ii. 127) $\mathrm{\ddot{S}i}$ 96·16, $\mathrm{\bar{A}l}$ 0·08, 0·08, $\mathrm{\dot{N}i}$ 1·0, $\mathrm{\dot{C}a}$ 0·83, $\mathrm{\dot{H}}$ 1·85=100; and Rammelsberg, in the same (Pogg., cxii. 188), $\mathrm{\ddot{S}i}$ 97 $\mathrm{\bar{F}e}$, $\mathrm{\dot{N}i}$ 0·41, $\mathrm{\dot{C}a}$, $\mathrm{\dot{M}g}$ 0·51, $\mathrm{\dot{H}}$ 2·08.

4. *Prase.* Translucent and dull leek-green; so named from πράσον, *a leek.* Always regarde a stone of little value. The name is also given to crystalline quartz of the same color. "Vili est turbæ Prasius," says Pliny.

5. *Plasma* (Iaspis pt. *Plin.*, xxxvii. 37). Rather bright-green to leek-green, and also someti nearly emerald-green, and subtranslucent or feebly translucent; sometimes dotted with white

Heliotrope, or *Blood-stone*, is the same stone essentially, with small spots of red jasper, lool like drops of blood.

The *Iaspis*, or jasper of the ancients, was a semitransparent or translucent stone, and inclu in Pliny's time all bright-colored chalcedony excepting the carnelian (Sard). He gives sp prominence to sky-blue and green, and mentions also a shade of purple (the color of the best says), a rose color, the color of the morning sky in autumn, sea-green, terebenthine color (ye like turpentine, as interpreted by King), smoke-color (his capnias), etc.; but in general there tinge of blue, whatever the shade. The green kinds may have been chrysoprase or plasma perhaps a variety of jade, a stone known in Europe since the Stone age. The green, with a running through it (Monogrammos), may have been plasma, or jade, with a narrow sean white quartz.

Pliny's *Prasius*, spotted with red, was our heliotrope; his *Heliotrope* (xxxvii. 60) was a l green stone (prase or plasma) veined with blood-red (jasper); and the jasper was so abun a part as to give a general red reflection to the whole when it was put in water in the face of sun, whence the name from ἥλιος, *sun*, and τρέπω, *to turn.*

6. *Agate* (Ἀχάτης [fr. Sicily] *Theophr.* Achates pt. *Plin.*, xxxvii. 54. Onyx pt. *Plin.*, 24). A variegated chalcedony. The colors are either (α) banded; or (β) in clouds; or (γ) d visible impurities.

α. Banded. The bands are delicate parallel lines, of white, tendon-like, wax-like, pale and brown, and black colors, and sometimes bluish and other shades. They follow waving or zi courses, and are occasionally concentric circular, as in the eye-agate (*Leucophthalmus* Plin., xx 62, and *Triophthalmus* ib., 71). The fine translucent agates graduated into coarse and opaque k The bands are the edges of layers of deposition, the agate having been formed by a depos silica from solutions intermittently supplied, in irregular cavities in rocks, and deriving their centric waving courses from the irregularities of the walls of the cavity. As the cavity ca contain enough of the solution to fill it with silica, an open hole has been supposed to be reta on one side to permit the continued supply; but it is more probable that it passes through the c layers by osmosis, the denser solution outside thus supplying silica as fast as it is deposited within. The colors are due to traces of organic matter, or of oxyds of iron, manganese, or titanium, and largely to differences in rate of deposition. The layers differ in porosity, and therefore in the rate at which they are etched by fluoric acid; and consequently the etching process brings out the different layers, and makes engravings that will print exact pictures of the agate. Owing also to the unequal porosity, agates may be varied in color by artificial means.

A brown banded agate afforded Redtenbacher (Ramm. Min. Ch., 1007) $\ddot{\mathrm{S}}\mathrm{i}$ 98·91, $\dddot{\overline{\mathrm{F}}}\mathrm{e}$ 0·72, $\dot{\mathrm{C}}\mathrm{a}\,\ddot{\mathrm{C}}$ 0·31=99·94.

β. Irregularly clouded. The colors various, as in banded agate.

A whitish clouded var. (*a*) is probably the *Leucachates* Plin. (fr. λευκός, *white*); (*b*) a wax-colored, his *Cerachates* (fr. *cera*, *wax*), a name that may have been applied also to ordinary wax-colored chalcedony, as the stone was one in little repute; (*c*) a reddish, his *Sardachates*, or carnelian-agate. The last probably included also banded kinds. *Hemachateæ* (fr. αἷμα, *blood*) was probably a true light-colored agate, blotched with red jasper, "blushing with spots of blood," as says Solinus (King, p. 207), of which there are very beautiful kinds, and not simple red jasper. *Iaspachates* must have been an agate in which bluish and greenish shades (Iaspis) predominated. These names are given by Pliny without accompanying descriptions.

γ. Colors due to visible impurities. (*a*) *Moss-agate*, or *Mocha-stone*, filled with brown moss-like or dendritic forms distributed through the mass. (*b*) *Dendritic Agate*, containing brown or black dendritic markings. These two are the *Dendrachates* Plin. (fr. δένδρον, *a tree*).

There is also *δ. Agatized wood:* wood petrified with clouded agate.

7. *Onyx* (*'Ονύχιον Theophr.* Onyx pt. [rest agate, stalagmite, q. v.] *Plin.*, xxxvii. 24) Like agate in consisting of layers of different colors, but the layers are in even planes, and the banding therefore straight, and hence its use for cameos, the head being cut in one color, and another serving for the background. The colors of the best are perfectly well defined, and either white and black, or white, brown and black alternate.

8. *Sardonyx* (Plin., xxxvii. 23). Like onyx in structure, but includes layers of carnelian (sard) along with others of white or whitish, and brown, and sometimes black colors.

9. *Agate-Jasper.* An agate consisting of jasper with veinings and cloudings of chalcedony.

10. *Silicious sinter.* Irregularly cellular quartz, formed by deposition from waters containing silica or soluble silicates in solution.

11. *Flint* (Silex pt. *Plin.*, Feuerstein *Germ.*). Somewhat allied to chalcedony, but more opaque, and of dull colors, usually gray, smoky-brown, and brownish-black. The exterior is often whitish, from mixture with lime or chalk, in which it is imbedded. Lustre barely glistening, subvitreous. Breaks with a deeply conchoidal fracture, and a sharp cutting edge. The flint of the chalk formation consists largely of the remains of infusoria (Diatoms), sponges, and other marine productions. The silica of flint, according to Fuchs, is partly soluble silica. See on this point p. 194. There is usually one per cent. or so of alumina and peroxyd of iron, with one or two of water. The coloring matter of the common kinds is mostly carbonaceous matter.

12. *Hornstone* (Silex pt., *Plin.*, Hornstein *Germ.*). Resembles flint, but more brittle, the fracture more splintery. *Chert* is a term often applied to hornstone, and to any impure flinty rock, including the jaspers. A grayish chalcedonic hornstone from Marienbad afforded Kersten $\ddot{\mathrm{S}}\mathrm{i}$ 90·30, $\dddot{\overline{\mathrm{A}}}\mathrm{l}$ 3·10, $\dddot{\overline{\mathrm{F}}}\mathrm{e}$ 1·73, $\dot{\mathrm{M}}\mathrm{g}$ 1·28, $\dot{\mathrm{C}}\mathrm{u}$ 0·94, $\dot{\mathrm{N}}\mathrm{a}$ and $\dot{\mathrm{K}}$ 0·70, $\dot{\mathrm{H}}$ 1·95 (Jahrb. Min., 1845, 656).

13. *Basanite*, *Lydian Stone*, or *Touchstone* (Lapis Lydius *Plin.*, xxxiii. 43, ? Basanites *id.*, xxxvi. 11). A velvet-black siliceous stone or flinty jasper, used on account of its hardness and black color for trying the purity of the precious metals. The color left on the stone after rubbing the metal across it indicates to the experienced eye the amount of alloy. It is not splintery like hornstone. It passes into a compact, fissile, siliceous, or flinty rock, of grayish and other colors, called siliceous slate, and also *Phthanyte;* and then resembles ordinary jasper of grayish and other shades, especially the banded jaspers.

14. *Jasper.* Impure opaque colored quartz. (*a*) *Red* (Hæmatitis *Plin.*, xxxvii. c. 60, not his Hæmatites), sesquioxyd of iron being the coloring matter. (*b*) *Brownish*, or *ochre yellow*, colored by *hydrous* sesquioxyd of iron, and becoming red when so heated as to drive off the water. (*c*) Dark green and brownish-green. (*d*) Grayish-blue. (*e*) Blackish or brownish-black. (*f*) *Striped* or *riband jasper* (Bandjaspis *Germ.*), having the colors in broad stripes. (*g*) *Egyptian jasper*, in nodules which are zoned in brown and yellowish colors.

Porcelain jasper is nothing but baked clay, and differs from true jasper in being B.B. fusible on the edges. *Red porphyry*, or its base, resembles jasper, but is also fusible on the edges, being usually an impure feldspar.

C. Besides the above there are also:—

1. *Granular Quartz*, or *Quartz-rock.* A rock consisting of quartz grains very firmly compacted; the grains often hardly distinct. 2. *Quartzose Sandstone.* 3. *Quartz-conglomerate.* A rock made of pebbles of quartz with sand. The pebbles sometimes are jasper and chalcedony, and make a beautiful stone when polished. 4. *Itacolumite*, or *Flexible Sandstone.* A friable sand-rock, con

sisting mainly of quartz sand, but containing a little talc, and possessing a degree of fle bility when in thin laminæ. 5. *Buhrstone.* A cellular, flinty rock, having the nature in part coarse chalcedony.

6. *Pseudomorphous Quartz.* Quartz appears also under the forms of many of the mineral speci which it has taken through either the alteration or replacement of crystals of those species. T most common quartz pseudomorphs are those of calcite, barite, fluorite, and siderite. (*a*) *Tabu quartz* consists of intersecting plates of quartz, and is probably a result of the quartz being dep ited among intersecting plates of other minerals, as barite. (*b*) *Haytorite* of C. Tripe (Phil. Mag. 40, 1827) is a pseudomorph after datholite. (*c*) *Beckite* Duf. is a pseudomorph after coral, chal donic in character, from Devonshire, England; it contains some of the carbonate of lime of t original coral (Church, Phil. Mag., IV. xxiii. 95). (*d*) *Babel-quartz* is quartz which has impressi of cubes of fluor, arising from its having been deposited over the crystals. (*e*) *Silicified shells* proper pseudomorphs in quartz; they occur through many rock strata, including limestones. (*Silicified wood* is quartz pseudomorph after wood. The texture of the original wood is usua well retained, it having been formed by the deposit of silica from its solution in the cells of t wood, and finally taking the place of the walls of the cells as the wood itself disappeared.

Pyr., etc.—B.B. unaltered; with borax dissolves slowly to a clear glass; with soda dissol with effervescence; unacted upon by salt of phosphorus. Insoluble in muriatic acid, and o slightly acted upon by solutions of fixed caustic alkalies. When fused and cooled it becomes o silica, having G.=2·2.

Obs.—Quartz occurs as one of the essential constituents of granite, syenite, gneiss, mica schi and many related rocks; as the principal constituent of quartz-rock and many sandstones; as unessential ingredient in some trachyte, porphyry, etc.; as the vein-stone in various rocks, a for a large part of mineral veins; as a foreign mineral in the cavities of trap, basalt, and relat rocks, some limestones, etc., making geodes of crystals, or of chalcedony, agate, carnelian, et as imbedded nodules or masses in various limestones, constituting the flint of the chalk formati the hornstone of other limestones—these nodules sometimes becoming continuous layers; masses of jasper occasionally in limestone. It is the principal material of the pebbles of gra beds, and of the sands of the sea-shore and sand beds everywhere. It is reported by G. Rose occurring in the meteorite of Xiquipulco (Pogg., cxiii. 184).

Silica also occurs in solution (but mostly as a soluble alkaline silicate) in heated natural wate as those of the Geysers of Iceland, New Zealand, and California, and very sparingly in many c mineral waters.

Switzerland, Dauphiny, Piedmont, the Carrara quarries, and numerous other foreign localiti afford fine specimens of rock crystal. The most beautiful amethysts are brought from Ind Ceylon, and Persia, where they occur in geodes, and as pebbles; inferior specimens occur Transylvania, in large crystalline groups; in the vicinity of Cork, and on the island of M Ireland. The *false topaz* is met with in Brazil. *Rose quartz* occurs in a vein of manganese, tr ersing the granite of Rabenstein, near Zwiesel in Bavaria. *Prase* is found in the iron mines Breitenbrunn, near Schwartzemberg in Saxony; and in Brittany, near Nantes and Rennes. T amygdaloids of Iceland and the Faroe Islands, afford magnificent specimens of *chalcedony;* a Hüttenberg and Loben in Carinthia, etc. A smalt-blue variety, in cubical crystals (pseudomorp of fluorite), occurs at Treszytan, in Transylvania. The finest *carnelians* and *agates* are found Arabia, India, Brazil, Surinam, Oberstein, and Saxony. Scotland affords smaller but handso specimens (Scotch pebbles). *Chrysoprase*, at Kosemütz in Silesia. *Aventurine quartz*, at Cape Gata in Spain. *Cat's eye*, in Ceylon, the coast of Malabar, and also in the Harz and Bava *Plasma*, in India and China, whence it is usually brought in the form of beads. *Heliotrope*, Bucharia, Tartary, Siberia, and the island of Rum in the Hebrides. *Float stone*, in the chalk f mation of Menil Montant, near Paris, and in some of the Cornish mines. The banks of the N afford the Egyptian jasper; the striped jasper is met with in Siberia, Saxony, and Devonshire. *yellow jasper* is found at Vourla, bay of Smyrna, in a low ridge of limestone, to the right of t watering-place, between the harbor and the high hills back; it is associated with opal, chry prase, and hornstone, and these minerals seem to occupy in the limestone the place of hornsto which is found in various parts of the adjoining country, and also at Napoli di Romania in Gree The plains of Argos are strewn with pebbles of *red jasper*. A variety of sandstone occurs in t layers at Villa Rica, Brazil, remarkable for its flexibility; a similar *flexible sandstone* occurs in North Carolina gold region.

In New York, quartz crystals are abundant in Herkimer Co., at Middleville, Little Falls, Sa bury, and Newport, loose in cavities in the Calciferous sand-rock, or imbedded in loose earth, sometimes, according to Beck, in powdered anthracite. Fine dodecahedral crystals, at the b of specular iron in Fowler, Herman, and Edwards, St. Lawrence Co. In Gouverneur, cryst with tourmaline, etc., in limestone, which have rounded angles as if they had been partially fus On the banks of Laidlaw lake, Rossie, large implanted crystals. The Sterling ore bed, Antwe Jefferson Co., interesting dodecahedral crystals. 4 m. E. of Warwick, crystals presenting rhombohedral form, in jasper. At Palatine, Montgomery Co., crystals, having one end termina with the usual pyramid, while the other is rounded and smooth. Diamond Rock, near Lansingburgh, an old but poor locality. At Ellenville lead mine, Ulster Co., in elegant groups. At Diamond island and Diamond Point, Lake George, quartz crystals, as in Herkimer Co. In Mass., crystals with unusual modifications, sparingly at the Charlestown syenite quarry, one of which from the cabinet of Mr. J. E. Teschemacher is represented in f. 193. It has the adjacent planes 2-2 and $3\text{-}\frac{3}{2}$ uneven, and $-\frac{1}{2}$ with a triangular furrow but sharp edges; the rest are lustrous; with the reflective goniometer, reflecting the sun's rays, $R \wedge \frac{8}{3}\text{-}\frac{8}{3} = 175°$. Pelham and Chesterfield, Mass., Paris and Perry, Me., Benton, N. H., Sharon, Vt., and Meadow Mount, Md., are other localities of quartz crystal. Near Quebec, fig. 191, and other crystals similar, but the inverse. At Chesterfield, Mass., small unpolished *rhombohedrons*, in granite. At Paris, Me., handsome crystals of brown or smoky quartz. In large crystals, often perfect and weighing several pounds, at Minnesota mine, Lake Superior, occasionally enveloped in metallic copper, as if cast around the crystals. Drusy quartz, of brown, apple-green, and other tints, at Newfane, Vt. For other localities, see the catalogue of localities in the latter part of this volume.

Rose quartz, at Albany, and Paris, Me., Acworth, N. H., Williamsburg, Mass., Southbury, Conn., and Port Henry, Essex Co., N. Y.; *smoky quartz*, at Goshen, Mass., Richmond Co., N. Y., etc.; *amethyst*, in trap, at Keweenaw Point, Pic bay, and Gargontwa, on Lake Superior; also in the same rock at Bristol, Rhode Island, and sparingly throughout the trap region of Massachusetts and Connecticut; in Surry, New Hampshire; in Pennsylvania, in East Bradford, Aston, Chester, and Providence (one fine crystal over 7 lbs. in weight), in Chester Co.; very handsome at the Prince vein, Lake Superior. but now hardly obtainable, as the mine is not worked; also very large fine crystals, near Greensboro, N. C. Crystallized green quartz, in talc, at Providence, Delaware Co., Penn.; at Ellenville, N. Y., with chlorite. Chalcedony and agates of moderate beauty, in the same trap region; more abundantly about Lake Superior, the Mississippi, and the streams to the west; at Natural Bridge, Jefferson Co., N. Y.; about the Willamet, Columbia, and other rivers in Oregon; abundant and beautiful on N. W. shore of Lake Superior. Belmont's lead mine, St. Lawrence Co., N. Y., has afforded good chalcedony and chrysoprase, associated with calcite. Red jasper is found on Sugar Loaf Mt, Maine; in pebbles on the banks of the Hudson at Troy; yellow, with chalcedony, at Chester, Mass.; red and yellow, near Murphy's, Calaveras Co., Cal. Heliotrope occupies veins in slate at Bloomingrove, Orange Co., N. Y.

Smoky quartz in large crystals, some over 100 lbs., have been found on Paradise R., Nova Scotia.

Quartz pseudomorphs, after hexagonal and scalenohedral crystals of calcite and cubes of fluorite, at Westhampton, Mass.; after barite, probably, in Rutherford Co., N. C., often filled with water.

Quartz crystals occasionally occur of enormous size. A group in the museum of the university at Naples weighs nearly half a ton. A crystal belonging to Sig. Rafelli, of Milan, measures 3¼ ft. in length and 5½ in circumference, and its weight is estimated at 870 lbs; another in Paris is 3 ft. in diameter and weighs 8 cwt. About a century since a drusy cavity was opened at Zinken, which afforded 1,000 cwt. of rock crystal, and at that early period brought $300,000. One crystal weighed 800 lbs. A group from Moose Mountain, New Hampshire, at Dartmouth College, weighs 147½ lbs., and contains 48 crystals; four of them are from 5 to 5½ inches in diameter, ten from 4 to 4½ inches. A crystal from Waterbury, Vt., 2 ft. long and 18 inches through, weighs 175 lbs.

Several varieties of this species have long been employed in jewelry. The *amethyst* has always been esteemed for its beauty. Like most other stones, it is less brilliant by candle-light; it appears to best advantage when surrounded with pearls and set in gold. The color of the amethyst is often irregularly diffused, as is well described by Pliny, "ad viciniam crystalli descendet albicante purpuræ defectu," purple, gradually fading into white. It was called *amethyst*, αμεθυστος, on account of its pretended preservative powers against intoxication, from α, *not*, and μεθυω, *to intoxicate*. This is not, however, the only *amethyst* of the ancients. The violet-colored sapphire, the violet fluorite (scalpturis faciles, Plin., *easily graven*), and some other purple species, were designated by the same name; and it has been supposed that garnet was also included.

Cameos are in general made of onyx, which is well fitted for this kind of miniature sculpture. The most noted of the ancient cameos, is the Mantuan vase at Brunswick. It was cut from a single stone, and has the form of a cream pot, about seven inches high and two and a half broad; on its outside, which is of a brown color, there are white and yellow groups of raised figures, representing Ceres and Triptolemus in search of Proserpine. The Museo Borbonico, at Naples, contains an onyx measuring eleven inches by nine, representing the apotheosis of Augustus, and another exhibiting the apotheosis of Ptolemy on one side and the head of Medusa on the other; both are splendid specimens of the art, and the former is supposed to be the largest in existence.

The carnelian is often rich in color, but is too common to be much esteemed; when first obtained from the rock they are usually gray or grayish-red; they receive their fine colors from an exposure of several weeks to the sun's rays, and a subsequent heating in earthen pots. The colors of agate, when indistinct, may be brought out by boiling in oil, and afterward in sulphuric acid; the latter carbonizes the oil absorbed by the porous layers, and thus increases the contrast of the different colors. Agate is often made into mortars for chemical and pharmaceutical preparations, and, according to Pliny, it was employed for the same purpose by the physicians of his day. Pliny also mentions that "the best cautery for the human body is a ball of crystal acted on by the sun" (xxxvii. 10) He deplores the extravagance of his times, as exhibited in the crystal drinking cups and vases of the wealthy.

Jasper admits of a brilliant polish, and is often formed into vases, boxes, knife-handles, etc. It is also extensively used in the manufacture of Florentine mosaics.

Quartz is distinguished by its *hardness*—scratching glass with facility; *infusibility*—not fusing before the blowpipe; *insolubility*—not attacked by water or the acids; *uncleavability*—one variety being tabular, but proper cleavage never being distinctly observed. To these characteristics the action of soda B.B. may be added.

The word quartz is of German provincial origin. Agate is from the name of the river Achates, in Sicily, whence specimens were brought, as stated by Theophrastus.

Alt.—Pseudomorphs of pyrite, tin ore, stannite, magnetite, hematite, and voltzite, after quartz, have been met with.

232. OPAL. Opalus, Pæderos, *Plin.*, xxxvii. 21, 22. Quartz resinite *H.*, Tr., ii. 1801.

Massive, amorphous; sometimes small reniform, stalactitic, or large tuberose. Also earthy.

H.=5·5—6·5. G.=1·9—2·3. Lustre vitreous, frequently subvitreous; often inclining to resinous, and sometimes to pearly. Color white, yellow, red, brown, green, gray, generally pale; dark colors arise from foreign admixtures; sometimes a rich play of colors, or different colors by refracted and reflected light. Streak white. Transparent to nearly opaque.

Comp.—$\ddot{\text{Si}}$, as for quartz, silica being dimorphous, the opal condition being one of lower degrees of hardness and specific gravity, and, as generally believed, of incapability of crystallization. Water is usually present, but it is regarded as unessential. It varies in amount from 2·75 to 21 p. c; or, mostly, from 3—9 p. c.=$\ddot{\text{Si}}+\frac{1}{9}\dot{\text{H}}$ to $\ddot{\text{Si}}+\frac{1}{3}\dot{\text{H}}$ (or 9 $\ddot{\text{Si}}+\dot{\text{H}}$ to 3 $\ddot{\text{Si}}+\dot{\text{H}}$). Opal often contains more or less of quartz mixed with it; and most of the analyses are unsatisfactory, because they leave the amount of the latter wholly unconsidered; and since solubility in a hot solution of caustic potash is not a decisive test of opal, as shown by Rammelsberg (Pogg., cxii. 177), no method for its exact determination is known. (See p. 192, under QUARTZ.) Rammelsberg's percentage results are as follows; under the heading ign. & $\dddot{\text{S}}$, the sum of the loss by both is given, and in brackets that by drying over sulphuric acid alone:

	G.	G. after ign.	Ign. & $\dddot{\text{S}}$.		Insol.
Semiopal, Grochau	2·101	1·878	6·55		7·21
" Vallecas, *brown*	2·216	2·224	11·75	[8·26]	18·5—39·3
" " *white*			4 54	[1·78]	19·2—53·5
Geyserite, Iceland			8 83	[3·41]	4·8 (=$\bar{\text{F}}\text{e}$)
Hyalite, Walsch	2·185		3·28	[0]	9·7—19·9
" " after ign.		1·507			21· —45·9

Moreover, optical characters do not afford decisive distinctions; for Ehrenberg has found (Ber. Ak. Berlin, 65, 1849, Ramm., Pogg., cxii. 191) that *hyalite*, after ignition and before, and *chrysoprase* are alike doubly-refracting; *chalcedony* from Faröe and *semiopal* from Vallecas, doubly-refracting, with spots of singly-refracting; *semiopal* fr. Grochau and *flint*, singly-refracting, with spots of doubly-refracting.

Var.—1. *Precious Opal.* Exhibits a play of delicate colors, or, as Pliny says, presents various refulgent tints in succession, reflecting now one hue and now another. Seldom larger than a hazel nut; a mass in the Vienna museum has the size of a man's fist and weighs 17 oz., but has numerous fissures, and is not wholly free from the matrix.

2. *Fire-opal* (Feueropal, fr. Mexico, *Humboldt*, *Karsten*, Klapr. Beitr., iv. 156, 1807). Hyacinth-red to honey-yellow colors, with fire-like reflections, somewhat irised on turning.

3. *Girasol.* Bluish-white, translucent, with reddish reflections in a bright light.

4. *Common Opal.* In part translucent; (*a*) milk-white to greenish, yellowish, bluish; (*b*) *Resin opal* (Wachsopal, Pechopal, *Germ.*), wax-, honey- to ochre-yellow, with a resinous lustre; (c

dull olive-green and mountain-green; (*d*) brick-red. Includes *Semiopal* (Halbopal *Wern.*, Bergm. J., 375, 1789); also (*e*) *Hydrophane*, which is translucent, whitish, or light-colored, adheres to the tongue, and becomes more translucent or transparent in water (to which the name, from ὕδωρ, *water*, and φαίνω, *to make clear*, alludes), a very common quality of opal. (*f*) *Forcherite* (Auhhorn, Wien. Ztg. Abendbl., Jul. 11, 1860); an orange-yellow opal, colored by orpiment; G.=2·17 Maly (J. pr. Ch., lxxxvi. 501). It is from Reittelfeld, in Upper Styria.

5. *Cacholong* (Kaschtschilon *of Kalmucks* and *Tartars* [=beautiful stone], Kascholong *Germ.* Perlmutter-opal *Karst.*, Tab., 1808). Opaque, bluish-white, porcelain-white, pale-yellowish or reddish; often adheres to the tongue, and contains a little alumina.

6. *Opal-agate.* Agate-like in structure, but consisting of *opal* of different shades of color.

7. *Menilite* (Pechstein de Menil Montant *Delarbre & Quinquet*, J. de Phys., xxxi. 219, 1787; Menilite *de Saussure*, Delameth. T. T., ii. 169, 1797. Leberopal *Karst.*, Tab., 24, 1800). In concretionary forms, tuberose, reniform, etc., opaque, dull grayish, grayish-brown, occurring imbedded in a shaly argillaceous deposit.

8. *Jasp-opal* (Karst. Tab., 26, 1808; Opal-jasper, Eisenopal, *Hausm.*, Handb., 428, 1813). Opal containing some yellow oxyd of iron and other impurities, and having the color of yellow jasper, with the lustre of common opal.

9. *Wood-opal* (Holz-opal *Germ.*). Wood petrified by opal.

10. *Hyalite* (Mullerisches Glas [=Muller's Glass, after the discoverer]; Hyalit *Wern.*, Hoffm. Min., ii. *a*, 134, 1812, *Karst.*, Tab., 22, 1800; Gummistein *Blumenb.*, Nat., 553; Glasopal *Hausm.*, Handb., 424, 1813). Clear as glass and colorless, constituting globular concretions, and also crusts with a globular, reniform, botryoidal, or stalactitic surface; also passing into translucent, and whitish.

11. *Fiorite*, *Siliceous Sinter* (Kieselsinter *Germ.*; *Santi*, Viaggio al Montomiata, Pisa, 1795, Crell's Ann., ii. 589, 1796; *Thomson*, J. de Phys., xxxix. 407, 1791, Breve Notizia di un Viaggiatore sulle Incrost. Sil. termali d'Italia, etc., 1795, Crell's Ann., i. 108, 1796, Bibl. Brittan, 185, 1796 (? name fiorite here given); *Pfaff.*, Crell's Ann., ii. 589, 1796; Resinite termogino (*Ital.*). Includes translucent to opaque, grayish, whitish, or brownish incrustations, porous to firm in texture; sometimes fibrous-like or filamentous, and, when so, pearly in lustre (then called *Pearl-sinter*); formed from the decomposition of the siliceous minerals of volcanic rocks about fumaroles, or from the siliceous waters of hot springs. It graduates at times into hyalite. (*a*) The original *fiorite* (or pearl-sinter), as described by Thomson, occurs in tufa in the vicinity of Santa Fiora, Italy, and also on Ischia, and at the Solfatara near Naples, in globular, botryoidal, and stalactitic concretions, pearly in lustre. Thomson also mentions (1791) a similar incrustation as formed from the hot waters of the Sasso lagoons. It was referred by Werner to hyalite in 1816 (Hoffmann). (*b*) The *Michaelite* (J. W. Webster, Am. J. Sci., iii. 391, 1821) is similar, from the island of St. Michaels, one of the Azores, where it occurs in snow-white incrustations, capillary or filiform in structure, pearly in lustre, with G.=1·866. (*c*) *Geyserite* (Kieseltuff (fr. Geysers) *Klapr.*, Beitr., ii. 109, 1797; Geysirite *Delameth.*, Min., 1812; Damour, Bull. G. Fr., 1848, 157) constitutes concretionary deposits about the Iceland geysers, presenting white or grayish, porous, stalactitic, filamentous, cauliflower-like forms; also compact-massive, and scaly-massive; H.=5; rarely transparent, usually opaque; sometimes falling to powder on drying in the air.

12. *Float-stone* (Quartz nectique, *H.*, Tr., ii. 1801; Schwimmstein *Germ.*). In light concretionary or tuberose masses, white or grayish, sometimes cavernous, rough in fracture. So light, owing to its spongy texture, as to float on water. The concretions sometimes have a flint-like nucleus.

13. *Tripolite* (Trippel, Terra Tripolitana (fr. Tripoli, in part), *Wall.*, 32, 1747. Infusorial earth; Bergmehl, Kieselmehl, Kieselguhr, *Germ.* Farina fossilis. Randanite *Salvetat*, Ann. Ch. Phys., III. xxiv. 348, 1848). Formed from the siliceous shells of Diatoms and other microscopic species, as first made known by Ehrenberg, and occurring in deposits, often many miles in area, either uncompacted, or moderately hard. (*a*) *Infusorial Earth*, or *Earthy Tripolite*, a very fine-grained earth looking often like an earthy chalk, or a clay, but harsh to the feel, and scratching glass when rubbed on it. (*b*) *Randanite*, a kaolin-like variety from Ceyssat near Randan, in Dept. Puy de Dome, and from Algiers, containing 9 to 10 p. c. of water. A deposit at Santa Fiora in Tuscany was made known by G. Fabbroni in 1794 (Giorn. Fis.-med. di D. Brungnatelli, p. 154; Crell's Ann., ii. 199, 1794; Bergmehl v. Santa Fiora *Klaproth*, Beitr., vi. 348). It consists of a grayish-white, loose, mealy earth; Fabbroni states that he made bricks of it which would float like those which Pliny described as made in Spain from a sort of pumice-like earth (xxxv. 49), and supposes the material the same. Ehrenberg has shown it to be an infusorial earth. (*c*) *Tripoli slate* (Polishing slate, Polierschiefer, Tripelschiefer, Saugkiesel, Klebschiefer, *Germ.*), a slaty or thin laminated variety, fragile; G.=1·909—2·08. Often much impure from mixture with clay, magnesia, oxyd of iron, etc. (*d*) *Alumocalcite* (fr. Eibenstock, Breith., Char., 97, 326, 1832) is a milk-white material, having a hardness of only 1 to 1½; G.=2·174; it may be a variety of tripolite, containing a little lime and alumina.

Analyses: 1, Klaproth (Beitr., ii. 151); 2, v. Kobell (Char., 252, 1830); 3–6, Damour (Bull. G

Fr., II. v. 162, 1848); 7, Klaproth (l. c., iv. 156); 8, id. (ib., ii., 157); 9, Forchhammer (Pogg., xxx 331); 10, G. J. Brush (This Min., 152, 1854); 11, Klaproth (l. c., v. 19); 12, id. (ib., ii. 154); 1 Tschermak (Ber. Ak. Wien, xiii. 381); 14, Wrightson (Ann. Ch. Pharm., liv. 358); 15, Stuck (Nose Beschr. vulk., Foss., 73); 16, Forchhammer (l. c.); 17, 18, Damour (l. c.); 19, Klaprot (l. c., ii. 160); 20. 21, V. d Mark (Verh. nat. Ver. Bonn, ix. 1852); 22, Wertheim (Ramm. Min. Ch 133); 23, G. J. Brush (This Min., 691, 1850); 24, J. L. Smith (Am. J. Sci., xv. 435); 25, Klaproth (l. c., ii. 166); 26, 27, R. Brandes (Nogg. Geb. Rh.-Westph., i. 338); 28, V. d. Mark (l. c., 29, Klaproth (l. c., ii. 162); 30, Beudant (Tr., ii. 18).

31, Damour (l. c.); 32, Schaffgotsch (Pogg., lxviii. 147); 33, Damour (l. c.): 34, Bucholz (Geh J., i. 202, viii. 176); 36–38, Damour (l. c.); 39, Klaproth (l. c.); 40, Kersten (Schw. J., lxvi. 25); 4 Forchhammer (Pogg., xxxv. 331); 42, 43, Bickell (Ann. Ch. Pharm., lxx. 290); 44, Pattisc (Phil. Mag., III. xxv. 495); 45, Mallet (ib., IV. v. 285).

46, Klaproth (l. c., vi. 348); 47, 48, Fournet & Salvetat (Ann. Ch. Phys., III. xxiv. 348); 4 Baumann (Ramm. Min. Ch., 136); 50, R. Hoffmann (J. pr. Ch., xc. 467); 51, Hanstein & Schul (Ann. Ch. Pharm., xcv. 292); 52, Kuhlmann (ZS. nat. Ver. Halle, viii. 478); 53, Klaproth (l. c v. 112); 54, 55, Bucholz (Leonh. Tasch., vi. 5, 8); 56, Kersten (Freiesleb. Mag. Orykt., Heft 5

		S̈i	Ħ	Äl	F̶e	Ċa	Ṅa	K̇	
1.	Czorwenitza, *precious opal*	90	10	——	——	——	——	——	=100 Klaproth
2.	" "	[89·06]	10·94	——	——	——	——	——	=100 Kobell.
3.	" G.=2·029	[93·90]	6·10	——	——	——	——	——	=100 Damour.
4.	Mexico, *limpid*, G.=2·029	[91·12]	8·88	——	——	——	——	——	=100 Damour.
5.	" *chatoyant*, G.=2·024	[89·90]	10·10	——	——	——	——	——	=100 Damour.
6.	" "	[93·95]	6·05	——	——	——	——	——	=100 Damour.
7.	Zimapan, *Fire-opal*	92·00	7·75	——	0·25	——	——	——	=100 Klaproth
8.	Kosemütz, *milk-w.*	98·75	[1·05]	0·10	0·10	——	——	——	=100 Klaproth
9.	Faröe, *Fire-opal*	88·73	7·97	0·99	——	0·49	0·34		Ṁg 1·48=100
10.	Georgia, " G.=2·07	91·89	5·84	1·40	——	Ṁg 0·92	——	——	=100·05 Brush
11.	Moravia, *gray*	85	8^a	3	1·75	——	——	——	, C 1, Bit. 0·33=99·08 Klaprot
12.	Hubertsburg, *Hydrophane*	93·13	5·25	1·62	——	——	——	——	=100 Klaproth
13.	Thebes, "	85·8	8·4	——	——	Ṁg 4·9	——	——	=100·1 Tsch.
14.	Schiffenberg, *Semi-opal*	90·20	2·73	1·86	4·01	" 0·86	0·90	0·80	S̈0·31=101·76W
15.	Hanau "	82·75	10·00	3·50	3·00	Ċa 0·25	——	——	=99·50 Stucke.
16.	Faröe, *Cacholong*	95·32	3·47	0·20	——	0·06	0·06	0·07	, Ṁg 0·4=99·5
17.	Iceland, *Resinopal*, G.=2·095	[92·03]	7·97	——	——	——	——	——	=100 Damour.
18.	Mexico, "	[95·40]	4·60	——	——	——	——	——	=100 Damour.
19.	Telkebanya, "	93·5	5·0	——	1·0	——	——	——	=100 Klaproth
20.	Rosenau, *ywh.-brown*	91·82	5·61	0·14	2·15	Ṁg 0·18	——	0·10	=100 Mark.
21.	" w. ext. of last.	89·54	5·08	0·27	4·94	" 0·17	——	——	=100 Mark.
22.	Meronitz, *gnh.-brown*	83·73	11·46	——	3·58	Ċa 1·57	——	——	, Ṁg0·67=101W
23.	Vourla, *gyh.-green*, G.=2·054	[94·9]	5·1	——	——	——	——	——	=100 Brush.
24.	Harmanjick, *Resinopal*	92·0	4·15	——	——	Ṁg 3·0	——	——	=99·15 Smith.
25.	Menil-Montant, *Menilite*	85·5	$11·0^b$	1·0	0·5	0·5	——	——	=98·5 Klaprot
26.	Oberkassel, *Wood-opal*	93·01	4·12	0·12	0·37	——	——	——	=99·62 Brande
27.	Quegstein, Siebengeb. "	86·00	9·97	0·50	3·50	——	——	——	, S̈0·20=100·17
28.	Stenzelberg, *Jaspopal*	88·28	5·07	0·31	5·58	Ṁg 0·16	——	——	=100 Mark.
29.	Telkebanya, "	43·5	7·5	——	47·0	——	——	——	=98·0 Klaprot
30.	Jasztraba, Hung."	47·81	13·17	0·93	38·09	——	——	——	=100 Beudant.

2. *Hyalite, Fiorite or Siliceous Sinter.*

		S̈i	Ħ	Äl	F̶e	Ċa	Ṅa	K̇	
31.	Waltsch, Bohem., *Hyalite*	[96·94]	3·06	——	——	——	——	——	=100 Damour.
32.	" " "	95·5	3·0	——	0·8	0·2	——	——	=99·5 Schaffg.
33.	Kaiserstuhl "	[96·99]	3·01	——	——	——	——	——	=100 Damour.
34.	Frankfort, a. M. "	92·00	6·33	——	——	——	——	——	=98·33 Buchol
35.	Azores, *Michaelite*	82·29	16·35	1·36	*tr.*	——	——	——	=100 Webster.
36.	Iceland, *Geyserite*	87·67	10·40	0·71		0·40	0·82	*tr.*	=100 Damour.
37.	" " *gray*	[92·59]	7·41	——	——	——	——	——	=100 Damour
38.	" " *white*	[91·23]	8·97	——	——	——	——	——	=100 Damour.
39.	" "	98·0	——	1·5	0·5	——	——	——	=100 Klaproth
40.	" "	94·01	4·10	1·70	——	——	——	——	=99·81 Kerst.
41.	" "	84·43	7·88	3·07	1·91	0·70		0·92	, Ṁg 1·06 Forchh.
42.	" "	85·26	4·79	0·69	3·26	0·29	0·11	0·11	, S̈ 2·49=100 B

	$\ddot{Si}$	$\dot{H}$	$\ddot{\bar{Al}}$	$\ddot{\bar{Fe}}$	$\dot{Ca}$	$\dot{Na}$	$\dot{K}$
43. Iceland, *Geyserite*	91·56	5·76	1·04	0·18	0·33	0·16	0·19, $\ddot{S}$ 0·31, $\dot{Mg}$ 0·41 =100 Bickell.
44. N. Zealand, " G.=1·968	77·35	7·66	9·70	3·72	1·74	—	——=100·17 Pattis.
45. " "	94·20	3·06	1·58	0·17	*tr.*	0·85[c]	——=99·86 Mallet.
3. *Tripolite, Infusorial Earth, Floatstone.*							
46. Santa Fiora, *Bergmehl*	79	12	5	3	—	—	——=99 Klaproth.
47. Ceyssat, *Randanite*	87·2	10·0	2·00		0·8[d]	—	——=100 Fournet.
48. Algiers, "	80·00	9·00	1·41	0·55	0·56	2·00,	ins. $\ddot{S}$ 6·48=100 S.
49. Bilin, *Tripolite*, G.=1·862.	87·58	8·89	2·04		1·09	——	$\dot{Mg}$ 0·30=99·90 Bau.
50. " "	80·30	10·90	5·40		0.44	*tr.*	0·30, $\dot{Mg}$. 0·43[f], Org. 1·30=99·08 Hoffmann.
51. Luneberg, *Earth*	87·86	8·43	0·13	0·73	0·75[e]	——	,Org. 2·28=100·18 H.
52. Ebstorf, "	90·86	9·01	0·29	0·23	0·16[e]	——	,$\dot{Mg}\ddot{C}$ 0·09=100·64 K.
53. Mauritius, *Kieselguhr*	72·0	21·0	2·5	2·5	—	—	——=98·0 Klaproth.
54. Paris, *Q. nectique*, lighter	94·0	5·0	0·5		—	—	——=99·5 Bucholz.
55. " " heavier	91·0	6·0	0·25		$\dot{Mg}$ *tr.*	——	, $\dot{Ca}\ddot{C}$ 2·00=99·25 B
56. Eibenstock, *Alumocalcite*	86·60	4·00	2·23	—	$\dot{Ca}$ 6·25	—	——=99·08 Kersten.

[a] Somewhat ammoniacal. [b] With some carbonaceous material. [c] Na Cl. [d] With some magnesia. [e] Carbonate of lime. [f] Also ammonia 0·01.

Randanite of Salvetat (anal. 48) corresponds to the formula $\ddot{Si}^{3}\dot{H}$ (=$\ddot{Si}$ 90·9, $\dot{H}$ 9·1) when dried at 16° C., and $\ddot{Si}^{6}\dot{H}$ (=$\ddot{Si}$ 95·3, $\dot{H}$ 4·7) when dried at 100° C. The precious opal of Hungary, analyzed by v. Kobell (anal. 2), lost 7·5 p. c. on drying at a low heat, and the rest of the water, or 3·44 p. c., on ignition.

Pyr., etc.—Yields water. B.B. infusible, but becomes opaque. Some yellow varieties, containing oxyd of iron, turn red.

Obs.—Occurs filling cavities and fissures or seams in igneous rocks, porphyry, and some metallic veins. Also imbedded, like flint, in limestone, and sometimes, like other quartz concretions, in argillaceous beds; also formed from the siliceous waters of some hot springs; also resulting from the mere accumulation, or accumulation and partial solution and solidification, of the siliceous shells of infusoria—which consist essentially of opal-silica. The last mentioned is the probable source of the opal of limestones and argillaceous beds (as it is of flint in the same rocks), and of part of that in igneous rocks. It exists in most chalcedony and flint. Being like quartz in origin, it is natural that the two should be often mixed together. Common opal and hyalite are products of the decomposition of a Roman cement at the hot springs of Plombières in France.

Precious opal occurs in porphyry at Czerwenitza, near Kashau in Hungary, at Frankfort, and at Gracias a Dios in Honduras. *Fire opal* occurs at Zimapan in Mexico; Faröe; near San Antonio, Honduras. *Common opal* is abundant at Telkebanya in Hungary; near Pernstein, Luckau, and Smrezet in Moravia; in Bohemia; at Kosemütz in Silesia; Hubertsburg in Saxony; Stanzelberg and Quegstein in Siebengebirge; Steinheim near Hanau; in Faröe, Iceland; the Giant's Causeway, and the Hebrides; also within ¼ m. and to the S.W. of the watering-place at Vourla, the harbor of Smyrna, along with yellow jasper and hornstone, imbedded in a low ridge of yellowish compact limestone; of a wax-yellow and grayish-green color, occasionally white, at the Giant's Causeway. *Hyalite* occurs in amygdaloid at Schemnitz, Hungary; in clinkstone at Waltsch, Bohemia. *Wood opal* forms large trees in the pumice conglomerates of Saiba, near Neusohl; Kremnitz, Hungary; Faröe; near Hobart Town, Tasmania; and in many other regions of igneous rocks.

The Luneberg earth contains many species of infusoria, and is 10 to 18 ft. thick.

In U. S, *hyalite* occurs sparingly in N. York, at the Phillips ore bed, Putnam Co., in thin coatings on granite; rarely in N. C., Cabarrus Co., with the auriferous quartz; in Georgia, in Burke and Scriven Cos., lining cavities in a siliceous shell-rock; in Washington Co., good fire opal; at the Suanna spring, Florida, small quantities of siliceous sinter.

The precious opal, when large, and exhibiting its peculiar play of colors in perfection, is a gem of high value. It is cut with a convex surface.

233. **JENZSCHITE.**—A *second* modification of amorphous silica is mentioned above (p. 194) as announced by G. Jenzsch. The facts may receive other explanation. For the present the opals supposed to represent it may be included under the above name. The characteristic is a specific gravity of 2·6, like quartz-silica, while soluble in a hot solution of caustic potash. The kinds here referred to are a white cacholong from Hüttenberg in Carinthia, G.=2·591; from Hutberg, near Weissig, in amygdaloid, G.=2·633—2·647; from the porphyry of Regensberg, G.=2·620; from Brazil, G =2·596. They are generally associated with chalcedony, and Jenzsch regards them as a result of its alteration.

II. TERNARY OXYGEN COMPOUNDS.

1. SILICATES.

A. ANHYDROUS SILICATES.

The following are the general subdivisions of the Anhydrous Silicates:

I. Bisilicates. Oxygen ratio for the bases and Silica 1 : 2.

II. Unisilicates. Oxygen ratio for the bases and Silica 1 : 1.

III. Subsilicates. Oxygen ratio for the bases and Silica 1 : less tha 1; mostly 1 : $\frac{2}{3}$; but also 1 : $\frac{1}{2}$, and 1 : $\frac{3}{4}$.

These subdivisions are essentially the same that were brought forwar in the last edition of this work. The section of Tersilicates has, howeve disappeared, the species hitherto arranged under that head being proved t have no existence; and the few Sesquisilicates, and the Micas and Fel spars, are added to the Unisilicates.

Constitution and Formulas of Silicates.—The bases in the Silicates comprise various elemen of Series I. (see p. 2) in their different states of oxydation, protoxyd, sesquioxyd, or deutoxyd, an possibly tritoxyd; namely, K, Na, Li, Th, Cs, H, Ba, Sr, Ca, Mg, Ce, La, Di, Fe, Mn, Cr, Al, an rarely also Zn, Ni, Co, Ti; and in a few cases boron, of Series II., in the tritoxyd state. The el ment silicon is so strongly negative, that in its oxygen combinations all other elements prese are relatively basic.

The basic elements enumerated, when in the same state of oxydation, are mutually replaceabl and, as the analyses beyond illustrate, 8 or 10 often occur in the same compound, combined eith in simple, or indeterminate, ratios. But while in general thus replacing one another, there a certain groups, as, for example, the Feldspar and Scapolite, in which $\ddot{\ddot{\text{Al}}}$ is not replaced by F nor $\dot{\text{Ca}}$, $\dot{\text{Na}}$, $\dot{\text{K}}$ by $\dot{\text{Mg}}$, or $\dot{\text{Fe}}$, the presence of the latter ingredients being an irregularity, an proof of mixture or alteration.

The basic elements are also mutually replaceable when in *different* states of oxydation, und the law that parts equal in power of combination with oxygen are equivalent or isomorphou that is, *the replacing power equals the combining power.* Thus $3\,R\,O\ (=R^3\,O^3)$, $R^2\,O^3$, $\frac{3}{2}\,R\,O^2\ (=R^{\frac{3}{2}}\,O^3)$, $\frac{3}{5}\,R^2\,O^5$, $R\,O^3$ are replaceable; and so also are $R^2\,O^2\ (=2\,R\,O)$, and $R\,O^2$; for the basic met is combined with an equal amount of oxygen, 3 atoms in the former group, and 2 in the latte The basic metals of these different oxyds by themselves represent so many different states co responding to the states of oxydation, and are therefore equivalents in combination. The abo formulas, if divided by 3, become reduced to the protoxyd form $R\,O$, $R^{\frac{2}{3}}\,O$, $R^{\frac{1}{2}}\,O$, $R^{\frac{2}{5}}\,O$, $R^{\frac{1}{3}}\,O$, a the expressions for the different states of the basic metals, to R, $R^{\frac{2}{3}}$, $R^{\frac{1}{2}}$, $R^{\frac{2}{5}}$, $R^{\frac{1}{3}}$. The first thr of these states have been denominated in a note to page 2, and in the Introduction, p. xv, t *alpha*, *beta*, and *gamma* states; the expressions are correspondingly written αR, βR, γR, δR, ϵ $\alpha R\,O$ equals $R\,O$, or a protoxyd. So also $\beta R\,O=\frac{1}{3}\,(R^2\,O^3)$, or a third of a sesquioxyd; $\gamma R\,O$ $\frac{1}{2}\,(R\,O^2)$, or half of a deutoxyd; and $\epsilon R\,O=\frac{1}{3}\,(R\,O^3)$, or one-third of a tritoxyd. αR, βR, γR, δ ϵR, are mutually replaceable, or equivalent in substitutions.

The *Bisilicates* come under a single general formula, which may either have the form A, or th of B. The α is here dropped, it being unnecessary.

A. $(\dot{R}^3, \ddot{\ddot{R}}, \ddot{R}^{\frac{3}{2}}, \dddot{R})\,\ddot{Si}^3$ B. $(R\,O, \beta R\,O, \gamma R\,O, \epsilon R\,O)\,\ddot{Si}$

The *Unisilicates* have the corresponding formula:

A. $(\dot{R}^3, \bar{R}, \ddot{R}^{\frac{3}{2}}, \dddot{R})^2\ \ddot{Si}^3$ B. $(R\,O, \beta R\,O, \gamma R\,O, \epsilon R\,O)^2\ \ddot{Si}$

As deutoxyds and tritoxyds occur as bases only in a few minerals, these general formulas for the ordinary species are:

Bisilicates	A. $(\dot{R}^3, \bar{R})\ \ddot{Si}^3$	B. $(R\,O, \beta R\,O)\ \ddot{Si}$
Unisilicates	$(\dot{R}^3, \bar{R})^2\ \ddot{Si}^3$	$(R\,O, \beta R\,O)\ \ddot{Si}$

If the latter formulas (B) be multiplied by 3, after substituting the value of β R, they become the exact equivalent of the former; but they are not necessarily the better for this multiplication, because chemistry is not yet able to decide positively whether, in the different cases, the multiplier should not rather be 6, 9, or some other number.

In the *new system* of chemistry the formulas of the Bisilicates and Unisilicates, in their most general form, are written in the following manner, essentially, by writers on the subject, except that the letter R is here used with the Greek letters to express the metal in the different states of oxydation: *

Bisilicates $\left.\begin{matrix} Si\,\Theta \\ R^2, \bar{R}, \beta\bar{R}, \gamma\bar{R} \end{matrix}\right\}\Theta^2$ Unisilicates $\left.\begin{matrix} Si \\ R^4, \bar{R}, \beta\bar{R}, \gamma\bar{R} \end{matrix}\right\}\Theta^4$

These formulas may be more conveniently written in a single line, as follows; and to facilitate a comparison, the formulas of the older system are here added:

	Old system.	Old system modified.	New system.
Bisilicates	$(\dot{R}^3, \bar{R})\ \ddot{Si}^3$	$(RO, \beta R\,O)\ \ddot{Si}$	$Si\,\Theta\|\Theta_2\|(R, \bar{R}, \beta\bar{R})$
Unisilicates	$(\dot{R}^3, \bar{R})^2\ \ddot{Si}^3$	$(RO, \beta R\,O)^2\ \ddot{Si}$	$Si\|\Theta_4\|(R_2, \bar{R}, \beta\bar{R})_2$

By means of fractions prefixed to the Rs or $\bar{R}$s, the ratios of the constituents may be expressed, as in the older formulas.

The *Subsilicates* vary in formula according to the varying ratios, as presented beyond (p. 362) The only silicates having the basic metals in the sesquioxyd state alone occur among the Subsilicates.

Besides the silicates that are obviously Bisilicates and Unisilicates, there are others which, while bisilicate or unisilicate in type, contain a surplus of silica in serial ratios.

The *Feldspar* group is remarkable for its unity in crystallographic and all physical characters, evincing the profoundest isotypism; and yet the oxygen ratio for the bases and silica varies from 1 : 1 to 1 : 3. The fact that all the essential characters of a Feldspar appear in their perfection under the unisilicate ratio shows that the amount of silica of a Unisilicate is all that is required to make a Feldspar, and hence that the type is strictly *unisilicate;* and further, that the excess of silica must exist in the species in some state consistent with conformity to the unisilicate type. The amount of silica in the species of the Feldspar group *increases* with the *increasing proportion of alkali* in the mineral, from anorthite, a *Unisilicate without*, usually, *any alkali*, to albite and orthoclase, literal *Trisilicates*, with the protoxyd bases *solely alkaline.*

The *Micas* vary in the same way, being unisilicate strictly in the species containing the least alkali, and having a higher proportion as the alkali increases, and the highest in the lithia micas, in one of which the ratio is 1 : 2. The *Meionite* section of the Scapolite group is in *meionite* strictly unisilicate, without alkali, while *mizzonite* has much alkali and more silica in proportion than meionite, and *marialite* (which like mizzonite is hardly distinguishable from meionite in crystallographic or physical characters) is bisilicate, with the alkali constituting much the larger part of the protoxyd bases. The Scapolite section of the Scapolite group illustrates the same point. The special ratios for this and each of the preceding groups are stated in the general remarks preceding the section on the Unisilicates.

Among Bisilicates, *spodumene* is closely related to the Pyroxene group in crystallization and other characters, including the oxygen ratio for the bases and silica, although alumina and lithia are prominent constituents. *Petalite* has the same crystallization (as shown by Descloizeaux) and the same constituents as spodumene, and therefore is also pyroxene-like in its fundamental characteristics; and yet it contains twice the proportion of silica, the oxygen ratio for $\dot{R}$, $\bar{R}$, $\ddot{Si}$ in spodumene being 1 : 4 : 10, and in petalite 1 : 4 : 20, a contrast of great interest in this connect oı as remarked by Descloizeaux. The amount of silica in spodumene shows what is essential to tl type, and therefore proves that both are essentially Bisilicates. It differs from petalite in th the protoxyd bases include a little lime and protoxyd of iron (about *one-twelfth* of all the protoxyd from the average of the best analyses, those of Rammelsberg, Hagen, and Smith & Brush), whi in petalite they are purely alkaline.*

---

* R^2 stands for 2 of a monad element, as potassium, sodium, lithium, thallium, cæsium, rubidium, hydrogen, and $\bar{R}$ for other basic elements, as already explained. See also Am. J. Sci., II. xliv 252, 261, and Introd., p. xv.

The Feldspars, Micas, and the Meionite and Scapolite groups are examples of a surplus c silica in species under the unisilicate type, and the Spodumene group under the bisilicate. In eac the alkali present appears to be the determinative cause. The surplus silica above what the typ requires may have one of the two following conditions: Either it may be (1) *part basic* (*half* of under the unisilicate type, and *one-third* of it under the bisilicate type); or it may be (2) *all acce sory* silica. The formula of albite, under the unisilicate type, to which it is shown above to b long, would be as follows, according to these two methods:

1st method $(\frac{1}{3}\dot{N}a^3+\frac{2}{3}\ddot{A}l+\frac{1}{6}\ddot{S}i^{\frac{3}{2}})^2\ddot{S}i^3$, or $Si\|\Theta_4\|(\frac{1}{3}Na_2+\frac{2}{3}\beta Al+\frac{1}{6})Si)_2$
2d method $(\frac{1}{4}\dot{N}a^3+\frac{3}{4}\ddot{A}l)^2\ddot{S}i^3+3\ddot{S}i$, or $Si\|\Theta_4\|(\frac{1}{4}Na_2+\frac{3}{4}\beta Al)+SiO)_2$

For other examples see the formulas of the Unisilicates beyond (p.

From the facts here explained it follows that the Mica and Feldspar groups should be annexe entire to the section of Unisilicates; and petalite to the section of Bisilicates. The intermediat silicates are thus mostly disposed of without the provision of other sections. Iolite has the ratio for bases and silica of muscovite (or 1 : 1½), and its excess of silica above that of the Unisil icates may be of the same nature as in that species. The case of nephelite may be similar.

The *hydrous* species of silicates are here separated from the *anhydrous*, as in other divisions i the classification, because the course seems most convenient in the present imperfect state o chemical science. There is no criterion yet furnished for deciding upon the state of the wate present, whether part, or all, or none, is basic; and until chemists have some means of reachin safe conclusions on this point, the true relations of the hydrous and anhydrous species cannot t any great extent be positively made out. Moreover there is often doubt as to whether the wate present is simply hygrometric and accidental; or whether it exists as a result of incipient or advanced alteration of the mineral; or whether it belonged to the species from its origin; an these doubts still further complicate the subject.

In some silicates, as euclase for example, the water appears to be so plainly basic that th species have been arranged beyond with the anhydrous; and this is the beginning of a fina disregard of the distinction which will probably before long be warranted.

In the descriptions of the silicates beyond, the chemical formulas given are those of the ol system, as these are equally intelligible to all chemists. But in the tables preceding the genera divisions of the species, the new formulas are introduced as well as the old.

Note on the History of the Silicates. In the work of the Swedish mineralogist Wallerius, of 1747 silicates as such are unrecognized, and the only species of those now so called which are described are the gems that passed under the names of *emerald*, *beryl*, *topaz*, *hyacinth*, *chrysolite*, *garnet*; *clay* of various kinds and names; *mica*, *talc*, *serpentine*, *amianthus*, *asbestus*, *feldspar*, and the convenient pocket for various undetermined heavy stones, named *Corneus*—the *Hornbärg* of the Swedish mineralogist, and *Roche de Corne* of his French translator, and which embraced *Skiörl* (*Schörl* of the Germans) as a prominent part of it. Quartz (Kieselsten, or Silex) in its many varieties, with opal, made up a large part of the non-metallic division of the science, occupying 30 pages out of 200. Feldspar is placed in the genus Spatum, as *Spatum pyrimachum* (or scintillating spar) alongside of fluor, Iceland spar, and heavy spar; and sapphire and the other precious stones are in the group of Gems. All of these species excepting feldspar had special names in Pliny's time; and feldspar is distinctly referred to in Agricola as "Silex ex eo ictu ferri facile ignis elicitur, in cubis aliisque figuris intersectis constans" (p. 314, 1546).

Cronstedt's work of 1758 includes with the preceding the species *Zeolite*, a recent discovery of his own (1756); but adds no others. He shows however his acumen in making his group of *Kiesel-Arter* (siliceous minerals) to include not only the varieties of quartz, but also feldspar and the gems above enumerated (and his adding to it the diamond is not surprising). Garnet and schörl are left outside, and make the two species of his *Granat-Arter*; *Mica* (Glimmer-Arter) and *Asbestus* (Asbest-Arter), with Ler-Arter (clay minerals), are the other independent groups. Transparent tourmalines from Ceylon were among the gems of the day, having been first introduced into Europe in 1707 or before, but they are not distinctly mentioned by Cronstedt or Wallerius.

---

* See further on this subject a paper by the author in Am. J. Sci., II. xliv. 398, 1867.

The group of Schörl increased in its varieties for the next twenty-five years, and after that became prolific in species, and much of the history of mineralogy is involved in its various phases. The following observations make, therefore, an introduction to the synonymy of many minerals beyond.

The *Corneus*, or *Hornbürg*, of Wallerius included a variety of hard, cheap or worthless stones, rather heavy, mostly of dark colors from black to dull green. The name alludes to a resemblance to horn in the aspect of some of the kinds. To *Corneus solidus* belonged the massive, compact, flinty rocks of black and lighter shades; also petrosilex (or *Hälleflinta* of the Swedes, which means *false flint*) of different shades; and massive hornblende ("granulis compactis"), though the name hornblende was, by a mistake of its German use, given by Wallerius to a black zinc-blende alone. His *Corneus fissilis* embraced lamellar forms of hornblende and pyroxene, and some slaty rocks. White *Corneus crystallisatus* was his *Skiörl*, which comprised opaque tourmalines, and other prismatic minerals of black, brown, green, and reddish colors, as hornblende, actinolite, and perhaps pyroxene, and at the head of the list basalt, and basanite or Lydian stone.

Cronstedt's *Skörl* made up his genus *Basaltes*, and was nearly synonymous with the *Corneus crystallizatus* of Wallerius. Its varieties were better defined; and to massive, lamellar, and columnar hornblende, actinolite and pyroxene and crystallized opaque tourmaline were added; and in an appendix to the species. cruciform staurotide. The name *Hornblende* is applied only to the massive variety or rock which Cronstedt made a *bole*, and called *Bolus induratis particulis squamosis*; it probably covered other similar stones.

J. Hill in his work on Fossils, published in London, and according to the title page in 1771 (though de Lisle says it was not issued until 1772), says of the "Shirls," that "as to size we see them from that of barley corn up to the Giant's Causeway," and the columns of the latter he calls "Irish Shirl," or "Basaltes Hibernicus." The group contains also macle or chiastolite from Andalusia, besides tourmaline, etc.

In the editions of Wallerius of 1772 and 1778 there is a little advance beyond the first as regards the number and classification of the species. Cronstedt is followed in the position of feldspar, and in the name "Basaltes" for the schörls; and Corneus is restricted to massive, fibrous, and coarse columnar stones, among which stands "hornblende" as *Corneus spathosus*, and "trapp" as *Corneus trapezius*.

At this period de Lisle brought crystallography to bear on the subject. But while making known new distinctions, he did not appreciate their full value, or the precision required for thorough work. As a consequence, the group of Schörls (or Schorls, as he writes the word) in his later treatise of 1783, reached its greatest extension, although in a partly divided state. He early pronounced basaltic columns no crystals, and dropped off this excrescence. He showed in 1772 that the gem tourmaline, his *Transparent rhomboidal schorl*, was identical in form with the common black schorl. But still he made the latter a distinct *species*, his *Opaque rhomboidal schorl*, and included in it, along with black or opaque tourmaline, crystals of hornblende, augite, octahedrite from Oisans, rutile (needles in quartz), and, as a white variety, thin twins of albite, whose relation to feldspar he did not perceive; and even hexagonal nephelite from Vesuvius has a passing remark under this head. Axinite, then a novelty from Dauphiny, was made a short lenticular variety of *Transparent rhomboidal schorl*, or tourmaline, its *rhomboidal* planes proving to his eye the relationship. The massive mineral called *Hornblende*, or *Roche de Corne*, referred by Cronstedt to *Bole*, he annexes to Schorl as a massive or semicrystallized kind, but makes it a separate species, *Schorl argileux*, although apparently appreciating that it was little entitled to the distinction. *Schorl cruciforme* was his last species in the group, and to it were referred both andalusite and staurolite—the latter his *Pierre de croix*, with the prismatic angle of 130° by his measurement; and the former, *Macle basaltique*, with an angle of 95°. The garnets and schorls were placed in a common division, as done by Cronstedt, and garnet was made the first species, with tourmaline the second, and "cruciform schorl" the fifth. Garnet included the "white garnet," as it was called, of Vesuvius (leucite), first observed by Ferber in 1772. Besides these Silicates, de Lisle's work has its several groups of Gems, Feldspar, Argillaceous Minerals (embracing mica, asbestus, talc, serpentine), Zeolite, and Quartz. Labradorite, from Labrador (first brought to Europe about 1770), stands as a variety of feldspar, to which it had been referred by Werner; idocrase, of which many figures are given by him (first described and figured by Cappeler in 1722), meionite (hyacintes blanches), from Somma, and harmotome from Andreasberg (his *hyacinte blanche cruciforme*, made calcareous spar by v. Born in 1775, who first mentions and figures it, but a hyacinth-like *siliceous* species by Bergmann in 1780), are placed with zircon as kinds of *hyacinth*.

After de Lisle, as chemistry and crystallography made progress, the disintegration of the great Schorl group went rapidly forward, until the only thing left to it was common tourmaline; and now the name, once so important, has become a mere mineralogical relic. In Werner's system of 1789, as published by Hoffmann (Bergm. J., i. 369, 1789), Schörl includes only the species Tourmaline as it now stands. The *Kieselarten*, or Siliceous species (commencing with the diamond still), comprised the different gems; among which stands chrysoberyl (the modern), and, as distinct species, axinite, prehnite, hornblende of various kinds, with feldspar, mica, chlorite, the cla etc.; while under *Talkarten*, or Magnesian species, there are kyanite, actinolite, with asbest talc, serpentine, nephrite, etc.

Silica was first proved to be a chemical constituent of many mineral species by Bergmann; a in his Opuscula (1780) and his Sciagraphia Regni Mineralis (1782) he distinguishes, after analys by himself (made by fusion with potash, a method of his own), the following minerals as siliceo compounds of alumina, with or without lime or magnesia, namely, topaz, emerald, garnet, sch (black tourmaline), hornblende, mica, zeolite from Iceland, feldspar, and the clays; and as esse tially magnesian silicates, containing lime and a little iron, and little or no alumina, actinoli asbestus (mountain cork and mountain leather), amianthus, steatite. These were the investig tions that commenced the disbanding of the schorls, and before Werner's system of 1789 w published, many other analyses, more or less imperfect, had already been made by Wiegle Klaproth, Achard, Heyer, Mayer, Höpfner, Pelletier, and other chemists of the day.

The word *Schörl* of the Germans has been supposed to be derived from the name of a locali of the mineral, *Schorlau* (meaning Schörl-village) in Germany. But Prof. Naumann says (in recent letter to the author) that it is more likely that the name is a miner's term of unknow origin, and that the village got its name from the occurrence there of the schörl. Some Germ mineralogists have pronounced it of Swedish origin, and as first used by Cronstedt. But occurs in Brückmann's Magnalia Dei, published at Braunschweig in 1727, on page 175, where is spelt *schirl*. It exists also still earlier, as the author has found, in Ercker's Aula Subterrane first published in 1595, *shurl* and wolfram being spoken of as among the rejected material auriferous washings; and again in the yet older work of Gesner, De Rerum Foss. etc., 1565, 87, where schurl (misspelt? *schrul*) is given as the German for "Lapilli nigri steriles" of a tin vei which, "quando cum lapillis plumbi candidi [or tin] coquuntur plumbum consumunt," etc again, in Matthesius's Sarepta, 1562, in the 9th "Predigt," where "Schurl" is quite ful described, and also, in the next paragraph, "Wolffrumb." The name Schörl (or Schurl) was that time used quite indefinitely for the *sterile* (or metallurgically worthless) black little ston ("nigri lapilli") accompanying tin ore and gold, especially the former; and, as they were amo the refuse of the ore-washings, Adelung suggests that Schörl may have come from the old Ge man word *Schor*, meaning *impurities*, or *refuse*.

General Pyrognostic Characters of the Silicates. In the systematic pyrognostic examination silicates, the following points should be particularly noticed:

1. If *in the closed tube* the substance prove hydrous, the water given out should be tested to whether it is acid or alkaline. If acid, this may be evidence that the mineral contains fluorin and if alkaline, that possibly the substance is an altered mineral. In the former case, the wat should be (*a*) tested with Brazil-wood paper; (*b*) the tube should be carefully observed, to asce tain whether it has been dimmed or etched by the action of the fluorine; and, further (*c*), the te for fluorine, by fusing in the open tube with salt of phosphorus, should be employed.

2. In the examination B.B. *on charcoal* it should be noted that silicates containing much ir become magnetic; and silicates of the oxyds of iron, copper, etc., yield metallic buttons on fusio with soda.

3. In examining the mineral *in the platinum-pointed forceps*, it should always be treated in O. to ascertain (*a*) whether it imparts a color to the flame; and (*b*) its fusibility, remembering th some silicates, infusible in O.F., become fusible by a reduction of their bases to a lower state oxydation in R.F. It is to be noted that (*c*) only infusible and light-colored silicates can be test for alumina B.B. with cobalt solution, since all fusible silicates, not containing metallic oxyds, gi a cobalt-blue glass; (*d*) a small amount of soda in a silicate may, by the intense yellow color imparts to the flame, mask a much larger percentage of potash or other alkali, as in the case some varieties of potash-feldspar (orthoclase); (*e*) when silicates, like hornblende, pyroxene, garnet, contain various isomorphous bases, the fusibility of the species has a wide range; garnet, for example, it varying from the easy fusibility of almandine to the infusibility of ouvar vite; (*f*) a few silicates react alkaline after ignition or fusion.

4. In *treatment with the fluxes*, it is to be noted (*a*) that most silicates are dissolved in soda wi effervescence. (*b*) If sulphur or sulphuric acid is present, the mineral gives in R.F. a sulph which reacts for sulphur when moistened and placed on a surface of silver. (*c*) Borax dissolv silicates; and if they contain metallic oxyds, the nature of these oxyds may be determined treatment in O.F. and R.F. (*d*) Salt of phosphorus decomposes almost all silicates, dissolving t bases, and leaving a gelatinous skeleton of insoluble silica; and if metallic oxyds are present, the may also impart a characteristic color to the bead in O.F. and R.F.

I. BISILICATES.

ARRANGEMENT OF THE SPECIES.

I. AMPHIBOLE GROUP. Crystallization anisometric, either orthorhombic or clinohedral, and angle of prism not 120°.

(1) PYROXENE SUBGROUP. $I \wedge I = 86° - 88°$. Composition $\dot{R}\,\ddot{Si}$, or $(\dot{R}^3, \bar{R})\,\ddot{Si}^3$; and when both $\dot{R}$ and $\bar{R}$ are present, ratio of $\dot{R}^3 : \bar{R} = 3:1$ to $1:2$.

a. Crystallization orthorhombic. Optic-axial plane normal to a diagonal section; one bisectrix normal to the base. Contain little or no lime.

234. ENSTATITE	$\dot{Mg}\,\ddot{Si}$	$Si\,\Theta\|\Theta_2\|Mg$
235. HYPERSTHENE	$(\dot{Mg}, \dot{Fe})\,\ddot{Si}$	$Si\,\Theta\|\Theta_2\|Mg, Fe$
236. DIACLASITE	$(\dot{Mg}, \dot{Fe}, \dot{Ca})\,\ddot{Si}$	$Si\,\Theta\|\Theta_2\|Mg, Fe, Ca$

b. Crystallization monoclinic. Optic-axial plane normal to a diagonal section; bisectrix not normal to the base.

α Bases mainly or wholly protoxyds; much lime; little or no alkali.

237. WOLLASTONITE	$\dot{Ca}\,\ddot{Si}$	$Si\,\Theta\|\Theta_2\|Ca$
238. PYROXENE A.	$\dot{R}\,\ddot{Si}$	$Si\,\Theta\|\Theta_2\|R$
B.	$\dot{R}\,(\ddot{Si}, \bar{Al}^{\frac{2}{3}})$	$(Si, \beta Al_2)\Theta\|\Theta_2\|R$

β Bases largely sesquioxyds; little or no lime; much alkali.

239. ÆGIRITE	$(\frac{1}{2}\dot{R}^3 + \frac{1}{2}\bar{Fe})\,\ddot{Si}^3$	$Si\,\Theta\|\Theta_2\|(\frac{1}{2}(Na_2, R) + \frac{1}{2}\beta Fe)$
240. ACMITE	$(\frac{1}{3}\dot{R}^3 + \frac{2}{3}\bar{Fe})\,\ddot{Si}^3$	$Si\,\Theta\|\Theta_2\|(\frac{1}{3}(Na_2, R) + \frac{2}{3}\beta Fe)$

c. Crystallization triclinic. Optic-axial plane not normal to one of the diagonal sections, or to the base.

241. RHODONITE	$\dot{Mn}\,\ddot{Si}$	$Si\,\Theta\|\Theta_2\|Mn$
242. BABINGTONITE	$(\frac{3}{4}\dot{R}^3 + \frac{1}{4}\bar{Fe})\,\ddot{Si}^3$	$Si\,\Theta\|\Theta_2\|(\frac{3}{4}R + \frac{1}{4}\beta Fe)$

(2) SPODUMENE SUBGROUP. $I \wedge I = 86° - 88°$. Composition $(\dot{R}^3, \bar{R})\,\ddot{Si}^3$; and $\dot{R}^3 : \bar{R} = 1:4$; $\dot{R} = \dot{Na}, \dot{Li}$, with some $\dot{Ca}$, $\dot{Fe}$ in Spodumene.

243. SPODUMENE	$(\frac{1}{5}\dot{R}^3 + \frac{4}{5}\bar{Al})\,\ddot{Si}^3$	$Si\,\Theta\|\Theta_2\|(\frac{1}{5}(R_2, R) + \frac{4}{5}\beta Al)$
244. PETALITE	a. $(\frac{1}{5}\dot{R}^3 + \frac{4}{5}\bar{Al})\,\ddot{Si}^3 + 3\,\ddot{Si}$	$Si\,\Theta\|\Theta_2\|(\frac{1}{5}R_2 + \frac{4}{5}\beta Al) + Si\,\Theta_2$
	b. $(\frac{3}{5}(\frac{1}{5}\dot{R}^3 + \frac{4}{5}\bar{Al}) + \frac{2}{5}\ddot{Si}^{\frac{3}{2}})\,\ddot{Si}^3$	$Si\,\Theta\|\Theta_2\|(\frac{3}{5}(\frac{1}{5}R_2 + \frac{4}{5}\beta Al) + \frac{2}{5}\gamma Si)$

(3) AMPHIBOLE SUBGROUP. $I \wedge I = 123° - 125°$ (corresponding to *i*-2 of Pyroxene Subgroup).

a. Crystallization orthorhombic. Optical characters as under *a* above.

245. KUPFFERITE	$\dot{Mg}\,\ddot{Si}$	$Si\,\Theta\|\Theta_2\|Mg$
246. ANTHOPHYLLITE	$(\frac{3}{4}\dot{Mg} + \frac{1}{4}\dot{Fe})\,\ddot{Si}$	$Si\,\Theta\|\Theta_2\|(\frac{3}{4}Mg + \frac{1}{4}Fe)$

b. **Crystallization monoclinic. Optical characters as under *b* above.**

α Bases mainly or wholly protoxyds; little or no alkali.

247. **Amphibole**	A.	$\dot{\mathrm{R}}\,\ddot{\mathrm{Si}}$	$\mathrm{Si}\,\Theta\vert\Theta_2\vert\bar{\mathrm{R}}$
	B.	$(\dot{\mathrm{R}}, \hat{\mathrm{H}})\,\ddot{\mathrm{Si}}$	$\mathrm{Si}\,\Theta\vert\Theta_2\vert(\mathrm{H}_2, \bar{\mathrm{R}})$
	C.	$\dot{\mathrm{R}}\,(\ddot{\mathrm{Si}}, \ddot{\bar{\mathrm{A}}}\mathrm{l}^{\frac{2}{3}})$	$(\mathrm{Si}, \beta\bar{\mathrm{A}}\mathrm{l}_2)\,\Theta\vert\Theta_2\vert\bar{\mathrm{R}}$

β Bases largely sesquioxyds; much alkali.

248. **Arfvedsonite**	$(\frac{2}{5}\,\dot{\mathrm{R}}^3 + \frac{3}{5}\,\bar{\mathrm{F}}\mathrm{e})\,\ddot{\mathrm{Si}}^3$	$\mathrm{Si}\,\Theta\vert\Theta_2\vert(\frac{2}{5}\,(\mathrm{Na}_2, \bar{\mathrm{R}}) + \frac{3}{5}\,\beta\bar{\mathrm{F}}\mathrm{e})$
249. **Crocidolite** .		

Appendix to Amphibole Group

250. **Wichtisite**	$?(\frac{3}{4}\,\dot{\mathrm{R}}^3 + \frac{1}{4}\,\bar{\mathrm{R}})\,\ddot{\mathrm{Si}}^3$	$\mathrm{Si}\,\Theta\vert\Theta_2\vert(\frac{1}{2}\,(\mathrm{Na}_2, \bar{\mathrm{R}}) + \frac{1}{2}\,\beta(\bar{\mathrm{A}}\mathrm{l}, \mathrm{Fe})$
251. **Glaucophane**	$(\frac{3}{5}\,\dot{\mathrm{R}}^3 + \frac{2}{5}\,\bar{\mathrm{R}})\,\ddot{\mathrm{Si}}^3$	$\mathrm{Si}\,\Theta\vert\Theta_2\vert(\frac{3}{5}\,\bar{\mathrm{R}} + \frac{2}{5}\,\beta\bar{\mathrm{R}})$
252. **Sordawalite**	$?\,(\frac{1}{2}\,(\dot{\mathrm{M}}\mathrm{g}, \dot{\mathrm{F}}\mathrm{e})^3 + \frac{1}{2}\,\ddot{\bar{\mathrm{A}}}\mathrm{l})\,\ddot{\mathrm{Si}}^3$	$\mathrm{Si}\,\Theta\vert\Theta_2\vert(\frac{1}{2}\,(\bar{\mathrm{M}}\mathrm{g}, \bar{\mathrm{F}}\mathrm{e}) + \frac{1}{2}\,\beta\bar{\mathrm{A}}\mathrm{l})$
253. **Tachylyte**		

II. BERYL GROUP. **Crystallization hexagonal; not micaceous.**

254. **Beryl**	$(\frac{1}{2}\,\dot{\mathrm{B}}\mathrm{e}^3 + \frac{1}{2}\,\ddot{\bar{\mathrm{A}}}\mathrm{l})\,\ddot{\mathrm{Si}}^3$	$\mathrm{Si}\,\Theta\vert\Theta_2\vert(\frac{1}{2}\,\bar{\mathrm{B}}\mathrm{e} + \frac{1}{2}\,\beta\bar{\mathrm{A}}\mathrm{l})$
255. **Eudialyte**	$(\frac{2}{3}\,\dot{\mathrm{R}}^3 + \frac{1}{3}\,\ddot{\mathrm{Z}}\mathrm{r}^{\frac{3}{2}})\,\ddot{\mathrm{Si}}^3$	$\mathrm{Si}\,\Theta\vert\Theta_2\vert(\frac{2}{3}\,(\mathrm{Na}_2, \bar{\mathrm{R}}) + \frac{1}{3}\,\gamma\bar{\mathrm{Z}}\mathrm{r})$

III. POLLUCITE GROUP. **Crystallization isometric.**

256. **Pollucite**	$(\dot{\mathrm{C}}\mathrm{s}^3, \ddot{\bar{\mathrm{A}}}\mathrm{l})\,\ddot{\mathrm{Si}}^3$	$\mathrm{Si}\,\Theta\vert\Theta_2\vert(\mathrm{Cs}_2, \beta\bar{\mathrm{A}}\mathrm{l})$

The fact of the *orthorhombic* form of some species of the Amphibole group (those so characte ized above) was first ascertained by Descloizeaux through optical examination. Under **Petalit** the formulas *a* and *b* are those of the two methods explained on page 204.

234. ENSTATITE. Diallage métalloïde pt. *H.*, Tr., 1801. Bronzit *Karst.*, Klapr., Gehlen's J iv. 151, 1807; *Karst.*, Tab., 40, 91, 1808; *Klapr.*, Beitr., v. 34, 1810. Blättriger Anthophyll *Wern.*, 1808, Hausm. Entw., 1809. Bronzite. Chladnite *Shep.*, Am. J. Sci., II. ii. 381, 184 Enstatit *Kenng.*, Ber. Ak. Wien, xvi. 162, 1855. Protobastit *A. Streng.*, ZS. G., xiii. 71, 1861.

Orthorhombic. $I \wedge I = 87^\circ$ and 93°, Kenngott; 88° and 92°, Descloizeau Observed planes: *I*, *i-ĭ*, *i-ī*. $I \wedge$ *i-ĭ* $= 133^\circ\ 30'$, $I \wedge$ *i-ī* $= 136^\circ\ 30'$. Cleavage *I*, easy; *i-ĭ*, *i-ī*, less so. Sometimes a fibrous appearance on the cleavag surface. Also massive and lamellar.

H.=5·5. G.=3·1−3·3; 3·19, Vosges, Damour. Lustre a little pearl on cleavage-surfaces to vitreous; often metalloidal in the bronzite variety Color grayish-white, yellowish-white, greenish-white, to olive-green an brown. Streak uncolored, grayish. Double refraction positive; optic-axia plane brachydiagonal; axes very divergent.

Comp., Var.—$\dot{\mathrm{M}}\mathrm{g}\,\mathrm{Si}$, or $(\dot{\mathrm{M}}\mathrm{g}, \dot{\mathrm{F}}\mathrm{e})\,\ddot{\mathrm{Si}}$; the $\dot{\mathrm{F}}\mathrm{e}$ atomically not over one-fourth of the protoxyd $\mathrm{Mg}\,\ddot{\mathrm{Si}}$=Silica 60, magnesia 40=100.

Var. 1. *With little or no iron; Enstatite.* Color white, yellowish, grayish, or greenish-white lustre pearly-vitreous; G.=3·10−3·13. *Chladnite*, which makes up 90 p. c. of the Bishopvill meteorite, belongs here and is the purest kind.

2. *Ferriferous*; *Bronzite.* Color grayish-green to olive-green and brown; lustre of cleavage-surface adamantine-pearly to submetallic or bronze-like. Ratio of $\dot{\mathrm{Mg}}$ to other protoxyds in anal. 3, 11¾ : 1; in 4, 8 : 1; in 5, 6½ : 1; in 6, 4½ : 1; in 7, 5¾ : 1; in 9, 4¾ : 1; in 11 (the so-called *protobastite*), 4¾ : 1.

Analyses: I., 1, v. Hauer (Ber. Ak. Wien, xvi. 165); 2, J. L. Smith (Am. J. Sci., II. xxxviii. 225); II. 3, Pisani (Descl. Min., i. 537); 4, Damour (Descl. Min., i. 45); 5, 6, v. Köhler (Pogg., xiii. 101); 7, 8. Regnault (Ann. d. M., III. xiv., 147), 9, v. Kobell (J. pr. Ch., xxxvi., 303); 10, Garrett (Am. J. Sci., II. xv. 333); 11, 12, A. Streng (ZS. G., xiii. 73, B. H. Ztg., xxiii. 54):

			$\dddot{\mathrm{Si}}$	$\bar{\dddot{\mathrm{Al}}}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Mn}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$	$\dot{\bar{\mathrm{H}}}$
I.	1.	Aloysthal, *Enst.*	56·91	2·50	2·76	——	35·44	——	1·92=99·53 Hauer.
	2.	*Chladnite*	(⅔) 59·97	—— $\bar{\dddot{\mathrm{Fe}}}$	0·40	——	39 37	——	——, $\dot{\mathrm{Na}}$, $\dot{\mathrm{K}}$, $\dot{\mathrm{Li}}$ 0·74=100·48 S.
II.	3.	Leiperville	57·08	0·28	5·77	——	35·59	——	0·90=99·62 Pisani.
	4.	Vosges	(¾) 56·70	0·60	7·72	——	33·63	——	1·04=99·67 Damour.
	5.	Stempel	57·19	0·70	7·46	0·35	32·67	1·30	0·63=100·30 Köhler.
	6.	Ultenthal	56·81	2·07	8 46	0·62	29·68	2·19	0·22=100·05 Köhler.
	7.	"	55·84	1·09	10·78	——	30·37	——	1·80=99·88 Regnault.
	8.	Styria	56·41	——	6·56	3·30	31·50	——	2·38=100·15 Regnault.
	9.	Greenland	58·00	1·33	10·14	1·00	29·66	——	——=100·13 Kobell.
	10.	Texas, Pa.	55·45	1·13	9·60	0·98	31·83	——	——=98·99 Garrett.
	11.	Harzburg	53·45	3·71	8·54	0·16	30·86	2·19	0·87, $\bar{\dddot{\mathrm{Cr}}}$ 0·89, $\dot{\mathrm{Fe}}\,\bar{\dddot{\mathrm{Cr}}}$ 0·07 = 100·74 Streng.
	12.	"	54·15	3·04	12·17	——	28·37	2·37	0·19=101·34 Streng.

G., anal. 5, fr. Stempel near Marbourg, 3·241; 6, fr. Seefeldalpe in the Ultenthal, Tyrol, 3,258; 6, ib., 3·241; 8, fr. serpentine of Gulsen near Kraubat in Styria, 3·125; 11, from a rock at Baste, Harz, called melaphyre, 3·29.

Pyr., etc.—B.B. almost infusible, being only slightly rounded on the thin edges; F.=6. Insoluble in muriatic acid.

Obs.—Occurs near Aloysthal in Moravia, in serpentine (the variety had been considered scapolite); at the W. base of Mt. Bresouars in the Vosges, olive-green, in serpentine; in Pennsylvania, at Leiperville and Texas; at Kupferberg in Bavaria; at Baste in the Harz (*Protobastite*); and at the other localities mentioned. The bronzite also of Lettowitz and Goldenstein in Moravia, of Aipstein near Sontra in Hesse, of Cape Lizard in Cornwall, may belong here according to Descloizeaux; but their chemical and optical characters are not yet ascertained. The brown pyroxene-like mineral which is a prominent constituent of the rock called *Lherzolite*, from the department of Arriège, France, is referred here by Descloizeaux.

The bronzite of Leiperville afforded Descloizeaux prisms of 87° and 93°; and that of Texas, half a mile W. of the village, occurs in large foliated and fibrous masses; neither is submetallic in lustre. Descloizeaux first defined the limits of this species, as here laid down.

Named from ἐνστάτης, an *opponent*, because so refractory. The name *bronzite* has priority, but a bronze lustre is not essential, and is far from universal. Shepard's *chladnite* was so imperfectly and incorrectly described that the name cannot claim precedence; he made it a tersilicate of magnesia (l. c.).

Alt.—*Bastite* or *Schiller spar*, the original from Baste in the Harz, is regarded by Streng as altered protobastite or bronzite. G. Rose long since pronounced it a result of the alteration of some mineral of the pyroxene group. *Phæstine* Breith. is stated by Breithaupt to be altered bronzite or bronze-like pyroxene. Enstatite occurs altered to talc. See BASTITE, p. 469.

235. HYPERSTHENE. Labradorische Hornblende (fr. I. St. Paul) *Wern.*, Bergm. J., 376, 391, 1789. Diallage métalloïde pt. *H.*, Tr., 1801. Hypersthène *H.*, Ann. Mus., ii. 17, 1803. Labrador Hornblende; Metalloidal Diallage pt. Paulit *Wern.*, 1812, Hoffm. Min., ii. 2, 143, 1815.

Orthorhombic. $I \wedge I$=86° 30′ and 93° 30′. Cleavage: *i*-*ĭ* perfect, *I* and *i*-*ī* distinct but interrupted. Usually foliated massive.

H.=5—6. G.=3·392. Lustre somewhat pearly on a cleavage-surface, and sometimes a little metalloidal. Color dark brownish-green, grayish-black, greenish-black, pinchbeck-brown. Streak grayish, brownish-gray.

Translucent to nearly opaque. Brittle. Optic-axial plane brachydiagon; axes very divergent; bisectrix negative.

Comp.—$(\dot{\text{Mg}}, \dot{\text{Fe}})\ddot{\text{Si}}$. $\dot{\text{Fe}}$ to $\dot{\text{Mg}}=1:2$ or above this; in anal. 1, $1:1\cdot8$; in 2, $1:1\cdot4$; =S 54·2, protoxyd of iron 21·7, magnesia 24·1=100. Analyses: 1, Damour (Ann. d. M., IV. v. 1 2, Muir (Thom. Min., i. 202); 3, 4, Hunt (this Min., 4th ed., and Rep. Geol. Can., 1863, 468 Streng (B. H. Ztg., xxiii. 54);

	$\ddot{\text{Si}}$	$\ddot{\bar{\text{A}}}\text{l}$	$\dot{\text{Fe}}$	$\dot{\text{Mn}}$	$\dot{\text{Mg}}$	$\dot{\text{Ca}}$	$\dot{\text{H}}$
1. Labrador	51·36	.0·37	21·27	1·32	21·31	3·09	——=98·72 Damour.
2. Skye	51·35	——	33·92	——	11·09	1·84	0·50=98·70 Muir.
3. Chateau Richer	51·35	3·70	20·56	——	22·59	1·68	0·10 (ign.)=99·93 Hunt
4. " "	51·85	3·90	20·20	*tr.*	21·91	1·60	0·20 (ign.)=99·66 Hunt
5. Harzburg	52·88	3·90	18·23	——	22·22	3·55	0·56=101·34 Streng.

Breithaupt gives for *I*∧*I* in the bronzite of Fichtelgebirge 88° and 92°.

Pyr., etc.—B.B. fuses to a black enamel, and on charcoal yields a magnetic mass. Parti decomposed by muriatic acid.

Obs.—Hypersthene occurs at Isle St. Paul, Labrador (anal. 1); at Chateau Richer and Adèle, Mille Isles, Canada (anal. 3, 4), grayish-black and brown, with the laminæ curved; at Isle of Skye (anal. 2); in Greenland; at Farsund and elsewhere in Norway; and reported from Penig in Saxony; Ronsberg in Bohemia; the Tyrol; Elfdalen in Sweden; Neurode in lesia; in Thuringia; the Fichtelgebirge; Voigtland.

It is often associated with labradorite, constituting a dark-colored, granite-like rock, ca *Hyperyte.*

Named from 'υπέρ and σθένος, *very strong*, or *tough.*

236. DIACLASITE. Gelber Schillerspath *Freiesleben*, Schill. Foss. Baste, 13, 1794. Talk iger Hornblende, *Hausm.*, Nordd. Beitr. B. H., i. 15, 1806. Diaklas *Breith.*, Char., 58, 1823. aklasit *Hausm.*, Handb., 498, 1847.

Orthorhombic. *I*∧*I*=93° and 87°. Observed planes: *I*, *i-ī*, *i-ĭ*, and often in hexagonal plates. Cleavage: *i-ĭ* perfect; *i-ī* imperfect. Folia massive.

H.=3·5–4. G.=3·054, Köhler. Lustre pearly and metalloidal on cleavage-face. Color brass-yellow, greenish-gray. Streak greenish-gray nearly uncolored. Transparent in thin laminæ, translucent. Feel so what greasy. Brittle. Optic-axial plane *i-ī*, axes very divergent; bisect negative.

Comp.—$(\dot{\text{Mg}}, \dot{\text{Fe}}, \dot{\text{Ca}})\ddot{\text{Si}}$, Köhler. Analyses: 1, Köhler (Pogg., xiii. 101); 2, A. Streng (B Ztg., xxiii. 54):

	$\ddot{\text{Si}}$	$\ddot{\bar{\text{A}}}\text{l}$	$\dot{\text{Fe}}$	$\dot{\text{Mn}}$	$\dot{\text{Mg}}$	$\dot{\text{Ca}}$	$\dot{\text{H}}$
1. Baste	53·74	1·33	11·51	0·23	25·09	4·73	3·76=100·39 Köhler.
2. Harzburg	53·31	7·49	8·14	——	25·37	3·56	1·55, alk. 0·58, $\ddot{\bar{\text{C}}}\text{r}$ 0·29=101·73 Str

Pyr., etc.—Same as for bronzite.

Obs.—In crystals or foliated masses imbedded in serpentine rock at Baste near Harzb associated with euphotide; also from the gneiss mountains of Guadarrama, Spain. Resem bronzite, but the plane of the optical axis is macrodiagonal instead of brachydiagonal.

237. WOLLASTONITE. Tafelspath (fr. Dognatzka) *Stütz*, Neue Einr. Nat. samml. W 144, 1793. Tabular Spar. Schaalstein *Wern.*, 1803, Ludwig's Min Wern., ii. 212, 1804, M Null Kab., ii. 1, 1804. Wollastonite *H.*, Tr., 1822. Vilnite (fr. Vilna) *Horodeki*, Descl. Min., ii.

Monoclinic. $C=69°\ 48'$, $I\wedge I=87°\ 28'$, $O\wedge 2\text{-}i=137°\ 48'$; $a:b:$ 0·4338 : 1 : 0·89789. Observed planes, *O*; vertical, *i-i*, $i\text{-}\frac{3}{2}$, $i\text{-}\frac{5}{4}$, *I*, $i\text{-}\frac{4}{3}$, clinodome, 2-ì; hemidomes, $\frac{1}{3}\text{-}i$, 1-*i*, 3-*i*, 5-*i*, $-\frac{1}{3}\text{-}i$, −1-*i*, −3-*i*, −5-*i*; he

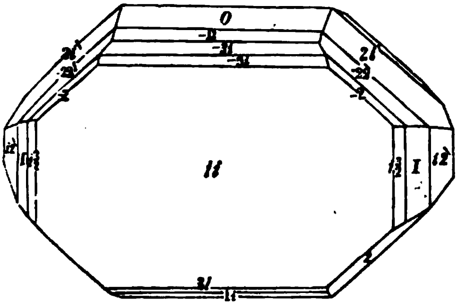
octahedral, 2, 2-2̀, −2, −2-2̀. Fig. 201 in the pyroxene or normal position, but with the edge *O*/*i-i* the obtuse edge; f. 202 in the position given the crystals by authors who make *i-i* the plane *O*, and 2-ì the plane *I*.

O ∧ −1-*i*=160° 30′
O ∧ −3-*i*=139 53
O ∧ −5-*i*=130 42
O ∧ 1-*i*=154 25
O ∧ 3-*i*=114 16
O ∧ *i-i*=110 12

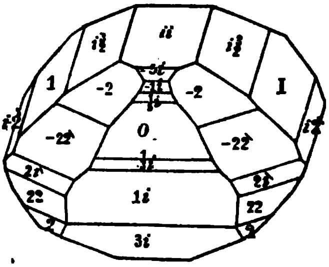
i-i ∧ −1-*i*=129° 42′
i-i ∧ −3-*i*=150 19
i-i ∧ −5-*i*=159 30
i-i ∧ 3-*i*=135 32
i-i ∧ 1-*i*=95 23
i-i ∧ −2=132 54
i-i ∧ 2=93 52

i-i ∧ 1=111° 48′
i-i ∧ $\frac{1}{3}$-*i*=77 56
i-i ∧ −2-2̀=120 50
i-i ∧ *i*-$\frac{3}{2}$=145 8
i-i ∧ *i*-2̀=115 34
i-i ∧ *I*=133 44

201



202



Vesuvius.

Rarely in distinct tabular crystals. Cleavage: *O* most distinct; *i-i* less so; 1-*i* and −1-*i* in traces. Twins: composition-face *i-i*. Usually cleavable massive, with the surface appearing long fibrous, fibres parallel or reticulated, rather strongly coherent.

H.=4·5—5. G.=2·78—2·9; 2·785—2·895, United States, Thomson; 2·805, Haidinger. Lustre vitreous, inclining to pearly upon the faces of perfect cleavage. Color white, inclining to gray, yellow, red, or brown. Streak white. Subtransparent—translucent. Fracture uneven, sometimes very tough. Optic-axial plane *i-i*; divergence 70° 40′ for the red rays; bisectrix of the acute angle negative; inclined to a normal to *i-i* 57° 48′, and to a normal to *O* 12°, Descl.

Comp.—$\dot{\mathrm{C}}\mathrm{a}\,\ddot{\mathrm{S}}\mathrm{i}$=Silica 51·7, lime 48·3=100. Analyses: 1, Stromeyer (Untersuch., 1, 356); 2. H. Rose (Gilb. Ann., lxxii. 70); 3, v. Kobell (J. pr. Ch., xxx. 469); 4, Weidling (Œf. Ak. Stockh., 1844, 92); 5, Bonsdorff (Schw. J., xxxiii. 368); 6, Rammelsberg (Pogg., lxxvii. 265); 7, Wiehage (Ramm. Min. Ch., 450); 8, M. F. Heddle (Phil. Mag., IV. ix. 452); 9, W. Hampe (B. H. Ztg., xx 267); 10, Vanuxem (J. Ac. Philad., ii. 182); 11, Seybert (Am. J. Sci., iv. 320); 12, Morton (Ann. Phil., 1827); 13, Beck (Min. N. Y, 271); 14, 15, J. D. Whitney (J. Soc. N. H. Boston, v. 486) 16. Bunce (This Min., 3d ed., 696):

	$\ddot{\mathrm{S}}\mathrm{i}$	$\dot{\mathrm{F}}\mathrm{e}$	$\dot{\mathrm{M}}\mathrm{g}$	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\mathrm{H}}$	
1. Cziklowa	51·45	0·40	——	47·41	0·08,	$\overset{\cdots}{\bar{\mathrm{M}}}\mathrm{n}$ 0·26= Strom.
2. Perhoniemi	51·60	——	——	46·41	——,	gangue 1·11=99·12 Rose.
3. C di Bove	51·50	——	0·55	45·45	2·00=99 50 Kobell.	
4. Göckum	50·72	0·85	0·88	43·80	——,	$\dot{\mathrm{M}}\mathrm{n}$ 0·33, $\dot{\mathrm{C}}\mathrm{a}\,\ddot{\mathrm{C}}$ 2·73 Weidl.
5. Skräbböle	52·58	$\overset{\cdots}{\bar{\mathrm{F}}}\mathrm{e}$ 0·13	0·68	44·45	0·99=99·83 Bonsdorff.	
6. Harzburg	53·01	——	1·04	44·91	1·59=100·55 Ramm.	
7. Vesuvius	51·90	$\dot{\mathrm{F}}\mathrm{e}$ 0·96[a]	0 65	46·44	——=99·95 Wiehage.	
8. Mourne Mts.	50·43	0·84	0·39	43·92	1·36,	$\ddot{\mathrm{C}}$ 2·37[b]=99·31 Heddle.

[a] With $\dot{\mathrm{M}}\mathrm{n}$.   [b] From mixed calcite.

	$\ddot{\text{Si}}$	$\dot{\text{Fe}}$	$\dot{\text{Mg}}$	$\dot{\text{Ca}}$	$\dot{\text{H}}$
9. Auerbach	52·01	$\ddot{\bar{\text{Fe}}}$ 0·93	——	46·74	——, $\ddot{\bar{\text{Al}}}$ 1·87=101·55 Hampe.
10. Willsborough	51·67	" 1·35	——	47·00	——=100·02 Vanuxem.
11. "	51·0	" 1·3	——	46·0	1·0=99·3 Seybert.
12. Bucks Co., Pa.	51·50	" 1·00	——	44·10	0·75=97·35 Morton.
13. Diana	51·90	" 0·25	——	47·55	——=99·70 Beck.
14. Cliff mine	49·09	——	0·14	46·38	2·96, $\dot{\text{Mn}}$ 0·48, $\ddot{\bar{\text{Al}}}$ 0·23 Whitney.
15. "	49·06	——	——	44·87	[2 96], " 0·93 " 1·28 Whitney.
16. Grenville, Can.	53·05	$\dot{\text{Fe}}$ 1·20	——	45·74	——=99·99 Bunce.

Pyr., etc.—In the matrass no change. B.B. fuses easily on the edges; with some sod blebby glass, with more, swells up and infusible. With muriatic acid gelatinizes; most vari effervesce slightly from the presence of calcite.

Obs.—Wollastonite is found in regions of granite and granular limestone; also in basalt lavas.

Occurs in the copper mines of Cziklowa in Hungary; at Dognatzka and Nagyag; accompan garnet, fluorite, and native silver, in limestone, at Pargas in Finland, and Kongsberg in Norw occurs at Perhoniemi and Skräbböle, Finland; at Göckum in Sweden; at Vilna in Lithu (vilnite); at Harzburg in the Harz; at Auerbach, in granular limestone; at Vesuvius, rarely in crystals; of a greenish-white color in lava at Capo di Bove, near Rome; in Ireland, at Dunn Head, on the shores of the Mourne Mts.

In the United States, in *N. York*, at Willsborough, forming the sides of a large vein of ga traversing gneiss; at Lewis, 10 m. south of Keeseville, with colophonite, abundant; ¼ m. N Lewis Corners, with garnet and quartz; at Roger's Rock, near the line between Essex Warren Cos., with garnet and feldspar; Diana, Lewis Co., about 1 m. from the Natural Bri in abundance, in large white crystals; at Booneville, Oneida Co., in boulders, with garnet pyroxene. In *Penn.*, Bucks Co., 3 m. W. of Attleboro', associated with scapolite, pyroxene, sphene. In *Mich.*, of a red color at the Cliff Mine, Kewenaw Point, Lake Superior, and on Royale, a very tough variety, but now exhausted. In *Canada*, at Grenville, with sphene green coccolite; at St. Jerome and Morin, C. E, with apatite, in large tabular masses of a fib structure.

Scacchi obtained from Vesuvian crystals (f. 202) *i-i* ∧ 3-*i*=185° 29′, *i-i* ∧ 1-*i*=95° 26′, *i-i* ∧ =78° 2′, *i-i* ∧ 1=111° 46′.

The form 2-*i* is usually made the vertical prism *I*, with *I*∧*I*=95° 36′ (or 35′). But the crys in the position above given exhibit the near isomorphism with pyroxene.

Named after the English chemist, Wollaston; also called *tabular spar* from its lamellar fo and structure.

The *soda-tabular spar* of Thomson, from near Kilsyth, is pectolite.

237A. EDELFORSITE. (Kalksilikat fr. Ædelfors, Kalktrisilikat, *Hisinger*, Ac. H. Stockh., 1 191, 1839. Edelforsit *v. Kob.*, Grundz., 202, 1838. Ædelforsit *Erdmann.*) Forchhammer shown (Danske Ac. Forh., Ap. 1864) that Hisinger's mineral is an impure wollastonite, contai some quartz and feldspar, with often carbonate of lime and garnet. It occurs compact, feathery fibrous, and part without any distinct crystalline structure. H. of portions 4; in other parts giving sparks with the steel, showing a hardness of 6—7. G.=2·584, Hisin 3·0, v. Kobell. Color white, grayish-white, or with a tinge of yellow. Hisinger and v. K have analyzed the mineral, and made it a distinct species; yet their results are considerably cordant, like their determinations of the sp. gr. They obtained: 1, Hisinger (l. c.); 2, v. K (J. pr. Ch., xci. 344):

	$\ddot{\text{Si}}$	$\ddot{\bar{\text{Al}}}$	$\ddot{\bar{\text{Fe}}}$	$\dot{\text{Fe}}$	$\dot{\text{Mg}}$	$\dot{\text{Ca}}$
1.	57·75	3·75	1·00	——	4·75	30·16, $\ddot{\bar{\text{Mn}}}$ 0·68=98·06 Hisinger.
2.	61·36	7·00	——	2·70	8·63	20·00, $\dot{\text{Mn}}$ *tr.*=99·69 Kobell.

Hisinger deduced the formula $\dot{\text{Ca}}^3\,\ddot{\text{Si}}^2$, and v. Kobell $9\,\dot{\text{R}}^3\,\ddot{\text{Si}}^2+\ddot{\bar{\text{Al}}}^2\,\ddot{\text{Si}}^3$.

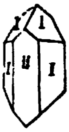
The edelforsite of Gjellebäk in Norway has also been shown by Forchhammer (l. c.) t essentially wollastonite. Hisinger obtained, as the mean of two analyses, $\ddot{\text{Si}}$ 43·368, $\dot{\text{Ca}}$ 38· $\dot{\text{Mn}}$ 4·962, $\dot{\text{Fe}}$ 1·434, $\ddot{\text{C}}$ 11·368. It has the aspect of tremolite. Forchhammer has found "o ite" of N. Greenland (Asbestagtig Okenit *Dr. Rink*) to be wollastonite.

238. PYROXENE. Corneus pt. *Wall.*, 138, 1847. Basaltes pt. *Cronst.*, 68, 1758. Sc noir *de Lisle*, Crist., 265, 1772; Schorl noir en prisme à huit pans terminé par une pyra dièdre, etc. (fr. volc. Vivarais) *Faujas*, Volc. Viv., 89, fig. D, 1778. Schorl oct. obliqua tronqué [made a distinct species] *Démeste*, Lett., i. 382, 1779. Schorl opaque rhomboidal

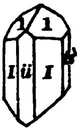
Schorl opaque qui paroissent deriver d'un octaèdre rhomboidal (fr. volc. Auvergne, Vesuv., Viv., Etna), *de Lisle*, Crist., ii. 396, 407, 415, figs. 12, 13, 14 (twin), 17, 18, pl. V., 1783. Augit (fr. volc.) *Wern.*, Freiesleben in Bergm. J., 243, 1792. Volcanite *Delameth.*, Sciagr., ii. 401, 1792. Pyroxene (fr. Etna, Arendal, etc.) *H.*, J. d. M., v. 269, 1799; Tr., iii. 1801. Pentaklasit *Hausm.*, Handb., 687, 1813.

Monoclinic. *C*=73° 59′, *I* ∧ *I*=87° 5′, *O* ∧ 2-ì=131° 17′; *a* : *b* : *c*= 0·5412 : 1 : 0·91346. Observed planes: *O*; vertical, *I*, *i-i*, *i-ì*, *i*-5, *i*-$\frac{3}{2}$, *i*-3, *i*-2, *i*-2̀, *i*-3̀; hemidomes, 1-*i*, 2-*i*, 3-*i*, −$\frac{1}{2}$-*i*, −1-*i*, −3-*i*, −5-*i*; clinodomes, 1-ì, 2-ì, 4-ì; pyramidal, $\frac{1}{2}$, $\frac{3}{5}$, 1, $\frac{3}{2}$, $\frac{2}{5}$, 2, 3, −$\frac{1}{2}$, −1, −$\frac{3}{2}$, −2, −$\frac{5}{3}$, −3, −4; 1-3, $\frac{3}{2}$-3, −$\frac{3}{2}$-3, −4-2; −6-$\grave{\frac{3}{2}}$, −5-$\grave{\frac{5}{3}}$, 2-2̀, $\frac{8}{3}$-2̀, −2-2̀, −4-2̀, 3-3̀, −3-3̀, 5-5̀, −$\frac{5}{2}$-5̀.

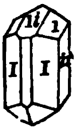
203



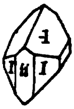
204



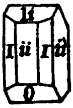
205



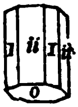
206



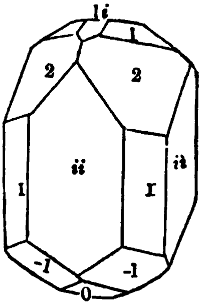
207



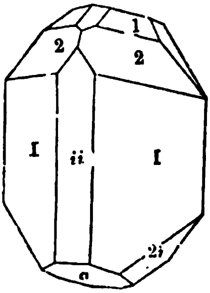
208



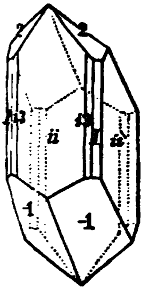
209



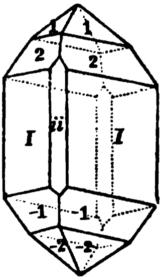
210



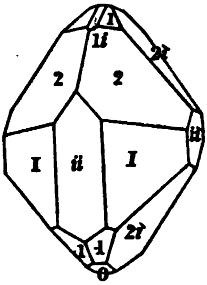
211



212

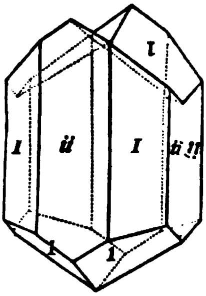


213



Long Pond.

214



O ∧ *I*=100° 57′
O ∧ −1-*i*=155 51
O ∧ 1-*i*=148 35
O ∧ 3-*i*=109 31
O ∧ *i-i*=106 1
O ∧ $\frac{1}{2}$=168 13
O ∧ −1=146 9
O ∧ −2=130 6
O ∧ 1=137 49
O ∧ 2=114 28

O ∧ 1-ì=150° 20′
O ∧ *i-ì*=90
I ∧ 1=121 14
I ∧ 2=144 35
I ∧ −1=134 48
I ∧ −2=150 51
2-ì ∧ 2-ì, ov. *O*,=82 34
i-i ∧ −1-*i*=130 10
i-i ∧ 1-*i*=105 24
i-i ∧ *i*-2=152 15

i-i ∧ *I*=133° 33′
i-i ∧ *i*-2̀=115 25
i-i ∧ *i*-3̀=107 35
i-2 ∧ *i*-2, ov. *i-i*,=124 30
i-2̀ ∧ *i*-2̀, ov. *i-i*,=50 50
i-ì ∧ −3-3̀=143 34
1 ∧ 1=120 32
2 ∧ 2=95 30
−1 ∧ −1=131 24
−2 ∧ −2=111 10

Cleavage: *I* rather perfect, often interrupted; *i-i* sometimes nearly perfe *i-ì* imperfect; *O* sometimes easy. Crystals usually thick and stout. Twi composition-face *i-i* (f. 214). Often coarse lamellar, in large masses, pa lel to *O* or *i-i*. Also granular, particles coarse or fine; and fibrous, fib often fine and long.

H.=5–6. G.=3·23–3·5, Lustre vitreous, inclining to resinous; so pearly. Color green of various shades, verging on one side to white grayish-white, and on the other to brown and black. Streak white to g and grayish-green. Transparent—opaque. Fracture conchoidal—unev Brittle. In crystals from Fassa, optic-axial plane *i-ì*; divergence 110° 113°; bisectrix of the acute angle positive, inclined 51° 6′ to a normal *i-i* and 22° 55′ to a normal to *O*, Descl.

Comp., Var.—Bisilicate of different protoxyd bases, under the general formula $\dot{\mathrm{R}}\,\ddot{\mathrm{Si}}$; t bases ($\dot{\mathrm{R}}$) being lime ($\dot{\mathrm{Ca}}$), magnesia ($\dot{\mathrm{Mg}}$), protoxyd of iron ($\dot{\mathrm{Fe}}$), protoxyd of manganese (and sometimes potash ($\dot{\mathrm{K}}$), soda ($\dot{\mathrm{Na}}$), and oxyd of zinc ($\dot{\mathrm{Zn}}$). Usually two or more of these b are present. The first three, lime, magnesia, and protoxyd of iron, are most common; but lin the only one that is present always and in large percentage.

Besides the substitutions of different protoxyd bases for one another, these same bases ar times replaced by sesquioxyd bases ($\ddot{\bar{\mathrm{Al}}}$, $\ddot{\bar{\mathrm{Fe}}}$, $\ddot{\bar{\mathrm{Mn}}}$), though sparingly; and the silica occasionall alumina. The species has therefore the general formula $(\dot{\mathrm{R}}^3, \ddot{\bar{\mathrm{R}}})\,(\ddot{\mathrm{Si}}, \ddot{\bar{\mathrm{Al}}}^{\frac{2}{3}})^3$, which may als written $(\dot{\mathrm{R}}, \ddot{\bar{\mathrm{R}}}^{\frac{1}{3}})\,(\ddot{\mathrm{Si}}, \ddot{\bar{\mathrm{Al}}}^{\frac{2}{3}})$.

The varieties proceeding from these isomorphous substitutions are many and diverse; and t are still others depending on the state of crystallization. The foliated and fibrous kinds e received separate names, and for a while were regarded as distinct species. Fibrous or colum forms are very much less common than in hornblende, and lamellar or foliated kinds more c mon. The crystals are rarely long and slender, or bladed, like those of that species.

The name *Pyroxene* is from πῦρ, *fire*, and ξένος, *stranger*, and records Haüy's idea that the m ral was, as he expresses it, "a stranger in the domain of fire," whereas, in fact, it is, next to feldspars, the most universal constituent of igneous rocks. This error, however, was more t counterbalanced by Haüy's discovery of the true crystallographic distinction of the species, w led him to bring together, under this one name, what Werner and others had regarded as dist species. The name, therefore, is properly the name of the species, while *Augite* is only enti to be used for one of its varieties.

The most prominent division of the species is into (A) the *non-aluminous;* (B) the *alumin* But the former of these groups shades imperceptibly into the latter.

These two groups are generally subdivided according to the prevalence of the magnesia, l protoxyd of iron, or protoxyd of manganese, or of two or three together of these protoxyd ba Yet here, also, the gradation from one series to another is in general by almost insensible sh as to composition and chemical characters, as well as all physical qualities.

I. CONTAINING LITTLE OR NO ALUMINA.

1. *Lime-Magnesia Pyroxene;* MALACOLITE. (Basaltes spatosus, γ hwit., pt., *Cronstedt*, 68, 1' Malacolit *Abildgaard* (Ann. Ch., xxxii. 1800); Delameth., J. de Phys, li. 249, 1800. Ala Mussite, *Bonvoisin*, ib., 409, May, 1806. Diopside (fr. Ala) *H.*, J. d. M., xx. 65, 1806 W Coccolite. Traversellit *Scheerer*, Pogg., xciii. 109, 1854.) Color white, yellowish, grayish-w to pale green. In crystals: cleavable and granular massive. Sometimes transparent and co less. G.=3·2–3·38. Contains lime and magnesia, with less than 4 p. c. of protoxyd of Formula, $(\dot{\mathrm{Ca}}, \dot{\mathrm{Mg}})\,\ddot{\mathrm{Si}}$. Anal. 1 corresponds to $(\frac{1}{3}\dot{\mathrm{Ca}} + \frac{2}{3}\dot{\mathrm{Mg}})\,\ddot{\mathrm{Si}}$; anal. 2–7 to $(\frac{1}{2}\dot{\mathrm{Ca}} + \frac{1}{2}\dot{\mathrm{Mg}})$ Silica 55·7, magnesia 18·5, lime 25·8.

a. Malacolite, as originally used, included a bluish-gray, grayish-green, and whitish translu variety from Sala, Sweden.

b. Alalite occurs in broad right-angled prisms, colorless to faint greenish or clear green, usu striated longitudinally, and came originally from Mt. Ciarmetta, in the Mussa Alp.

c. Traversellite, from Traversella, occurs in similar long glassy crystals, usually rectang (planes *i-i*, *i-ì*), much striated longitudinally, often clear green at one end and colorless at other; cleavage parallel to *I*, perfect.

d. Mussite is white, grayish-white, and apple-green (according to Bonvoisin's original desc tion), and occurs in prismatic implanted crystals, and also in masses made up of aggregated c tals, the obtuse prismatic edge rounded, and with cleavage parallel to the base. Named from locality, the Mussa Alp (or elevated plane of the Mussa).

The optical characters of malacolite are as stated near top of the preceding page. Descloizeaux found the axial divergence in a crystal from Ala for the red rays as observed in the air, 111° 40′; for the yellow 111° 20′; and Heusser obtained for the same 112° 27′, 112° 12′.

e. White Coccolite is a granular variety. The original *coccolite* was green.

Named *Malacolite* from μαλακος, *soft*, because softer than feldspar, with which it was associated; and *Diopside* from δις, *twice* or *double*, and ὄψις, *appearance*.

2. *Lime-Magnesia-Iron Pyroxene;* SAHLITE. (Malacolit pt. *of authors.* Diopside pt. *H.*, l. c. Sahlit (fr. Sala) *d'Andrada*, Scherer's J., iv. 31, 1800; J. de Phys., li., 241, 1800. Baicalit (fr. L. Baikal) *Renovanz*, Crell's Ann., ii. 1793, 21; Baikalit *Karst.*, Tab. 34, 74, 1800. Funkite, Duf. Min., iii. 761, 1847. Coccolit *d'Andrada*, Scherer's J., iv. 1800. Protheite (fr. Zillerthal) *Ure.* Asbestus pt.) Color grayish-green to deep green and black; sometimes grayish and yellowish-white. In crystals; also cleavable and granular massive. G.=3·25—3·4. Named from Sala in Sweden, one of its localities, where the mineral occurs in masses of a grayish-green color, having a perfect cleavage parallel to the basal plane (*O*). Formula $(\dot{C}a, \dot{M}g, \dot{F}e)\ddot{S}i$. In anal. 9, $\dot{C}a : \dot{M}g : \dot{F}e = 2 : 1 : 2$; in 10, 11, this ratio $=4 : 3 : 1$, corresponding to Silica 53·7, magnesia 13·4, lime 24·9, prot. iron 8·0=100.

b. Baikalite is a dark dingy green variety, in crystals, cleavable like the preceding parallel to *O.* Named from Lake Baikal, in Siberia, near which it occurs.

c. Protheite is sombre-green, in crystals, and approaches fassaite; from Zillerthal in the Tyrol.

d. Funkite is dark olive-green coccolite from Boksüter in Gothland, having a larger percentage of $\dot{F}e$ than $\dot{M}g$. It may be convenient to use this name for the pyroxene here included that contains 10 p. c. or more of protoxyd of iron.

e. DIALLAGE. (Diallage pt. *H.*, Tr., 89, 1801. Hypersthene pt. Bronzite pt.) Part of the so-called *diallage*, or thin-foliated pyroxene, belongs here, and the rest under the corresponding division of the aluminous pyroxenes.

Color grayish-green to bright grass-green, and deep green; lustre of cleavage surface pearly, sometimes metalloidal or brassy; H.=4; G.=3·2—3·35. Double refraction strong; bisectrix negative; inclined about 38° to a normal to *i-i*, and showing therefore, when viewed through *i-i*, a single system of rings in the field of the polarizing instrument (Descl.); the angle 35° to 40°, observed in the air (24°—26° in oil) in the diallage of Knockdallian in Scotland, of Zobtenberg and Baumgarten in Silesia; a grayish hypersthene-like mineral in large folia in the gabbro of the Ruben coal mine near Neurode; the vanadiferous bronzite of Genoa. But the green diallage of Neurode, analyzed by v. Rath (No. 4, p. 219), has this angle about 49° 50′; and so also that of Bormio in Veltlin; diverging thus from ordinary diallage and diopside. With this variety belongs part also of what has been called *hypersthene* and *bronzite*—the part that is easily fusible. Common especially in serpentine rocks.

Named from διαλλαγή, *difference*, in allusion to the dissimilar cleavages.

The grass-green diallage-like mineral *smaragdite*, constituting, with saussurite, a rock, is in part, at least, amphibole (q. v).

3. *Iron-Lime Pyroxene;* HEDENBERGITE. (Hedenbergite (fr. Tunaberg) *Berz.*, Nouv. Syst. Min., 206, 269, 1819; Hedenberg, Afh., ii. 169. Lotalite (fr. Lotala) *Severgin*, before 1814. Bolopherit *Breith.*, Handb., 582, 1847.) Color black. In crystals, and also lamellar massive; cleavage easy parallel to *i-i.* G.=3·5—3·58. Contains lime and protoxyd of iron, with little or no magnesia; formula $(\dot{C}a, \dot{F}e)\ddot{S}i$. Anal. correspond to $(\frac{1}{2}\dot{C}a+\frac{1}{2}\dot{F}e)\ddot{S}i$. Named after the Swedish chemist, Ludwig Hedenberg, who first analyzed and described the mineral. *Lotalite*, from Lotala in Finland, is in black lamellar masses. Beudant gives for the angles of hedenbergite *O* ∧ *I*=100° 10′—12′, *I* ∧ *I*=87° 15′; and Breithaupt for the Taberg mineral (*Pyroxenus diagonalis* Breith.) *I* ∧ *I* =87° 28′, *C*=73° 51′.

4. *Lime-Magnesia-Manganese Pyroxene;* SCHEFFERITE (Schefferit *J. A. Michaelson*, J. pr. Ch., xc. 170). Color reddish-brown. G.=3·39. Contains lime, magnesia, and protoxyd of manganese, and in the absence of zinc differs from jeffersonite. Formula $(\dot{C}a, \dot{M}g, \dot{M}n)\ddot{S}i$; from Longban.

The Richterite of Breith. (B. H. Ztg., xxiv. 364, 1865) is near schefferite in composition. It occurs in acicular crystals, having *I* ∧ *I*=133° 38′, which appears to be the angle *I* ∧ *i-i* of pyroxene (=133° 33′), with G.=2·826; color isabella-yellow, rarely pale yellowish-brown, and is easily fusible. If the prismatic angle is *I* ∧ *i-i* of pyroxene, the mineral belongs here. But Igelström finds a very similar mineral in aspect and composition at Paisberg, with *I* ∧ *I*=124°; and the analyses are given under amphibole (see p. 234).

5. *Lime-Iron-Manganese Pyroxene.* A variety from L. Laach, analyzed by Bischof, is here included.

6. *Lime-Iron-Manganese-Zinc Pyroxene;* JEFFERSONITE (*Keating & Vanuxem*, J. Ac. Philad., ii. 194, 1822). Color greenish-black. Crystals often very large (3–4 in. thick), with the angles generally rounded, and the faces uneven, as if corroded. G.=3·36. Contains lime, magnesia, protoxyd of

iron, and protoxyd of manganese, with oxyd of zinc; formula ($\dot{Ca}$, $\dot{Fe}$, $\dot{Mg}$, $\dot{Mn}$, $\dot{Zn}$) $\ddot{Si}$. Named after Mr. Jefferson.

II. ALUMINOUS.

7. *Aluminous Lime-Magnesia Pyroxene;* LEUCAUGITE (*Dana*). Color white or grayish. Contains alumina, with lime and magnesia, and little or no iron; formula ($\dot{Ca}$, $\dot{Mg}$) ($\ddot{Si}$, $\dddot{\overline{Al}}^{\frac{2}{3}}$). Looks like diopside. H.=6·5; G.=3·19, Hunt. Named from λευκος, *white*.

8. *Aluminous Lime-Magnesia-Iron Pyroxene;* FASSAITE, AUGITE. (For syn. of *Augite* see p. 212. Also: Basaltische Hornblende pt. *Wern.*, Bergm. J., 1792; Basaltine *Kirw.*, Min., i. 219, 1794. Fassait *Wern.*, Hoffm. Min., iv. 2, 110, 1817. [Not Fassaite *Dolomieu*, which was a zeolite.] Maclureite *Nuttal*, Am. J. Sci., v. 246, 1822=Amphibole *H. Seybert*, J. Ac. Philad., ii. 139, 1821. Pyrgom *Breith.*, Char., 140, 1832.) Color clear deep-green to greenish-black and black; in crystals, and also massive; subtranslucent to opaque; G.=3·25—3·5 Optical characters as for malacolite. Contain protoxyd of iron, with lime and magnesia; general formula ($\dot{Ca}$, $\dot{Mg}$, $\dot{Fe}$) ($\ddot{Si}$, $\dddot{\overline{Al}}^{\frac{2}{3}}$).

a. Fassaite (or *Pyrgom*). Includes the green kinds found in metamorphic rocks. Named from the locality at Fassa in the Tyrol, which affords deep-green crystals, sometimes pistachio-green, like the epidote of the locality. *Pyrgom* was so named from πύργωμα, *a tower*.

b. Augite. Includes the greenish or brownish-black and black kinds, occurring mostly in eruptive rocks, but also in metamorphic. Named from αὐγή, *lustre*.

The *Augite* of Werner (and Volcanite *Delameth.*) included only the black mineral of igneous rocks—the *volcanic schorl* of earlier authors.

c. Aluminous Diallage.

9. *Aluminous Iron-Lime Pyroxene;* HUDSONITE (*Beck*, Min. N. Y., 405, 1842). Lamellar or cleavable massive. Color black. Streak green. Often has a bronze tarnish. G.=3·5, Beck; 3·43—3·46, Brewer. Contains lime and protoxyd of iron, with but little magnesia; formula ($\dot{Ca}$, $\dot{Fe}$) ($\ddot{Si}$, $\dddot{\overline{Al}}^{\frac{2}{3}}$). Named from the Hudson river, in the vicinity of which it occurs, in Cornwall, Orange Co., N. Y.

b. Polylite of Thomson (Min., i. 495, 1836) may be the same compound. It is described as cleavable massive; G.=3·231; H.=6—6·5; color black; opaque; and is stated to come from a bed of magnetic iron ore at Hoboken, N. J., where no such bed of ore exists.

Appendix.—10. ASBESTUS. Asbestus is a finely fibrous variety, with the fibres easily separable and usually flexible. But most asbestus belongs to the species *hornblende*, which tends more to run into fibrous forms.

It is difficult to distinguish the hornblende asbestus from the pyroxene, except by noting its association with known varieties of one or the other species; and this method is not free from doubt. See further under HORNBLENDE for description, analyses, and localities of asbestus.

11. *Breislakite* (*Brocchi*, Cat. di una raccolta di Rocce, 28, 60, 70, 192, 1817; *Cyclopeite*, in Descl. Min., 65, 1862). Occurs in wool-like forms at Vesuvius and Capo-di-Bove. Its crystallographic identity with pyroxene has been shown by Chapman (Phil. Mag., xxxvii. 444, 1850). The particular variety of pyroxene to which it belongs has not been ascertained, as no analysis of it has been made. Named after Breislak, an Italian geologist.

12. *Lavroffite* (Lawrowit, Vanadin-Augit, Kokscharof, Bull. Ac. St. Pet., xi. 78, 1866) is an alumina pyroxene, colored green by vanadium, from the river Sludianka, beyond Lake Baikal, where it occurs coarse granular massive with quartz, and also in small imperfect crystals. Cleavage affords the prism 87° 7′; and there is the usual lamination from compound structure parallel to *O*. The color is fine emerald-green. It contains besides silica some alumina, iron, lime, magnesia, and a trace of manganese and vanadium; but no analysis has been made, so that its exact place among the pyroxenes is not certain.

I. CONTAINING LITTLE OR NO ALUMINA.

1. *Lime-Magnesia Pyroxene; Malacolite.* Analyses: 1, Nordenskiöld (Schw. J., xxxi. 457); 2, H. Rose (ib., xxxv. 86); 3, T. Wachtmeister (ib., xxx. 334); 4, Hermann (J. pr. Ch., xxxvii. 190); 5, H. Rose (Schw. J. xxxv. 86,); 6, Rammelsberg (J. pr. Ch., lxxxvi. 340); 7, F. J. Wiik (Arppe, in Act. Soc. Fenn., vi.); 8, Bonsdorff (Schw. J., xxxi. 158); 9, Kussin (Ramm., 4th Suppl., 12); 10, Wackenroder (Kastn. Arch., xiii. 84); 11, Brunner (Jahrb. Min., 186, 1855); 12, Range (Ramm. Min. Ch., 452); 13–15, T. S. Hunt (Rep. G. Can., 1863, 467, 468); 16, Redner (ZS. G., xviii. 397) 17, Merz (N. Ges. Zurich, 48, 1861):

		$\ddot{Si}$	$\dddot{\overline{Al}}$	$\dot{Fe}$	$\dot{Mn}$	$\dot{Mg}$	$\dot{Ca}$	$\dot{H}$	
1	Pargas, *bh -gn.*	55·40	—	2·50	2·83	22·57	15·70	—,	$\dddot{\overline{Mn}}$ 0·43=99·43 N
2	Longban, *ywh.*	55·32	—	$\dddot{\overline{Fe}}$ 2·16	$\dddot{\overline{Mn}}$ 1·59	16·99	23·01	—	=99·07 Rose.

	S̈i	Ä̶l	Ḟe	Ṁn	Ṁg	Ċa	Ḣ
3. Norway, *wh.*	57·40	0·43	——	——	16·74	23·10	——=97·57 Wacht.
4. Achmato'sk, *wh.*	53·97	——	2·00	0·57	17·86	25·60	——=100 Herm.
5. Orrijärvi, *w.*	54·64	——	1·08	2·00	18·00	24·94	——=100·66 Rose.
6. Gulsjö	55·11	——	0·54	——	18·39	25·63	——=99·67 Ramm.
7. Lupikko (½)	52·40	1·84	2·29	——	17·93	22·55,	Ṅa 1·20, K̇ 0·37=98·58 W
8. Tammare, *wh.*	54·83	0·28	0·99	——	18·55	24·76	Ḣ 0·32=99·73 Bonsd.
9. Brazil	55·61	——	1·20	——	17·82	25·11	——=99·74 Kussin.
10. Zillerthal, *wh.*	54·16	0·20	2·51	M̈n 0·18	18·22	24·74	——=100 Wack.
11. Sassgrat, *w.*	56·13	——	2·02	*tr.*	16·20	25·78	——=100·85 Brunner.
12. Retzbanya	56·08	——	1·38	——	17·36	25·05	——=99·82 Range.
13. Ottawa, C., *wh.*	54·50	——	1·98	——	18·14	25·87	0·40=100·89 Hunt.
14. Calumet I., *gnh.*	54·90	——	——	——	16·76	27·67	0·80=100·13 Hunt.
15. High Falls, C., *gy.*	54·20	——	3·24	——	17·02	25·65	0·45=100·56 Hunt.
16. Grenville, C.	52·54	——	8·06*	——	19·85	24·64	——=100·09 Redner.
17. Zermatt	54·74	——	3·45	——	17·82	22·90	0·58=99·49 Merz.

* With some alumina; the specimen associated with Eozoon.

No. 1, crystals, G.=3·267; 2, fr. Longban in Wermland; 3, fr. Tjötten in Norway; 4, G.=3·28; 5, fr. Finland; 7, ib., G.=3·215; 8, ib.; 9, G.=3·37; 11, fr. the Alps; 13, fr. Canada, G.=3·26—3·27; 14, fr. Canada, with Eozoon; 15, ib., G.=3·273—3·275.

2. *Lime-Magnesia-Iron Pyroxene; Sahlite; Funkite.* 1, H. Rose (Schw. J., xxxv. 86); 2, Reuterskiöld (Jahresb., xxv. 362); 3, Hisinger (Afh., iii. 291); 4, Arppe (Anal. Finsk. Min., 22); 5, 6, A. Erdmann (Ak. H. Stockh., 1848); 7, Winchenbach (Ramm. Min. Ch., 452); 8, Rammelsberg (ib., 452); 9, G. T. Bowen (Am. J. Sci., v. 344); 10, Erdmann (l. c.); 11, Payr (Ber. Ak. Wien, xxv. 560); 12, 13, H. Rose (l. c.); 14, v. Hauer (Ber. Ak. Wien, xii. 714); 15, Schultz (Act. Fenn., 1856); 16, Rammelsberg (J. pr. Ch., lxxxvi. 351); 17, Funk (Jahresb., 1844, 362); 18, Seybert (Am. J. Sci., v. 116); 19, H. Rose (l. c.); 20, C. W. C. Fuchs (Jahresb. Min., '62 802):

	S̈i	Ä̶l	Ḟe	Ṁn	Ṁg	Ċa	Ḣ
1. Sala, *Sahlite*	54·86	0·21	4·44	——	16·49	23·57	0·42=99·99 Rose.
2. Longban, *ywh.*	53·56	0·25	4·48	1·87	16·27	23·86	——=100·29 Reut.
3. " "	54·18	——	1·45	2·18	17·81	22·72	1·20=99·54 Hisinger.
4. Pargas, *gyh.-gn.*	52·67	0·54	4·54	——	19·52	21·03	——=98·30 Arppe.
5. Tunaberg, *gn.*	54·13	0·90	3·69	0·30	15·01	25·15	0·63=99·81 Erdm.
6. " *gn.*	53·82	0·95	7·95	0·89	12·20	23·55	0·54=99·90 Erdm.
7. Meseritz, *gn.*	54·46	2·46	3·78	0·78	14·39	24·01	——=99·83 Winch.
8. Edenville, *gnh.-b.*	55·01	——	4·95	——	16·95	22·80	0·86=100·07 Ramm.
9. N.Hav'n, Ct., *Sah.*	53·12	1·06	6·01	0·60	14·50	23·62	0·47=99·38 Bowen.
10. Tunab., *Cocc.*, *gn.*	53·50	0·76	9·74	1·90	13·59	20·42	0·27=100·18 Erdm.
11. Oberrochlitz, *wh.*	55·03	——	4·84	3·16	15·71	20·72	——=99·46 Payr.
12. Dalecarlia, *gn.*	54·55	0·14	8·14	M̈n 0·73	15·25	20·21	——=99·02 Rose.
13. " "	54·08	——	10·02	0·61	11·49	23·47	——=99·67 Rose.
14. Boksäter, *Funk.*	53·81	——	10·01	——	8·00	27·50	0·29=99·61 Hauer.
15. Finland, *gn.*	52·00	0·85	12·45	0·80	10·15	22·50	——=98·75 Schultz.
16. Kaiserst., *dk. gn.*	48·02	2·67	13·57	1·28	9·74	25·34	——=100·62 Ramm.
17. Nordmark	52·17	0·42	16·12	1·61	7·06	22·00	——=99·38 Funk.
18. L. Champl., *gn.*	50·33	1·53	20·40	*tr.*	6·83	19·33	0·67=99·09 Seybert.
19. Taberg, *bk.*	53·36	——	17·38	0·09	4·99	22·19	——=98·01 Rose.
20. Radauthal, *bk.* (½)	51·78	2·48*	16·91	——	7·03	21·00	0·04, Ṅa 0·19, K̇ 0·29=99·47 F.

* Includes Fe^2O^3 1·20.

No. 2, G.=3·27; 4, crystals; 5, G.=3·36; 8, cryst., G.=3·294; 9, cleavable massive, G.=3·127—3·294; 10, G.=3·30—3·37; 11, G.=3·395; 12, 13, fr. Björmyresweden; 14, fr. E. Gothland; 15, fr. I. Afvensor; 16, occurs mixed with scolopsite; 18, G.=3·377.

3. *Iron-Lime Pyroxene; Hedenbergite.* 1, H. Rose (Schw. J., l. c.); 2, Wolff (J. pr. Ch., xxxiv. 236); 3, Söchting (ZS. Nat. Ver. Halle, vii. 57):

	S̈i	Ḟe	Ṁg	Ċa
1. Tunaberg, *Hed.*	49·01	26·08	2·98	20·87=98·94 Rose.
2. Arendal, *bk.*	47·78	27·01	——	22·95=97·74 Wolff.
3. D. la Garde	52·23	27·47	7·46	12·84=100 Söchting.

No. 2, G.=3·467; 3, fr. "Melaphyre."

4. *Lime-Magnesia-Manganese Pyroxene; Schefferite.* Analysis: Michaelson (l. c.):

	S̈i	F̶e	Ḟe	Ṁn	Ṁg	Ċa	Ḣ	
1. Longban	52·31	3·97	1·63	10·46	10·86	19·09	0·60	=98·92 Michaelson.

5. *Lime-Iron-Manganese Pyroxene.* Analysis: Bischof (Lehrb., ii.):

	S̈i	Ä̶l	Ḟe	Ṁn	Ṁg	Ċa	Ṅa	K̇	
L. Laach	50·83	2·16	13·50	7·56	3·42	21·73	0·38	0·98	=100·56 Bischof.

6. *Lime-Iron-Manganese-Zinc Pyroxene; Jeffersonite.* Analysis: Hermann (J. pr. Ch., xlvii. 1

S̈i	Ä̶l	Ḟe	Ṁn	Żn	Ṁg	Ċa	Ḣ	
49·91	1·93	10·53	7·00	4·39	8·18	15·48	1·20	=98·62 Hermann.

II. ALUMINOUS PYROXENE.

7. *Lime-Magnesia P.; Leucaugite.* Analyses: T. S. Hunt (Rep. G. Can., 1853, 1863)

	S̈i	Ä̶l	F̶e	Ṁg	Ċa	Ḣ	
1. Bathurst, C.	51·50	6·15	0·35	17·69	23·80	1·10	=100·59 Hunt.
2. "	50·90	6·77	0·35	18·14	23·74	0·90	=100·45 Hunt.

8. *Lime-Magnesia-Iron P.; Fassaite, Augite.* Analyses: 1, Kudernatsch (Pogg., xxxvii. 577); Delesse (Ann. d. M., IV. xii. 293); 3, Richter & Scheerer (Sächs. Ges. Leipsic, ci. 93, 1858): Barthe (Ch. Centralbl., ii. 712); 5, Haughton (Dublin Q. J. Sci., v. 95); 6, Kudernatsch (l. c.); Klaproth (Beitr., v.); 8, Kudernatsch (l. c.); 9, Wedding (ZS. G., x. 395); 10, Rammelsberg (i xi. 497); 11, Klaproth (l. c.); 12, Kudernatsch (l. c.); 13–15, v. Waltershausen (Vulk. Gest., 10 110); 16, Rammelsberg (Pogg., ciii. 436); 17, Kudernatsch (l. c); 18–20, Rammelsberg (Pog lxxxiii. 458, ciii. 437); 21, Waltershausen (l. c., p. 110); 22, T. S. Hunt (Rep. G. Can., 18 468); 23, Tobler (Ann. Ch. Pharm., xci. 230):

		S̈i	Ä̶l	Ḟe	Ṁn	Ṁg	Ċa	Ḣ	
1.	Fassathal	50·15	4·02	12·04	——	13·48	19·57	——	=99·26 Kudernatsch.
2.	Vosges	49·16	5·08	7·19	*tr.*	15·95	18·87	2·26	=98·51 Delesse.
3.	Traversella	51·79	4·03	7·57	——	17·40	18·98	——	=99·77 R. & S.
4.	Zillerthal, *gn.*	48·47	8·22	4·30	——	15·59	21·96	0·73	=99·27 Barthe.
5.	Skye	50·80	3·00	9·61	1·08	15·06	19·35	0·60, Ṅa, K̇ 0·66	=100·16 H.
6.	Rhone, *bkh.-gn.* (3/2)	50·42	6·58	7·40	——	16·32	18·78	——	=99·50 Kud.
7.	" "	52·00	5·75	11·02	0·25	12·75	14·00	0·25	=96·02 Klapr.
8.	Vesuvius	50·90	5·37	6·25	——	14·43	22·96	——	=99·91 Kud.
9.	" of 1631	48·86	8·63	4·54	*tr.*	14·01	20·62	——, F̶e 2·73	=99·39 Wedd.
10.	" of 1858	49·61	4·42	9·08	——	14·22	22·83	——, F̶e *und.*	=100·16 Ramm
11.	Frascati	48·00	5·00	10·80	1·00	8·75	24·00	——	=97·55 Klaproth.
12.	Etna	50·55	4·85	7·96	——	13·01	22·29	——	=98·66 Kud.
13.	" *bk.* 4/3	47·63	6·74	11·39	0·21	12·90	20·87	0·28	=100·02 Walt.
14.	" *gnh-bk.*	51·70	4·38	4·24	——	21·11	18·02	0·49	=99·94 Walt.
15.	" Mascali	49·69	5·22	10·75	——	14·74	18·44	0·51	=99·35 Walt
16.	" Mt. Rossi	47·38	5·52	7·89	0·10	15·29	19·10	0·43, F̶e 3·85	=99·53 Ramm.
17.	Eiffel	49·39	6·00	7·39	——	13·93	22·46	——	=99·25 Kud.
18.	Hartlingen	47·52	8·13	13·02	0·40	12·76	18·25	——	=100·08 Ramm.
19.	L. Laach	50·03	3·72	6·65	0·15	13·48	22·85	——, F̶e 2·36	=99·24 Ramm.
20.	Schima, Boh.	51·12	3·38	5·45	2·63	12·82	23·54	——, F̶e 0·95	=99·89 Ramm.
21.	Iceland	49·87	6·05	5·92	——	16·16	22·00	——	=100 Walt.
22.	Montreal, *bk.*	49·40	6·70	F̶e 7·83	——	13·06	21·88	0·50, Ṅa 0·74, K̇ *tr*	=100·11
23.	Kaiserstuhl, *bn.*	44·40	7·83	11·81	0·11	10·15	22·60	1·03, Ṅa 2·13, K̇ 0·65	=100·7

Nos. 1–5, fr. metamorphic rocks; 6–23, fr. eruptive rocks. 2, fr. Ternuay, making with vos a so-called porphyry, G.=3·135; 3, var. pyrgom, G.=3·294; 4, G.=3·395; 5, the augite metamorphic dolerite on Loch Scavig in Skye; 6, G.=3·347; 12, G.=3·40; 13, G.=2·886; G.=3·204; 15, G.=3·228; 16, G.=3·376; 18, G=3·380; 19, G.=3·348; 20, G.=3·361; 22, dolerite, G.=3·341.

9. *Iron-Lime P.* (*with little Magnesia*). Analyses: 1, Deville (Et. Teneriffe, 1848); 2, Ho stetter (J. pr. Ch., xxvii. 375); 3, 4, Smith & Brush (Am. J. Sci., II. xvi. 369); 5, Thomson (M i. 495):

	$\ddot{\mathrm{S}}\mathrm{i}$	$\dddot{\bar{\mathrm{A}}}\mathrm{l}$	$\dot{\mathrm{F}}\mathrm{e}$	$\dot{\mathrm{M}}\mathrm{n}$	$\dot{\mathrm{M}}\mathrm{g}$	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\mathrm{H}}$
1. Teneriffe	48·05	4·18	23·41	——	9·40	14·96	——=100 Deville.
2. Azores	50·40	2·99	22·00	——	2·40	21·10	0·30=99·19 Hochst.
3. *Hudsonite*	39·30	9·78	30·40	0·67	2·98	10·39	1·95, $\dot{\mathrm{N}}\mathrm{a}$ 1·66, $\dot{\mathrm{K}}$ 2·48=99·61 S. & B.
4. "	38·58	11·05	30·57	0·52	3·02	10·32	1·95, $\dot{\mathrm{N}}\mathrm{a}$, $\dot{\mathrm{K}}$ 4·16=100·17 S. & B.
5. *Polylite*	40·04	9·42	34·08	6·60	——	11·54	0·40=102·08 Thomson.

Nos. 1, 2, fr. volcanic rocks; 3, 5, fr. metamorphic. 1, G.=3·179.

III. Diallage and Pseudo-hypersthene.

2 *c. Containing little or no Alumina.* Analyses: 1–5, v. Rath (Pogg., xcv. 533); 6, Hermann (Bull. Soc. Nat. Moscou, 1854, 273).

3 *c. Aluminous.* Analyses: 7, v. Rath (ZS. G., ix. 246); 8, 9, Regnault (Ann. d. M., III. xiii. 101); 10–12, Köhler (Pogg., xiii. 101); 13, Rammelsberg (Min. Ch., 464); 14, Köhler (l. c.); 15, v. Kobell (J. pr. Ch., xx. 472); 16, A. Streng (B. H. Ztg., xxiii. 54); 17, Delesse (Ann. d. M., IV. xvi.); 18, Schafhaütl (Ann. Ch. Pharm., li. 254); 19, 20, A. Streng (l. c.); 21, Seybert (J. Ac. Philad., ii. 141):

	$\ddot{\mathrm{S}}\mathrm{i}$	$\dddot{\bar{\mathrm{A}}}\mathrm{l}$	$\dot{\mathrm{F}}\mathrm{e}$	$\dot{\mathrm{M}}\mathrm{n}$	$\dot{\mathrm{M}}\mathrm{g}$	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\mathrm{H}}$
1. Glatz. *gwh.-gn.*	50·34	——	8·47	——	16·86	21·85	1·23=98·76 Rath.
2. " *d'k gn.*	50·00	0·42	8·54	——	15·87	21·11	1·69=97·63 Rath.
3. " "	51·78	1·12	10·97	——	15·58	20·04	0·22=99·71 Rath.
4. Neurode, *bk. Hyp.*	53·60	1·99	8·95	0·28	13·08	21·06	0·86=99·82 Rath.
5. Skye, " "	51·30	0·76	13·92	0·25	14·85	20·15	0·21=101·44 Rath.
6. Achmat'sk, *Diall.*	51·47	1·15	1·80	——	15·63	27·81	2·39=100·25 Herm.
7. Marmorera	49·12	3·04	11·45	——	15·33	18·54	1·46=98·94 Rath.
8. Piedmont, *Diall.*	50·05	2·58	11·98	——	17·24	15·63	2·13=99·61 Regnault.
9. Ural, "	52·60	3·27	5·35	——	16·43	20·44	1·59=99·68 Regnault.
10. Florence, "	53·20	2·47	8·67	0·38	14·91	19·09	1·77=100·49 Köhler.
11. Harz, "	53·71	2·82	8·08		17·55	17·06	1·04=100·27 Köhler.
12. Baste, *gnh.-bn.*	52·88	2·32	8·40		17·68	17·40	1·06=100·24 Köhler.
13. " "	52·00	3·10	9·36		18·51	16·29	1·10=100·36 Ramm.
14. Salzburg, *gn.*	51·34	4·39	8·23		15·69	18·28	2·11=100·04 Köhler.
15. " *gy.*	50·20	3·80	8·40	——	16·40	20·26	——=99·06 Kobell.
16. Harzburg, *Diall.*	52·84	4·56	9·41	——	16·05	13·16	3·29, alk. 0·39, $\dddot{\bar{\mathrm{F}}}\mathrm{e}$ 1·84, $\dddot{\bar{\mathrm{C}}}\mathrm{r}$ 0·09, $\ddot{\mathrm{T}}\mathrm{i}$ 0·22=101·85 Streng.
17. Odern, "	49·30	5·50	9·43	0·51	17·61	15·43	0·85, $\dddot{\bar{\mathrm{C}}}\mathrm{r}$ 0·30=98·93 Delesse.
18. Genoa, *met. Di.*	49·50	5·55	3·28	——	14·12	18·12	1·77, $\dddot{\mathrm{V}}$ 3·65, $\dot{\mathrm{N}}\mathrm{a}$ 3·75 Schafh.
19. Harzburg. *Hyp.*	52·34	3·05	8·84	——	15·58	19·18	0·66=99·65 Streng.
20. " "	51·26	3·62	9·11	——	16·69	19·18	0·34, $\dddot{\bar{\mathrm{F}}}\mathrm{e}$ 1·03=101·23 Streng.
21. Wilmington, "	52·17	4·00	$\dddot{\bar{\mathrm{F}}}\mathrm{e}$ 10·73	*tr.*	11·33	20·00	1·27=99·50 Seybert.

No. 1, fr. gabbro, G.=3·249; 2, ib., G.=3·244; 3, ib., G.=3·245; 4, ib., G.=3·336; 5, fr hypersthene rock, G.=3·343: 6, G.=3·21, H.=4·5; 7. fr. gabbro of Graubündten, G.=3·253; 8, met. diallage, G.=3·261; 9. met. diallage, fr. serpentine; 10, fr. gabbro, G.=3·256; 12, fr. gabbro, G.=3·23; 13, fr. gabbro, G.=3·300; 14, G.=3·28; 15, G.=3·2; 16, fr. gabbro; 18, vanadiferous bronzite, G.=3·25; 19, 20, fr. gabbro, pseudo-hypersthene; 21, pseudo-hypersthene, assoc. with quartz, G.=3·25; B.B. fus.

Pyr., etc.—Varying widely, owing to the wide variations in composition in the different varieties, and often by insensible gradations. Fusibility, from the almost infusible diallage to 3·75 in diopside; 3·5 in sahlite, baikalite, and omphacite; 3 in jeffersonite and augite; 2·5 in hedenbergite. Varieties rich in iron afford a magnetic globule when fused on charcoal, and in general their fusibility varies with the amount of iron. Jeffersonite gives with soda on charcoal a reaction for zinc and manganese; many others also give with the fluxes reactions for manganese. Most varieties are unacted upon by acids.

Obs.—Pyroxene is a common mineral in crystalline limestone and dolomite, in serpentine, and in volcanic rocks; and occurs also, but less abundantly, in connection with granitic rocks and metamorphic schists. The pyroxene of limestone is mostly the white and light green, or gray varieties; that of most other metamorphic rocks, sometimes white or colorless, but usually green of different shades, from pale green to greenish-black, and occasionally black; that of serpentine is sometimes in fine crystals, but often of the foliated green kind called *diallage;* that of eruptive rocks is the black to greenish-black *augite.*

In limestone the associates are often hornblende, scapolite, garnet, orthoclase, sphene. phlog pite, and sometimes brown tourmaline, chlorite, talc, zircon, spinel, rutile, etc.; and in oth metamorphic rocks mostly the same. In eruptive rocks the crystals are imbedded, and often oc with similarly disseminated chrysolite, crystals of orthoclase, sanidin, labradorite, leucite, etc.

Pyroxene is an essential constituent of many rocks. *Pyroxenyte* is a metamorphic rock consis ing mainly of compact pyroxene of the Sahlite section. *Lherzolyte*, from the borders of La Lherz, in the department of Ariégo in France (described by Charpentier and Dufrénoy as a varie of pyroxene), is a green pyroxenic rock. (For constitution, see under SPINEL.) Pyroxene alon with labradorite constitutes the dark gray and green to black eruptive rock called *doleryte*, whic often contains also magnetic iron ore in grains; and with labradorite and chrysolite, the relate rock *basalt*. *Doleritic* and *basaltic lavas* have the same composition. With leucite it forms th *leucitophyr*, the common igneous rock of Vesuvius; and with nephelin, *nephelinyte* or *nepheli* *doleryte*, another Italian igneous rock. The pyroxene of these igneous rocks is the black varie *augite;* and it often occurs in distinct crystals of the forms in figs. 203–206. Many kinds of *tuf* and the earthy basaltic rock called *wacke* (either a variety of tufa or a decomposed basalt (doleryte) often consist largely of crystals or grains of augite.

Diallage occurs generally in serpentine or steatitic rocks.

Many foreign localities of pyroxene have already been briefly indicated (pp. 214–219). Th crystals of Ala in Piedmont are associated with garnets and talc in veins traversing serpentine and the more transparent are sometimes cut and worn as gems.

In N. America, it occurs in *Maine*, at Raymond and Rumford, diopside, sahlite, etc.; at De Isle, diallage in serpentine. In *Vermont*, at Thetford, black augite, with chrysolite, in boulde of basalt. In *Mass.*, in Berkshire, white crystals abundant; at the Bolton quarries, same, good Westfield and Blanford, diallage in serp. In *Conn.*, at Canaan, white cryst. 2–3 in. long by 1– in. broad, in dolomite; in Trumbull, large green cryst. in limestone; in Reading, on the turnpik near the line of Danbury, small transp. cryst., and granular; at Watertown, near the Naugatuc white diopside. In *N. York*, in N. Y. Co., white cryst. in dolomite; at Warwick, fine crys (descr. and fig. by v. Rath, Pogg., cxi. 263); in Westchester Co., white, at the Sing-Sing quarries in Orange Co., in Monroe, at Two Ponds, cryst., often large, with scapolite, sphene, etc., in lim stone; 3 m. S.E. of Greenwood furnace, sahlite with coccolite; ¼ m. E. of same, in cryst. wit mica in limestone, one 6 in. long and 10 in. in circ.; 1 m. W. of Coffee's Hotel in Monroe, blac coccolite; 2½ m. N. of Edenville, gray cryst.; 1 m. N.W. of Edenville, black cryst. in limestone in Cornwall, the var. *hudsonite;* near Amity and Fort Montgomery, good; in Forest-of-Dea lamellar, green, and bronze-colored, with black coccolite; in Putnam Co., near Patterson, grayish white cryst., abundant; at Rogers' Rock, L. George, massive and granular (coccolite), gra green, brown; near Oxbow, on Vrooman Lake; in Lewis Co, at Diana, white and black cryst. in St. Lawrence Co., at Fine, in large cryst.; in Essex Co., near Long Pond, cryst. (f. 213), als beautiful green coccolite; at Willsboro', green coccolite with sphene and wollastonite. In *N. Je sey*, in Franklin, good cryst. In *Penn.*, near Attleboro', cryst. and granular; in Pennsbury, Burnett's quarry, diopside. In *Maryland*, Hartford Co., at Cooptown, diallage. In *Delaware*, Wilmington, a hypersthene-like variety (anal. 21), Nuttal's *Maclureite*. In *Canada*, at Bytow subtrp. white cryst., 1–1½ in., in limestone; at Calumet I., grayish-green cryst. in limestone wit phlogopite, some appearing to be altered *Eozoon;* at the High Falls of the Madawaska, crys sometimes 1 ft. long and 4 in. wide, having cryst. of hornblende attached; in Kildau, as a rock in Bathurst, colorless or white cryst.; near Ottawa, in large subtrp. cryst., in limestone; Grenville, dark green cryst., and granular; at Montreal, Rougemont and Montarvelli Mts., blac in doleryte.

Alt.—Pyroxene undergoes alteration in different ways, as has been well explained by Bischo and many species have been instituted on the material in different stages of change. In th simplest, there is only a taking up of water, producing a "hydrous augite." The water found i several of the analyses already cited may be from this source. In many cases a loss of silic appears to attend this hydration; and often, also, a loss of one or more of the bases (of whic the lime and iron are the first to go), through the dissolving agency of waters holding carbon acid, or carbonates, in solution. Thus may come the following substances:

13. HYDROUS AUGITE. Analyses 1, 2, 3 of an altered sahlite from Sala, Sweden, the thre analyses made on different fragments of the same piece, by H. Rose.

14. PICROPHYLL (Svanberg, Pogg., l. 662, 1839). Also from Sala, where it occurs both massiv with the cleavage of pyroxene, and fibrous, of a greenish-gray color, with H.=2·5 and G.=2·7 Analyses: 4, Svanberg (l. c.). Formula deduced $\dot{R}\,\ddot{S}i+\frac{2}{3}\dot{H}$. Named from πικρος, *bitter*, an φυλλον, *leaf*, in allusion to the odor when moistened.

15. PYRALLOLITE (*Nordenskiöld*, Schw. J., xxxi 389, 1820). From Finland, where it occur mostly in limestone, with pyroxene and scapolite. A pyrallolite from Sibbo in Finland ha been named *Vargasite*, after Count Vargas, Huot Min., ii. 676, 1841; Wargasit *Germ.* Analyse 5, Nordenskiöld (l. c.), of the original mineral from Storgord, whitish or greenish-white, w H.=3·5–4, G.=2·53–2·78, for which the formula $Mg\,\ddot{S}i+\frac{1}{2}\dot{H}$ has been written; 6–14, la

by Arppe, Furuhjelm, Runeberg, and Selin (Anal. Finsk. Min., 35), from different Finland localities—6, large whitish crystals from Storgard, G.=2·53; 7–10, from Kulla quarry in Kimito; 8, whitish, augitic in structure, H.=3—4; 9 and 10, whitish and earthy; 11, green and columnar, G.=2·70, H.=3—4, from Takvedaholm; 12, similar, from Skräbböle; 13, greenish and granular, with G.=2·61, from Haapakyla; 14, brownish or grayish-yellow and columnar, H.=3, G.=2·66, from Frugard. The crystalline structure is that of pyroxene. Named from πῦρ, *fire*, ἄλλος, *other*.

16. **Schiller Spar** in part (Schillerstein *Wern.*, *Bastite* pt.) An impure serpentine, from Baste in the Harz, having often the cleavage and forms of pyroxene; H.=3·5—4; G.=2·5—2·7; lustre metallic-pearly to subvitreous; color dark-green to pinchbeck-brown. Analysis 15, by Köhler (Pogg., xi. 192); 16, Rammelsberg (Pogg., xlix. 387). See further **Serpentine**.

17. **Traversellite** (*Scheerer*, Pogg., xciii. 109, 1854). A leek-green mineral, in crystals, having the form of pyroxene, from Traversella in Piedmont. Analysis: 17, R. Richter (l. c.).

18. **Pitkarandite** (*Scheerer*, Pogg., xciii. 100, 1854). Has a leek-green or dark-green color, and looks like unaltered pyroxene, having the crystal planes *I*, *i-i*, *i-i*, with cleavage parallel to *i-i*. It is from Pitkäranda in Finland. Analyses: 18, R. Richter (Pogg., xciii. 101); 19, Frankenhauser. Scheerer refers here part of pyrallolite (anal. 20).

19. **Strakonitzite** (*v. Zepharovich*, Jahrb. geol. Reichs., iv. 695, 1853). Approaches steatite. It occurs in greenish-yellow crystals, soft and greasy in feel, with G.=1·91. Analysis: 21, v. Hauer (l. c.).

20. **Monradite** (*Erdmann*, Ac. H. Stockh., 1842, p. 103). Probably a slightly altered pyroxene or hornblende. Described as occurring granular massive, with two unequal cleavages mutually inclined about 130°; with H.=6, G.=3·2673; color yellowish, honey-yellow, and lustre vitreous. Analysis: 22, Erdmann (l. c.). Formula deduced ($\dot{\mathrm{Mg}}$, $\dot{\mathrm{Fe}}$) $\ddot{\mathrm{Si}}+\frac{1}{4}\dot{\mathrm{H}}$. From Bergen in Norway. Named after Dr. Monrad.

		$\ddot{\mathrm{Si}}$	$\dddot{\bar{\mathrm{Al}}}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Mn}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$	$\dot{\bar{\mathrm{H}}}$
1.	*Altd. augite*	60·35	—	4·16	0·78	25·07	4·94	4·52=99·82 Rose.
2.	"	56·27	0·45	5·13	—	21·58	10·89	3·12=97·44 Rose.
3.	"	56·48	0·10	4·11	0·66	23·46	9·58	3·12=97·51 Rose.
4.	*Picrophyll*	49·80	1·11	6·86	—	30·10	0·78.	9·83=98·48 Svanb.
5.	*Pyrallolite*, Storg.	56·62	3·38	0·89	0·99	23·38	5·58	3·58, bit. & loss 6·38 Nord.
6.	" "	76·23	1·79	0·72	—	11·65	2·56	7·10=100·05 Arppe.
7.	" Kulla	56·9	1·4	0·6	—	[28·7]	3·9	8·5=100 Arppe.
8.	" "	48·88	0·48	1·55	0·76	24·72	10·69	12·33=99·41 Runeberg.
9.	" "	58·87	1·79	0·57	—	18·39	11·72	8·78=100·12 Selin.
10.	" "	66·18	0·87	1·83	—	18·77	5·53	6·48=99·66 Furuhjelm.
11.	" Takv.	55·17	1·13	1·45	0·09	26·85	6·33	9·15=100·17 Arppe.
12.	" Skrab.	55·92	1·55	1·86	1·68	26·12	6·34	7·56=101·03 Arppe.
13.	" Haap.	57·49	1·11	1·26	0·69	30·05	2·90	7·30=100·80 Arppe.
14.	" Frug.	63·87	0·34	2·18	—	23·19	3·74	7·32=100·64 Arppe.
15.	*Schiller spar*	48·08	1·73	10·91	0·57	26·16	2·75	12·43, $\dddot{\bar{\mathrm{Cr}}}$ 2·37 Köhler.
16.	"	41·48	6·49	16·61	—	27·24	—	10·13=101·95 Ramm.
17.	*Traversellite*	52·39	1·21	20·46	—	14·41	7·93	3·69=100·09 Richter.
18.	*Pitkarandite*	61·25	0·41	12·71	0·83	13·30	9·17	2·52=100·19 Richter.
19.	"	54·67	1·34	12·84	0·60	12·50	14·42	2·80=99·19 Frank.
20.	" Storg.	60·06	5·67	1·68	—	27·13	—	4·62, $\dddot{\bar{\mathrm{Fe}}}$ 0·67=99·83 Sch.
21.	*Strakonitzite*	53·42	7·00	15·41	—	2·94	1·37	19·86=100 Hauer.
22.	*Monradite*	56·17	—	8·56	—	31·63	—	4·04=100·40 Erdm.

T. S. Hunt has analyzed some altered pyroxenes (Logan's Rep., 1863, 490) from Canada, related closely in composition to his loganite (which is altered hornblende; see under **Hornblende**); and also

21. **Hydrous Diallages** (l. c., p. 469), that may be examples of other alterations of the species. The following are his analyses: No. 1, of a brittle cleavable-massive mineral, forming a bed in a deposit of apatite in North Elmsley, having the cleavages of pyroxene perfect; H.=3; G.=2·538—2·539; color greenish-gray; powder unctuous. No. 2, a similar material from N. Burgess, having the cleavage of pyroxene; a waxy lustre; H.=2—3, and G.=2·32—2·35; pale grayish-green color; an unctuous feel. No. 3, a coarse, cleavable, bronze-colored diallage, forming a rock at Ham. No. 4, a rock from Orford, consisting of small masses of pearly, translucent, celandine-green diallage, with H.=5·0, and G.=3·02—3·03:

		$\ddot{\mathrm{Si}}$	$\dddot{\bar{\mathrm{Al}}}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$	$\dot{\bar{\mathrm{H}}}$
1.	N. Elmsley, *loganitic*	($\frac{2}{7}$) 36·70	10·96	9·36	28·19	—	14·31=99·52
2.	N. Burgess, "	($\frac{3}{2}$) 39·30	14·25	4·41	25·73	—	16·93=100·62
3.	Ham, *diallagic*	50·00	—	13·59	27·17	3·80	6·30=100·86
4.	Orford, "	($\frac{3}{2}$) 47·15	3·45	8·73	24·55	11·35	5·88=101·56

A complete removal of the lime and iron produces *steatite* or *talc*, a common material of pseud morphs. *Rensselaerite* is a variety of steatite (see TALC), having sometimes the cleavage pyroxene. Pyrallolite is also in part talc or steatite (anal. 5, 13, 14). *Saponite* and *serpenti* (q. v.) are other results of the same kind of alteration. they consisting, like talc, of silic magnesia, and water. *Hortonite* is a steatitic pseudomorph of pyroxene, found in Orange C N. Y., with chondrodite.

The following are other kinds of pseudomorphs: Hematite, Limonite, Magnetite, Palagoni (which see). In the pyroxenes containing much iron, especially the augitic varieties, the protox of iron, when moisture and air are present, may pass to a higher state of oxydation, and t mineral take a *red* color (the color of anhydrous sesquioxyd of iron (*hematite*), or it may take water as well as oxygen, and become of a *brownish-yellow* color, the color of the hydrous sesq oxyd, or *limonite*. *Magnetite* is another result, and probably through the alteration of one of the oxyds as an intermediate state.

Palagonite, as Bunsen has observed, is one of the products arising in part from the change the iron to a sesquioxyd; it is the material of many tufas of volcanic regions, as those of Icela and Etna, such tufas having been made from doleritic or basaltic lavas abounding in pyroxen Bunsen remarks that palagonite may be made artificially by putting powdered basalt into a lar excess of caustic potash in fusion and pouring on water; the product, after washing, is hydrate pulverulent, and gelatinizes with weak acids, and its composition is like that of the pure palagonite of Iceland. For analyses, see p. 483.

Epidote is another mineral resulting from the kind of change here mentioned.

In one variety of the diallage from the gabbro of Harzburg (see analyses of others on p. 21 A. Streng found (B. H. Ztg., xxiii. 54) $\ddot{\mathrm{Si}}$ 45·73, $\dddot{\mathrm{\bar{A}l}}$ 5·60, $\dddot{\mathrm{\bar{F}e}}$ 12·18, $\dot{\mathrm{Fe}}$ 8·00, $\dot{\mathrm{Mg}}$ 12·55, $\dot{\mathrm{Ca}}$ 8·8 alkalies 0·55, $\dot{\mathrm{H}}$ 4·68=98·15—a percentage of oxyd of iron and of water which indicates parti alteration.

Cimolite. In the case of the aluminous pyroxene, when all the bases except the alumina a removed and water taken up, there may result *cimolite* (q. v.), a whitish clay-like earth, whi has been observed constituting pseudomorphs of augite at Bilin in Bohemia. In the change this aluminous silicate, alumina may possibly be added, to some extent, from an external sour as from feldspar decomposing in the same rock. Pisani gives the following composition of greenish aluminous, although talc-like, pseudomorph having the angles of pyroxene (C. R., li 51):

$\ddot{\mathrm{Si}}$	$\dddot{\mathrm{\bar{A}l}}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Na}}$	$\dot{\mathrm{K}}$	$\dot{\mathrm{H}}$
56·52	20·49	2·67	5·94	0·93	3·32	3·88	7·40

Glauconite. *Mica*. Under the action of alkaline waters, alkalies may be introduced. Th the hydrous mineral *glauconite* (q. v.) or *green earth* may result as a constituent of some augite pse domorphs; or the essentially anhydrous mineral *mica*, which has been observed by Kjerulf as pseudomorph after augite, in the Eiffel. Kjerulf gives the following analyses (1) of an unalter augite, and (2) the mica derived from it:

	$\ddot{\mathrm{Si}}$	$\dddot{\mathrm{\bar{A}l}}$	$\dddot{\mathrm{\bar{F}e}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Na}}$	$\dot{\mathrm{K}}$	Ign.
1. *Augite*	50·21	6·94	7·59	13·66	19·85	—	—	0·33=98·58
2. *Mica pseud.*	43·10	15·05	23·25	10·32	0·81	0·82	4·62	1·50, with $\ddot{\mathrm{Ti}}$ 1·03 as impurit

Acmite (q. v.) is considered by Bischof and Rose a pyroxene altered by the alkaline process.

Quartz. *Opal*. *Calcite*. The removal of the mineral by the decomposing and dissolvi agencies may be attended by the introduction of silica from the waters present, these waters ha ing become siliceous as a consequence of the decompositions. Hence may come siliceous pseud morphs, either anhydrous like *quartz*, or hydrous like *opal*. One such from Vesuvius is describ by Rammelsberg, which still contained some part of the bases, affording him on analysis (Pogg lixx. 387):

$\ddot{\mathrm{Si}}$ 85·31, $\dddot{\mathrm{\bar{A}l}}$ 1·58, $\dddot{\mathrm{\bar{F}e}}$ 1·67, $\dot{\mathrm{Mg}}$ 1·70, $\dot{\mathrm{Ca}}$ 2·66, $\dot{\mathrm{H}}$ 5·47=98·42.

In some cases the waters hold in solution carbonate of lime instead of silica, and this salt lime consequently takes the place of the removed mineral, and so *calcite* pseudomorphs after p roxene are produced.

22. URALITE. Augite also occurs altered to *hornblende*, and the product has been named *urali* by Rose (Pogg., xx. 322, 1830, xxvii. 97, xxxi. 619). The crystals have the form of augite, but t cleavage of hornblende. $I \wedge I = 124°$; they appear to consist of an aggregation of minute hornblend prisms. They are subtransparent in very thin laminæ, have a deep-green color, a greenish-whi streak, with H.=5 or nearly, and G.=3·14—3·15, Ural; 3·273, Silesia, v. Rath. Analyses: Kudernatsch (Pogg., xxxvii. 586); 2, Rammelsberg (Min. Chem., 490); 3, G. v. Rath (Pogg., xc 557):

	$\ddot{\text{Si}}$	$\dddot{\text{Al}}$	$\dot{\text{Fe}}$	$\dot{\text{Mn}}$	$\dot{\text{Mg}}$	$\dot{\text{Ca}}$	$\dot{\text{H}}$
1. Ural	53·05	4·56	16·37	*tr.*	12·90	12·47	——=99 35 Kuder.
2. "	50·75	5·65	16·48	0·79	12·28	11·59	1·80=99·34 Ramm.
3. Silesia	48·70	0·82	25·21	——	12·01	11·25	1·01, alk. *tr.*=99 Rath.

Uralite was obtained by Rose from a green porphyritic rock at Mostovaja, Lake Baltym, near Katharinenberg, and at Carminskoj, near Miask, in the Ural. It has since been reported from Arendal in Norway; Tavignolo, near Predazzo in the Tyrol; near Neurode in Silesia, in greenstone; Tunguragua in Quito; Mysore in India.

Artif.—Diopside has been observed as a furnace product at the iron-works of Philipsburg, N. Jersey (G. J. Brush, Am J. Sci., II. xxxix. 132); and dark-colored pyroxene at Gaspenberg; in an old furnace near Hacheburg; a copper furnace near Dillenburg; at Fahlun and Oldbury; a manganese-augite at Mägdesprung.

Formed in crystals, as diopside, artificially by the action of chlorid of silicon on magnesia (Daubrée); also, a grayish-white var., by mixing the constituents and exposing to a high heat (Berthier).

Augite in small yellow crystals has been found in old fumaroles at Eiterkopfe, near Andernach (v. Rath).

238A. **OMPHACITE.** (Omphazit [fr. Baireut] *Wern.*, Hoffm. Min., ii. 2, 302, 1812; *Breith.*, ib., iv. 2, 125, 1817, Handb., 612, 1841, B. H. Ztg., xxiv. 365, 397, 1865.)

Monoclinic. Cleavage: in two directions with the interangle 115°, one perfect, the other imperfect. Massive, granular, disseminated. H.=5—6. G.=3·2—3·3; 3·178—3 231, Breith.; 3·263, fr. Ober-Pferdt, 3·270. fr. between Wustuben and Weppenreuth, 3·243, fr. Silberbach, 3·301, fr. Stambach, all in the Fichtelgebirge, Fikenscher. Lustre vitreous. Color grass- to leek-green.

Comp.—Analyses by J. Fikenscher (B. H. Ztg., xxiv. 397):

	$\ddot{\text{Si}}$	$\dddot{\text{Al}}$	$\dot{\text{Fe}}$	$\dot{\text{Mg}}$	$\dot{\text{Ca}}$	$\dot{\text{Na}}$	$\dot{\text{K}}$	ign.
1. Ober-Pferdt	52·57	9·12	5·32	13·75	17·41	1·11	0·28	0·32=99·98
2. Wustuben	52·35	9·69	4·08	12·85	18·05	1·73	0·32	0·62=99·69
3. Silberbach	52·77	9·19	4·81	13·60	18 11	1·22	——	0·41=100·11
4. Stumbach	52·16	8·71	11·63	10·77	14·16	0·87	0·14	0·50=99·94
5. Pacher, Styria	50·29	6·67	3·26	15 22	21·50	0·88	0·88	0·45, $\dddot{\text{Cr}}$ 2·07=100·64

Anal. 1 gives for the O ratio of $\dot{\text{R}}$, $\dddot{\text{R}}$, $\ddot{\text{Si}}$, 2·6:1:6·1; No. 2, 2·8:1:6·4; No. 5, 13·3:3·75:26·13 (differing much from those adopted by Fikenscher). Although much care was taken to use the pure mineral, the results seem to indicate an intimate mixture with some alumina silicate; and possibly with lime-garnet or kyanite, which are its associates. If this be the case, the mineral may still be pyroxene or hornblende, as has been supposed. After an examination of the mineral, we regard with doubt the cleavage angle given by Breithaupt.

Omphacite occurs near Hof in Baireut, Bavaria, at the localities mentioned above, and also at Pacher in Styria. It is intimately mixed with a lime-garnet, and also usually with kyanite, making the tough greenish rock, spotted with pale garnet, called *eclogyte.* The rock contains often scales of a silvery mica. The name *Omphacite* is from ὄμφαξ, *an unripe grape*, alluding to the color; it is among the names of green stones mentioned by Pliny.

238B. **VIOLAN** Breithaupt (J pr. Ch, xv. 321, 1838). Occasionally in prismatic crystals, affording, according to Descloizeaux, the angles, and the planes *I*, *i-i*, *i-ì*, and *i-3*, of pyroxene, and cleavage in the direction of *I.* Usually lamellar massive, sometimes fibrous. H.=6. G.=3·233. Lustre waxy. Color dark violet-blue. Translucent, but in thin plates transparent.

Damour obtained (Descloizeaux's Min., i. 66), in an unsatisfactory analysis of the lamellar mineral (unsatisfactory because this variety is penetrated by a fibrous mineral which appears to be tremolite), $\ddot{\text{Si}}$ 56·11, $\dddot{\text{Al}}$ 9·04, $\dot{\text{Fe}}$ 2·46, $\dot{\text{Mn}}$ 2·54 $\dot{\text{Mg}}$ 10·40, $\dot{\text{Ca}}$ 13·62, $\dot{\text{Na}}$ 5·63,=99·80. Plattner had previously ascertained by his trials (J. pr. Ch., xv. 321) that it was a silicate of alumina, iron, manganese, lime, magnesia, and soda.

It is unaltered in the closed tube. B.B. fuses easily to a clear glass, coloring the flame yellow (soda). With borax and soda gives reactions for manganese and iron.

Occurs in small seams with white quartz, white fibrous tremolite spotted violet with manganese greenovite and manganesian epidote, in the braunite of St. Marcel, in the valley of Aosta, Piedmont. Named from its color.

239. ÆGIRITE. *Ægirin Esmark*, Berzelius, Jahrb. Min., 1835, 184.

Monoclinic, and isomorphous with pyroxene. Cleavage: *i-i* perfect; *I* less so; *i-ì* still less. Usual in striated or channelled prisms.

H.=5·5—6. G.=3·45—3·58; 3·578, fr. Skaadöe, Rammelsberg; 3·4 fr. Berkevig, Pisani. Lustre vitreous. Color greenish-black. Streak dar green. Subtranslucent to opaque.

Comp.—$\dot{\mathrm{R}}^3\ddot{\mathrm{Si}}^3+\bar{\mathrm{F}}\mathrm{e}\,\ddot{\mathrm{Si}}^3=(\frac{1}{2}\dot{\mathrm{R}}^3+\frac{1}{2}\bar{\mathrm{F}}\mathrm{e})\ddot{\mathrm{Si}}^3$=, if $\dot{\mathrm{R}}=\dot{\mathrm{C}}\mathrm{a}+\dot{\mathrm{N}}\mathrm{a}+\dot{\mathrm{F}}\mathrm{e}$, Silica 50·7, sesquioxyd of i 22·6, protoxyd of iron 10·1, lime 7·9, soda 8·7=100. Analyses: 1, Rammelsberg (Pogg., ciii. 2 302); 2, Pisani (C. R., lvi. 846):

	$\ddot{\mathrm{Si}}$	$\ddot{\bar{\mathrm{A}}}\mathrm{l}$	$\bar{\mathrm{F}}\mathrm{e}$	$\dot{\mathrm{F}}\mathrm{e}$	$\dot{\mathrm{M}}\mathrm{n}$	$\dot{\mathrm{M}}\mathrm{g}$	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\mathrm{N}}\mathrm{a}$	$\dot{\mathrm{K}}$	
1. Skaadöe	50·52	1·22	22·07	8·80	1·40	1·28	5·97	9·29	0·94	=100·72 Ramm.
2. Berkevig	52·11	2·47	22·80	8·40	——	0·41	2·60	12·10,		$\dot{\mathrm{H}}$ 0·30=101·19 Pisani.

For an imperfect anal. by Plantamour, see Bibl. Univ. Genève, 1841.

As Rammelsberg observes, ægirine holds the same relation in composition to pyroxene t arfvedsonite does to hornblende; in each alkalies being present, and sesquioxyd of iron replac to a large extent the protoxyd bases.

Pyr., etc.—B.B. fuses easily, coloring the flame yellow (soda); gives a magnetic globule charcoal. Not appreciably attacked by acids.

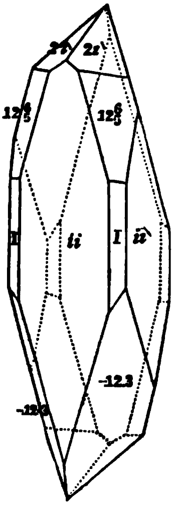
Obs.—Occurs with leucophanite, cancrinite, elæolite, in Norway, near Brevig, on the Isle Skaadöe, and at Berkevig; Hot Springs, Arkansas.

Von Hornberg obtained from a perfect crystal from Lamöe, *I*∧*I*=87° 21′—87° 47′, and 92° —92° 20′, the variation owing to a slight irregularity in the prism, the edges and faces being quite parallel.

Named after Ægir, the Scandinavian god of the sea.

240. ACMITE. Achmit *Ström*, Ak. H. Stockh., 1821, 160, and *Berz.*, ib., 163. Akmit *Ger*

215



Monoclinic. *C*=74°, *I*∧*I*=86° 56′; *a* : *b* : *c*=0·540 1 : 0·9135. Occurring planes: *O*; vertical, *i-i*, *i-ì*, dome, 2-*ì*; pyramidal, 4-2, —12-3, 12-$\frac{6}{5}$. 4-2 replaces t edge between 2-*ì* and *i-i*. Cleavage: *I* distinct; *i-ì* less Plane *i-i* often longitudinally striated or channelled. Twin composition-face *i-i*; common.

H.=6. G.=3·2—3·53; 3·43, Rammelsberg, piece of crystal; 3·53, same pulverized. Lustre vitreous, inclini to resinous. Streak pale yellowish-gray. Color browni or reddish-brown; in the fracture blackish-green. Opaq Fracture uneven—earthy. Brittle. Plane of optical a parallel to clinodiagonal section, Descl.

Comp.—$\dot{\mathrm{R}}^3\ddot{\mathrm{Si}}^3+2\bar{\mathrm{F}}\mathrm{e}\,\ddot{\mathrm{Si}}^3=(\frac{1}{3}\dot{\mathrm{R}}^3+\frac{2}{3}\bar{\mathrm{F}}\mathrm{e})\ddot{\mathrm{Si}}^3$=, if $\dot{\mathrm{N}}\mathrm{a}:\dot{\mathrm{F}}\mathrm{e}=3:1$, Silica 51 sesquioxyd of iron 30·4, protoxyd of iron 5·1, soda 13·2. Analyses: 1, B zelius (Ak. H. Stockh., 1821, 160); 2, Lehunt (Thomson's Min., i. 480); Rammelsberg (Pogg., ciii. 300):

	$\ddot{\mathrm{Si}}$	$\bar{\mathrm{F}}\mathrm{e}$	$\bar{\mathrm{M}}\mathrm{n}$	$\dot{\mathrm{F}}\mathrm{e}$	$\dot{\mathrm{M}}\mathrm{n}$	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\mathrm{N}}\mathrm{a}$	
1. Rundemyr	55·25	31·25	1·08	——	——	0·72	10·40,	$\ddot{\mathrm{T}}\mathrm{i}$ *tr.*=98·70 B.
2. "	52·02	——	——	28·08	3·49	0·88	13·33,	$\dot{\mathrm{M}}\mathrm{g}$ 0·50, $\ddot{\bar{\mathrm{A}}}\mathrm{l}$ 0·6 98·98
3. "	51·66	28·28	——	5·23	0·69	——	12·46,	$\dot{\mathrm{K}}$ 0·43, $\ddot{\mathrm{T}}\mathrm{i}$ 1· ign. 0·39=100·25

The protoxyd bases are mainly soda and protoxyd of iron. Rammelsberg makes the ratio the former to the latter 3 : 1. The ratio of the protoxyds to the sesquioxyds is 1 : 2, while i 1 : 1 in ægirine, and 1 : 4 in spodumene. Anal. 1 gives the O. ratio for bases and silica=1 : 2¼.

Pyr., etc.—B.B. fuses at 2 to a lustrous black magnetic globule, coloring the flame deep yell and with the fluxes reacts for iron and sometimes manganese. Slightly acted upon by acids.

Obs.—Acmite occurs at Rundemyr, 4 m. S. of Dunserud, near Kongsberg in Norway, in slen crystals, sometimes nearly a foot long, imbedded in feldspar and quartz; the crystals are of macled and bent, and quite fragile.

Named from 'ακμή, *a point*, in allusion to the pointed extremities of the crystals.

G. Rose has suggested that acmite, as hitherto observed, is probably in a somewhat altered condition, and that possibly the ægirine of Brevig is acmite in an unchanged state (Kryst. Ch. Min., 76, 1852).

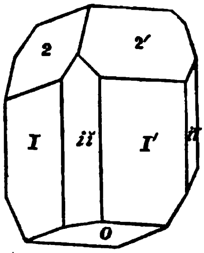
241. **RHODONITE.** Rother Braunstein pt. *Min. of last Cent.*; fr. Kapnik, *Ruprecht* (with anal.), Phys. Arb. Wien, i. 55, 1782; Crell's Ann., i. 297, 1790. Rothbraunsteinerz pt. *Wern.* Dichtes Roth-Braunsteinerz (Kapnikker Feldspath) *Karst.*, Tab., 54, 78, 1800 (favoring its being a distinct species, while others (Haüy, Reuss, etc.) supposed it the carbonate mixed with quartz). Rothstein pt., Kieselmangan, Mangankiesel, *Germ.* Manganese Spar pt.; Red Manganese; Bisilicate of Manganese. Rhodonit *Jasche*, Germar, in Schw. J., xxvi. 112, 1819 Hydropit *Germar*, ib., 115.

Bustamite (fr. Mexico), Bisilicate de Manganèse et de Chaux, *A. Brongn.*, Ann. Sci. Nat., viii. 411, 1826. Fowlerite (fr. Hamburgh, N. J.) *Shep.*, Min., 186, 1832, ii. 25, 1835. Kapnikite *Huot*, i. 239, 1841. Paisbergit *Igelström*, Œfv. Ak. Stockh., 148, 1851; J. pr. Ch., liv. 192, 1851. Mangan-Amphibol *Herm.*, J. pr. Ch., xlvii. 7, 1849=Hermannit *Kenng.*, Min., 71, 1853=Cummingtonit *Ramm.*, Min. Ch., 473, 1860.

Triclinic, but approximately isomorphous with pyroxene. Angles, according to Greg and Dauber, and also those of pyroxene:

	Greg.	Dauber.	In Pyroxene.
$I \wedge I$	87° 20′	87° 38′	87° 5′
$O \wedge I$	93 50	93 28½	100 57
$O \wedge I'$	110 40	111 8½	100 57
$I \wedge i\text{-}\breve{i}$	136 20	136 8½	133 32½
$I \wedge i\text{-}\bar{i}$	138 20	138 11½	136 27½
$I \wedge 2$	148 42	148 47	144 35
$I' \wedge 2'$	142 30	142 39½	144 35
$I \wedge 2'$	86 35	85 24	

216



Cleavage: *I* perfect; *O* less perfect. Usually massive.

H.=5·5–6·5. G.=3·4–3·68; 3·612, Longban; 3·634, Siberia; 3·63 Stirling, Hermann. Lustre vitreous. Color light brownish-red, flesh-red, sometimes greenish or yellowish, when impure; often black outside from exposure. Streak white. Transparent—opaque. Fracture conchoidal—uneven. Very tough when massive.

Comp., Var.—Silicate of manganese, $\dot{Mn}\,\ddot{Si}$=Silica 45·9, prot. manganese 54·1=100. Usually some $\dot{Fe}$ and $\dot{Ca}$, and occasionally $\dot{Zn}$, replaces part of the $\dot{Mn}$.

1. *Ordinary.* (*a*) Crystallized. Either in crystals or foliated. The ore in crystals from Paisberg, Sweden, was named *Paisbergite* under the idea that it was a distinct species. (*b*) Granular massive.

2. *Calciferous;* BUSTAMITE. Contains 9 to 15 p. c. of lime replacing part of the $\dot{Mn}$. Often also impure from the presence of carbonate of lime, which suggests that part of the lime replacing the $\dot{Mn}$ may have come from partial alteration. Grayish-red. Named after Mr. Bustamente, the discoverer.

3. *Zinciferous;* FOWLERITE. In crystals and foliated, the latter looking much like cleavable red feldspar; the crystals sometimes half an inch to an inch through. $I \wedge I$=86° 30′, Torrey. G.=3·34, Breith.; 3·44, Thomson. This mineral is mentioned by Fowler in Am. J. Sci., ix. 245, 1825 as *Siliceous oxyd of manganese* from Sterling, N. J., and as often containing dysluite (zinciferous spinel). It occurs under the same name in Robinson's Cat. Amer. Min., 298, 1825. It is Thomson's *ferrosilicate of manganese*, Ann. Lyc., N. Y., iii. 28, 1828.

Analyses: 1, Berzelius (Afhandl., i. 110, iv. 382); 2, 3, Ebelmen (Ann. d. M., IV. vii. 8); 4, Hermann (J. pr. Ch., xlvii. 6); 5, A. Schlieper (This Min., 463, 1850); 6, Igelström (J. pr. Ch., liv. 190); 7, H. Hahn (B. H. Ztg., xx. 267); 8, Dumas (Ann. Sci. Nat., viii. 411); 9, Ebelmen (l. c.), 10, Rammelsberg (ZS. G., xviii. 34); 11, Pisani (C. R., lxii. 102); 12, Hermann (l. c.); 13, Ra melsberg (Min. Ch., 459):

	$\ddot{S}i$	$\dot{F}e$	$\dot{M}n$	$\dot{Z}n$	$\dot{M}g$	$\dot{C}a$	$\dot{H}$	$\dot{C}a\ddot{C}$	
A. 1. Longban	48·00	——	49·04	——	0·22	3·12	——	——	= 100·38 Berz
2. Algiers	45·49	6·42	39·46	——	2·60	4·66	——	——	= 98·63 Ebelme
3. St. Marcel	46·37	——	47·38	——	——	5·58	——	——	= 99·28 Ebelme
4. Cummington	48·91	*tr.*	46·74	——	2·00	2·35	——	——	= 100 Hermann
5. "	51·21	4·84	42·65	——	*tr.*	2·93	——	——	= 101·13 Schlie
6. *Paisbergite*	46·46	3·31	41·88	——	0·91	8·13	——	——	= 100·69 Igelst
7. Elbingerode	44·86	1·52	42·98	——	6·15	3·06	0·95	——, $\ddot{A}l$ 0·74, Fe S² 0	= 100·65 Hal
B. 8. Mexico, *Bust.*	48·90	0·81	36·06	——	——	14·57	——	——	= 100·34 Duma
9. " "	44·45	1·15	26·96	——	0·64	14·43	——	12·27	= 99·90 Ebelme
10. " "	47·35	——	42·08	——	——	9·60	0·72	——	= 99·75 Ramm.
11. Vicentine "	46·19	1·05	28·70	——	2·17	13·23	3·06	6·95	= 101·35 Pisani
C. 12. Stirling, *Fowl.*	46·48	7·23	31·52	5·85	3·09	4·50	1·00	——	= 99·67 Herma
13. " "	46·70	8·35	31·20	5·10	2·81	6·30	0·28	——	= 100·74 Ramm

Schlieper found his specimen (one furnished by the author and seemingly unaltered) to consist par of carbonate of manganese and other bases. By digestion in concentrated muriatic acid, it affor 90·15 per cent. of silicate of manganese, and 9·85 soluble portion. The latter gave on analysis

$\dot{M}n\ddot{C}$ 50·52 $\dot{F}e\ddot{C}$ 8·60 $\dot{C}a\ddot{C}$ 37·17 $\dot{M}g\ddot{C}$ 2·44 $\dot{H}$ and loss 1·27 = 100.

Ten p. c. of carbonates had been previously found in the Cummington mineral, by E. Hit cock. Allowing that the ten p. c. of carbonates in Schlieper's specimen had been formed at expense of the bases in the rhodonite, and also that there was some free silica in minute poi or grains, as was obvious to the eye, the oxygen ratio cannot be taken as different from that rhodonite.

Hermann's *Mangan-amphibol* (l. c.) was based on an analysis of this Cummington mineral.

Ruprecht, who published his first analysis of the species in 1782, obtained $\ddot{S}i$ 55·06, mangan 35·15, iron 7·04, $\ddot{A}l$ 1·56, water 0·78 = 99·59. Huot based his species *Kapnikite* on this old analy

Brandes obtained for the *Hydropite*, a rose-colored ore from Kapnik, having G. = 2·8 (Schw. xxvi.) $\ddot{S}i$ 53·50, $\dot{M}n$ 41·93, $\dot{F}e$ 1·00, $\ddot{A}l$ 1·24, $\dot{H}$ 3·00; it has been considered a tersilicate, with formula $\dot{M}n^2\ddot{S}i^3$; but it was probably an impure rhodonite.

Pyr., etc.—B.B. blackens and fuses with slight intumescence at 2·5; with the fluxes gives actions for manganese; fowlerite gives with soda on charcoal a reaction for zinc. Slightly ac upon by acids. The calciferous varieties often effervesce from mechanical admixture with carb ate of lime. In powder, partly dissolves in muriatic acid, and the insoluble part becomes c white color. Darkens on exposure to the air, and sometimes becomes nearly black.

Obs.—Occurs at Longban, near Philipstadt in Sweden, in iron ore beds, in broad folia, and granular massive, the Paisberg iron mine, where it occurs, being the origin of the name *paisberg* also at Elbingerode, in the Harz; in the district of Katherinenberg in the Ural; with tetrahed at Kapnik in Transylvania; in Cornwall, etc.

Occurs in Cummington, Mass., and some of the neighboring towns, in boulders; also in W wick, Mass.; in an extensive bed on Osgood's farm, Blue Hill Bay, Maine; in Irasburg and Cov try, Vt.; near Winchester and Hinsdale, N. H.; at Cumberland, R. I.; *fowlerite* at Hamburg Stirling, New Jersey.

Named from *ῥόδον*, *a rose*, in allusion to the color. The name is attributed to Jasche by Ger (1819), but is not in the Kleine Min., Schriften of Jasche (1817).

Alt.—There are two prominent methods of alteration, which may act separately or toget (1) Through the strong tendency of the protoxyd of manganese to pass to a higher state of c dation; in which process the red color changes to brown or black, commencing with the exte which becomes a black crust to the mass. Indefinite mixtures thus result, which may be ei partly silicate, or wholly one or more oxyds of manganese. (2) Through the tendency of protoxyd of manganese and other protoxyds present to unite with carbonic acid afforded by a line carbonated waters, this causing the silicate to be penetrated with carbonate of mangan and often also with carbonate of lime or iron. The color of the result after this latter metho usually grayish-red to grayish-white, and sometimes brown.

I. *By Oxydation; not Hydrated or Carbonated.*

A. MARCELINE *Berthier* (Ann. Ch. Pharm., li. 79, 1832). Color grayish-black to iron-bl lustre submetallic; G. = 3·8; H. = 5·5—6. From St. Marcel in Piedmont. *Heteroclin* Br (*Evreinoff*, Pogg., xlix. 204, 1840) is from the same locality, and of the same nature, as recogn by Breithaupt.

B. DYSSNITE *v. Kobell* (Grundz., 328, 1838) is Thomson's *sesquisilicate of M.*, from Franklin, N. J (Ann. Lyc. N. York, l. c.), an iron-black ore, with G.=3·67; it is altered fowlerite. Von Kobell cites Thomson's analysis (see below), and gives no description of his own.

II. *By Oxydation; Hydrated.*

STRATOPEITE, Wittingite, Neotokite, are names of results of this kind of alteration. They are found along with rhodonite. They contain about 35 p. c. of silica. See NEOTOCITE under HYDROUS SILICATES. Opsimose of Beudant and Klipsteinite of v. Kobell are names of a similar hydrous silicate containing about 25 p. c. of silica.

III. *Carbonated.*

A. ALLAGITE *Jasche* (Germar, Schw. J., xxvi. 112, 1819; Grunmanganerz *Jasche.*, Kleine Min. Schriften, 10, 1817), from Schebenholze, near Elbingerode in the Harz, is either dull-green or reddish-brown, and affording du Menil (Gilb. Ann., lxi. 197) 7·5 p. c. carbonic acid. The name *Allagite*, like *Rhodonite*, is not in the Kleine Schriften of Jasche, but is attributed to Jasche by Germar.

B. PHOTICITE (*Germar*, Schw. J., xxvi. 116; Photizit *Brandes*, ib., 138) is yellowish-white, isabella- and wax-yellow, greenish-gray, pearl-gray, to rose-red; G.=2·8—3, from the same locality with the allagite. It afforded Brandes (ib., 136) 11 to 14 p. c. of carbonic acid, with some water. Corneous manganese (*Horn-mangan* of Jasche) is of similar nature, it containing 5 to 10 p. c. of carbonic acid; color brown to gray. And so also the Cummington rhodonite, which afforded Schlieper 10 p. c. or more of carbonates.

Analyses: 1, Berthier (l. c.); 2, Berzelius (Schw. J., xxi. 254); 3, Evreinoff (Pogg., xlix. 204); 4, Damour (Ann. d. M., IV., J. pr. Ch., xxviii. 284); 5, Thomson (Lyc. Nat. Hist., N. Y., iii. 33); 6, 7, du Menil (l. c.); 8–10, Brandes (l. c.):

	$\ddot{\text{Si}}$	$\bar{\text{A}}\text{l}$	$\bar{\text{M}}\text{n}$	$\bar{\text{F}}\text{e}$	$\dot{\text{C}}\text{a}$	$\dot{\text{M}}\text{g}$	$\dot{\text{H}}$	$\ddot{\text{C}}$
1. *Marceline*	26·00	3·00	67·23	1·23	1·40	1·40	——	——=100·25 Berthier.
2. *Heteroclin*	15·17	2·80	75·80	4·14	——	——	——	——=97·71 Berzelius.
3. "	10·16	——	85·87	3·28	0·61	——	——	——, $\dot{\text{K}}$ 0·44=100·36 Evr.
4. "	10 24	——	76 32	11·49	1·14	0·26	——	——=99·45 Damour.
5. *Dyssnite*	38·39	——	51·67	9·44	——	——	——	——=99·50 Thomson.
6. *Allagite, green*	16·00	——	——	73·71	——	——	——	7·50=97·21 du Menil.
7. " *brown*	16·00	——	——	75·00	*tr.*	——	——	7·50=98·50 du Menil.
8. *Photicite, ywh.*	39·00	0·25	0·50	46·13	——	——	3 00	11·00=99·88 Brandes.
9. " *gyh.*	36·00	6·00	0·50	37·39	——	——	6·00	14·00=99·89 Brandes.
10. *Horn-manganese*	35·00	——	0·25	57·16	——	——	2·50	5·00=99·91 Brandes.

Bustamite altered to kaolin has been described by Ebelmen (Ann d. M., IV. vii. 1) and Damour (Bull. G. Soc.. vii. 224).

Berthier obtained for a Graubündten (Grisons) ore (Ann. Ch. Phys., li. 79) $\ddot{\text{Si}}$ 15·3, $\bar{\text{M}}\text{n}$ 80·9, $\bar{\text{F}}\text{e}$ 1·0, $\bar{\text{A}}\text{l}$ 1·0=98·2; and Schweizer for the same (J. pr. Ch., xxiii. 278) $\ddot{\text{Si}}$ 15·50, $\bar{\text{M}}\text{n}$ 77·34, $\bar{\text{F}}\text{e}$ 3·70, $\dot{\text{C}}\text{a}$ 1·70, $\dot{\text{H}}$ 1·76=100.

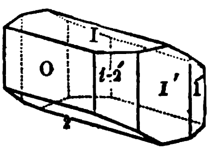
The ores, as alteration continues, graduate into true oxyds of manganese. A kind from Pesillo (called *Pesillite* by Huot, Min., 1841) afforded Berthier $\ddot{\text{Si}}$ 6·8, $\bar{\text{M}}\text{n}$ 84·2, O, $\dot{\text{H}}$ 6·7, $\bar{\text{F}}\text{e}$ 2·8, $\dot{\text{C}}\text{o}$ 0·8; it had lost nearly all of the silica in the change.

242. BABINGTONITE. *Levy*, Ann. Phil., II. vii. 275, 1824.

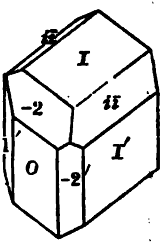
Triclinic, but, like rhodonite, approaching pyroxene in form. Observed planes as in the annexed figures. $I \wedge I$=87° 24′, Dauber; 87° 26′, Levy.

$O \wedge I$=92° 32′ $I \wedge -2$=150° 19′
$O \wedge I'$=112 12 $I \wedge -2'$=89 13
$O \wedge 1'$=132 24 $I' \wedge i\text{-}\breve{i}$=132 34
$O \wedge -2$=122 22 $I' \wedge i\text{-}\bar{i}$=135 16
$O \wedge -2'$=136 54 $I' \wedge -2$=98 37
$O \wedge 2$=117 $I' \wedge -2'$=155 18
$I \wedge i\text{-}\breve{i}$=134 50 $I' \wedge 1'$, adj.,=115 24
$I \wedge i\text{-}\bar{i}$=137 20

218



219



H.=5·5—6. G.=3·35—3·37; 3·355, Thomson; 3·366, Rammelsberg. Lustre vitreous, splendent. Color dark greenish-black; thin splinters green in the direction of *O*, and brow transversely. Faintly translucent; large crystals opaque, or faintly su translucent. Fracture imperfectly conchoidal.

Comp.—3 $\dot{R}^3\ddot{Si}^3+\ddot{\bar{Fe}}\ddot{Si}^3$, Rammelsberg; $=(\frac{3}{4}\dot{R}^3+\frac{1}{4}\ddot{\bar{Fe}})\ddot{Si}^3=$, if 9 $\dot{R}=2\dot{Fe}+1{\cdot}5\dot{Mn}+$ $\dot{Ca}$, Silica 50·1, sesquioxyd of iron 11·1, protoxyd of iron 10·0, protoxyd of manganese 7 lime 21·4=100. Analyses: 1, Arppe (Berz. Jahresb., xxii. 205); 2, R. D. Thomson (Phil. Ma xxvii. 123); 3, Rammelsberg (Pogg., ciii. 287, 304):

	$\ddot{Si}$	$\ddot{\bar{Fe}}$	$\dot{Mg}$	$\dot{Ca}$	$\dot{Fe}$	$\dot{Mn}$	$\ddot{\bar{Al}}$
1.	54·4	——	2·2	19·6	21·3	1·8	0·3, ign. 0·9=100·5 Arppe.
2.	47·46	——	2·21	14·74	16·81	10·16	6·48, ign. 1·24=99·10 Thomson.
3.	51·22	11·00	0·77	19·32	10·26	17·91	——, ign. 0·44=100·92 Ramm.

Pyr., etc.—B.B. fuses at 2·7 to a black magnetic globule, and with the fluxes gives reactic for iron and manganese. Unacted upon by acids.

Obs.—Babingtonite occurs in distinct crystals at Arendal, in Norway, associated with epid and massive garnet, and in the Shetland Isles, imbedded in white quartz. It was named af Dr. Babington; it resembles some dark varieties of pyroxene.

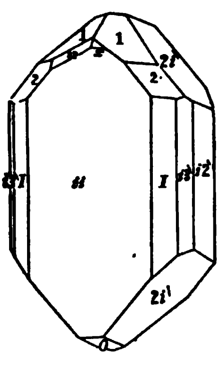
In the United States it is said to coat crystals of feldspar, at Gouverneur, St. Lawrence C N. Y. On cryst., see Dauber, Pogg., xciv. 402.

Small black polished crystals coating mica slate, or micaceous gneiss, at Athol, Mass., refer by Shepard to Babingtonite, may possibly belong here.

243. SPODUMENE. *D'Andrada*, Scherer's J., iv. 30, and J. de Phys., li. 240, 18 Triphane *H.*, Tr., iv. 1801.

Monoclinic. *C*=69° 40′ *I* ∧ *I*=87°, *O* ∧ 2-ì=130° 30′.

221



O ∧ *i-i*=69° 40′
O ∧ 1=134 12
O ∧ 2=110 50
i-i ∧ *I*=133 30
i-i ∧ *i-*3̀=107 33
2-ì ∧ 2-ì, top,=80
i-ì ∧ 2-ì=139 30
i-i ∧ 2-ì=102 54½

i-i ∧ 2=117° 19′
i-i ∧ 2-2=125 12
i-i ∧ 1=101 6
i-ì ∧ 2=134 19
I ∧ 2=145 50
I ∧ 1=121 28
1 ∧ 1=116 19
2 ∧ 2=91 24

Crystals large. Cleavage: *i-i* very perfect; *I* a perfect; 1-ì in traces; in striæ on *i-ì*. Twins, co position-face *i-i*. Also massive, with broad cleava surface.

H.=6·5–7. G.=3·13–3·19; 3·17, Haiding 3·188, Dublin Bay, Thomson; 3·133, Utö, Ramm berg; 3·137, Sterzing, id.; 3·182, Sterling, Smith; 3·18, Norwich, Bru Lustre pearly. Cross fracture vitreous. Color grayish-green, passing i greenish-white and grayish-white, rarely faint-reddish. Streak uncolor Translucent—subtranslucent. Fracture uneven.

Comp.—$\dot{R}^3\ddot{Si}^3+4\ddot{\bar{Al}}\ddot{Si}^3=(\frac{1}{5}\dot{R}^3+\frac{4}{5}\ddot{\bar{R}})\ddot{Si}^3=$if $\dot{R}=\dot{Li}$, Silica 64·2, alumina 29·4, lithia 6·4= Analyses: 1, R. Hagen (Pogg., xlviii. 361); 2, Thomson (Min., i. 302); 3, 4, Rammelsberg (Po lxxxv. 544); 5–8, Smith and Brush (Am. J. Sci., II. xvi. 372):

	$\ddot{Si}$	$\ddot{\bar{Al}}$	$\ddot{\bar{Fe}}$	$\dot{Ca}$	$\dot{Li}$	$\dot{Na}$	$\dot{K}$	$\dot{H}$
1. Utö	66·14	27·02	0·32	——	3·84	2·68	——	——=100 Hagen.
2. Killiney	63·81	28·51	$\dot{Fe}$ 0·81	0·73	5·60	——	——	0·36=99·84 Thom.
3. Utö	65·02	29·14	$\dot{Fe}$ *tr.*	0·50	5·47	0·46	0·14	——, $\dot{Mg}$ 0·15 Ramm.
4. Tyrol	65·53	29·04	$\dot{Fe}$ 1·42	0·97	4·49	0·07	0·07	——, $\dot{Mg}$ 0·07 Ramm
5. Norwich	64·04	27·84	0·64	0·34	5·20	0·66	0·16	0·50=99·38 S. & B.

	$\ddot{\text{Si}}$	$\bar{\text{Al}}$	$\bar{\text{Fe}}$	$\dot{\text{Ca}}$	$\dot{\text{Li}}$	$\dot{\text{Na}}$	$\dot{\text{K}}$	$\dot{\text{H}}$
6. Norwich	63 65	28·97		0·31	5·05	0·82[a]	—	0·50 S. & B.
7. "	63·90	28·70		0·26	4·99	0·80[a]	—	0·60 S. & B.
8. Sterling	64·50	25·30	2·55	0·43	5·65	1·10[a]	—	0·30, $\dot{\text{Mg}}$ 0·06=99·89 S. & B.

[a] With some potash; in 5, 6, 7, magnesia, *tr.*

In a specimen from Sterling, Mass., Hagen found $\ddot{\text{Si}}$ 65·247, $\bar{\text{Al}}$, $\bar{\text{Fe}}$ 27·556, and in another from Tyrol, $\ddot{\text{Si}}$ 66·027, $\bar{\text{Al}}$ 26·451. G. J. Brush's earlier analyses (Am J. Sci., II. x. 370) are rejected by him.

Pyr., etc.—B.B. becomes white and opaque, swells up, imparts a purple-red color (lithia) to the flame, and fuses at 3·5 to a clear or white glass. The powdered mineral, fused with a mixture of bisulphate of potash and fluor on platinum wire, gives a more intense lithia reaction. Not acted upon by acids.

Obs.—Occurs on the island of Utö in Südermanland, Sweden, with magnetic iron ore, quartz, tourmaline, and feldspar; also near Sterzing and Lisens in the Tyrol, and of a pale-green or yellowish color, imbedded in granite, at Killiney Bay, near Dublin, and at Peterhead in Scotland.

Occurs in granite at Goshen, Mass., associated at one locality with blue tourmaline and beryl; also at Chesterfield, Chester, Norwich, and Sterling, Mass.; at Windham, Maine, near the bridge, along with garnet and staurotide; at Winchester, N. H.; at Brookfield, Ct., a few rods north of Tomlinson's tavern, in small grayish or greenish-white individuals looking like feldspar; near Ballground, Cherokee Co., Ga. At Norwich, Mass., it is associated with triphyline, mica, beryl, and albite; one crystal from this locality was 16½ inches long, and 10 inches in girt. Fig. 221 is of a crystal from this locality, and is two-thirds the natural size. Well terminated crystals, having the terminal planes 2-*i*, 1, *O*, have been observed by A. B. Kittredge at the Sterling locality. Crystals also occur at Goshen.

Named from σποδὸς, *ashes*, because the mineral becomes ash-colored before the blowpipe.

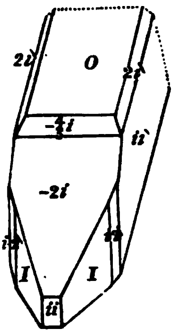
The following are the angles obtained by the author, with the common goniometer, from the Norwich crystals: $O \wedge i\text{-}i=69°\ 40'$, $i\text{-}i \wedge I=133°\ 30'$, $i\text{-}i \wedge i\text{-}\grave{3}=107°$. $2\text{-}\grave{i} \wedge 2\text{-}i$, top, $=80°$, $i\text{-}i \wedge 2\text{-}\grave{i}=139°\ 45'$, $i\text{-}i \wedge 2\text{-}i=103°$, $i\text{-}i \wedge 2=116°$, $i\text{-}i \wedge 1=100°\ 30'$, $i\text{-}i \wedge x=140°$, $i\text{-}\grave{i} \wedge 2=134°$, $i\text{-}\grave{3} \wedge 2=142°$, $I \wedge 2=144°$, $1 \wedge 1=117°$, $2 \wedge 2=92°$.

244. PETALITE.

Petalit *d'Andrada*, Scherer's J., iv. 36, 1800. Castor (fr. Elba) *Breith.*, Ann. Ch. Pharm., lxix. 436, 1849.

Monoclinic. $C=67°\ 34'=O$, below, on $i\text{-}i$; $I \wedge I=86°\ 20'$ ($87°-87\frac{1}{2}°$ observed), $O \wedge 2\text{-}\grave{i}=126°\ 2'$; $a:b:c=0·64511:1:0·8670$.

Observed planes: O; vertical, I, $i\text{-}\grave{i}$, $i\text{-}\grave{2}$, $i\text{-}i$; clinodome, $2\text{-}\grave{i}$; hemidomes, $-\frac{4}{3}\text{-}i$, $-2\text{-}i$, $-1\text{-}i$, $4\text{-}i$, $\frac{2}{5}\text{-}i$? (cleavage).


222

$O \wedge I=105°\ 8'$

$O \wedge I$, back, $=74\ 52$

$O \wedge -\frac{4}{3}\text{-}i=149\ 7$

$O \wedge -2\text{-}i=141\ 23$

$O \wedge -1\text{-}i=154\ 26$

$O \wedge i\text{-}\grave{2}=99\ 19$

$O \wedge i\text{-}\grave{i}=90$

$O \wedge 4\text{-}i$, adj., $=90°\ 23'$

$O \wedge \frac{2}{5}\text{-}i$, adj., $=117\ 27$

$-2\text{-}i \wedge \frac{2}{5}\text{-}i$, ov. $i\text{-}i$, $=101\ 10$

$i\text{-}i \wedge -2\text{-}i=151\ 3$

$i\text{-}\grave{i} \wedge I=136\ 50$

$i\text{-}\grave{i} \wedge i\text{-}\grave{2}=154\ 52$

$i\text{-}\grave{2} \wedge i\text{-}\grave{2}$, ov. I, $=50\ 15$

Observed cleavage angles of petalite: $O \wedge -2\text{-}i=141°\ 30'$, $O \wedge \frac{2}{5}\text{-}i=117\frac{1}{2}°-118°$, $-2\text{-}i \wedge \frac{2}{5}\text{-}i=100\frac{1}{2}°-101°$. Cleavage: O perfect; $-2\text{-}i$ easy. $\frac{2}{5}\text{-}i$ quite difficult or imperfect. Also massive, cleavable.

H.=6–6·5. G.=2·39–2·5. Lustre of O, or face of most perfect cleavage, pearly; elsewhere vitreous. Colorless, white, gray, occasionally reddish or greenish-white. Streak uncolored. Translucent. Fracture imperfectly conchoidal. Double refraction strong; optic-axial plane perpendicular to the plane of symmetry and parallel very nearly to O; bisectrix acute, positive; angle, in oil, for the red rays 86° 27½′, yellow 86° 42′,

Var.—1. *Castorite*, in distinct transparent crystals, affording the above angles and figure, according to Descloizeaux. G.=2·38, Breith.; 2·397–2·405, Damour. 2. *Ordinary petalite*, cleavable massive; and G.=2·42, Arfvedson; 2·45, Dr. Clarke; 2·426, C. G. Gmelin; 2·412, 2·420, 2·465, 2·448, 2·553, Damour, the last two from different parts of the same Utö specimen, and indicating, according to Damour, that the mineral is mixed with more or less quartz and feldspar. The cleavage $\frac{3}{8}$-*i* has been observed only in petalite.

Comp.—O. ratio for $\dot{\mathrm{R}}$, $\bar{\mathrm{R}}$, $\ddot{\mathrm{S}}\mathrm{i}$=1 : 4 : 20, Berz.; $(\frac{1}{5}\,\dot{\mathrm{R}}^3+\frac{4}{5}\,\bar{\mathrm{R}})\,\ddot{\mathrm{S}}\mathrm{i}^3+3\,\ddot{\mathrm{S}}\mathrm{i}$; or else with one-third of the excess of silica (3 $\ddot{\mathrm{S}}\mathrm{i}$) basic; =Silica 77·7, alumina 17·8, lithia 3·3, soda 1·2=100.

Analyses: 1, Arfvedson (Schw. J., xxii. 93); 2, Gmelin (Gilb. Ann., lxii. 399); 3, 4, R. Hagen (Pogg., xlviii. 361); 5, Rammelsberg (Pogg., lxxxv. 553); 6, Waltershausen (Vulk. Gest., 296); 7, 8, Smith & Brush (Am. J. Sci., II. xvi. 373); 9, Plattner (Ann. Ch. Pharm., lxix. 443):

	$\ddot{\mathrm{S}}\mathrm{i}$	$\bar{\mathrm{A}}\mathrm{l}$	$\dot{\mathrm{L}}\mathrm{i}$	$\dot{\mathrm{N}}\mathrm{a}$
1. Utö	79·212	17·225	5·761	——=102·198 Arfvedson.
2. "	74·17	17·41	5·16	$\dot{\mathrm{C}}\mathrm{a}$ 0·32, ign. 2·17=99·23 Gmelin.
3. "	77·812	17·194	2·692	2·302=100 R. Hagen.
4. "	77·067	18·000	2·660	2·273=100 R. Hagen.
5. "	77·79	18·58	3·80	1·19=100 Rammelsberg.
6. " *reddish*	76·74	18·66	2·69	——, $\bar{\mathrm{F}}\mathrm{e}$ 0·08, $\dot{\mathrm{M}}\mathrm{n}$ 1·0, $\dot{\mathrm{M}}\mathrm{g}$ 1·0 $\dot{\mathrm{H}}$ 0·97=99·95 W.
7. Bolton, Mass.	77·95	16·68	3·74	0·48, $\bar{\mathrm{F}}\mathrm{e}$ 0·62, $\dot{\mathrm{K}}$, $\dot{\mathrm{C}}\mathrm{a}$, *tr.*, $\dot{\mathrm{M}}\mathrm{g}$ 0·21, ign. 0·60=100·23 Smith & Brush.
8. "	77·90	15·85	3·52	0·53, $\bar{\mathrm{F}}\mathrm{e}$ 0·51, $\dot{\mathrm{K}}$, $\dot{\mathrm{C}}\mathrm{a}$, *tr.*, $\dot{\mathrm{M}}\mathrm{g}$ 0·26 ign 0·70 S. & B.
9. Elba, *Castorite*	78·01	18·86	2·76 (with *tr.* $\dot{\mathrm{K}}$, $\dot{\mathrm{N}}\mathrm{a}$)=100·24 Plattner. G.=2·392.	

The protoxyds in castorite are less than in petalite in the analysis made. But its cleavages, according to Rose, are like those of petalite, and its optical characters, according to Descloizeaux. Breithaupt still urges that they are distinct (B. H. Ztg., xxv. 85), and mentions their difference in sp. gr. as a prominent distinction.

Pyr., etc.—Gently heated emits a blue phosphorescent light. B.B. on charcoal becomes glassy, subtransparent, and white, and melts only on the edges; gives the reaction of lithia. With borax it forms a clear, colorless glass. Not acted on by acids.

Obs.—Petalite occurs at the iron mine of Utö, accompanying lepidolite, tourmaline, spodumene, and quartz; on Elba (*castorite*) in attached crystals; at Bolton, Mass., with scapolite; according to Bigsby, in a boulder containing tremolite, at York, near Toronto, Canada.

Lithia was first discovered in this mineral by Arfvedson. The name *petalite* is from πεταλον, *a leaf*, and alludes to the cleavage.

On cryst. of castorite and petalite, see Descl., Ann Ch. Phys., IV. iii. 264, 1864, and Pogg., cxxii. 648.

Descloizeaux, who gives the above figure, points out the isomorphism with spodumene, and the fact that the O. ratio differs by a multiple of 2 for the silica, it being 1 : 4 : 10 for spodumene and 1 : 4 : 20 for petalite.

245. KUPFFERITE. Kupfferit (fr. the Tunkinsk Mts.) *R. Hermann*, Bull. Soc. Nat. Moscou, xxxv. 243, 1862. Anthophyllite pt. Antholith pt. *Kenng.*

Monoclinic. $I \wedge I$=124° 15′–124° 30′. Cleavage: *I* perfect. In aggregations of prisms, like actinolite.

H.=5·5. G.=3·08, fr. Ilmen Mts. Lustre vitreous. Color emerald-green; brownish on weathering. Translucent in thin splinters.

Comp.—$\dot{\mathrm{M}}\mathrm{g}\,\ddot{\mathrm{S}}\mathrm{i}$, with but little $\dot{\mathrm{F}}\mathrm{e}$ replacing the $\dot{\mathrm{M}}\mathrm{g}$, like enstatite, it being an *enstatite hornblende* colored by chrome. Analyses: 1, Hermann (l. c., and J. pr. Ch., lxxxviii. 195); 2, 3, Heintz (Pogg., lviii. 168); 4, Lappe (Pogg., xxxv. 486); 5, Sackur (Ramm. Min. Ch., 472); 6, Thomson (Rec. Gen. Sci., iii. 336):

	$\ddot{\mathrm{S}}\mathrm{i}$	$\bar{\mathrm{A}}\mathrm{l}$	$\bar{\mathrm{C}}\mathrm{r}$	$\dot{\mathrm{F}}\mathrm{e}$	$\dot{\mathrm{N}}\mathrm{i}$	$\dot{\mathrm{M}}\mathrm{g}$	$\dot{\mathrm{C}}\mathrm{a}$	Alk.	Ign.
1. Ilmen Mts.	57·46	——	1·21	6·05	0·65	30·88	2·94	*tr.*	0·81=100 Hermann.
2. Pinel, *asbest.*	59·23	0·19	——	8·27	——	31·02	——	—	1·31=100 Heintz.
3. Tschussovaja	58·72	0·19	——	8·10	——	30·90	——	—	1·58=99·49 Heintz.
4. Koruk	58·48	——	——	9·22	——	31·38	0·04	—	——, $\dot{\mathrm{M}}\mathrm{n}$ 0·88=100 L.
5. Kupferberg, *anth.*	55·59	4·03	——	8·40	——	30·46	1·76	—	——=100·24 Sackur.
6. Perth, Can., "	57·60	3·20	——	2·10	——	29·30	3·55	—	3·55=99·30 Thomson

Analyses 2–6 are referred here because of the approximation to kupfferite in composition. The Perth mineral (received thus labelled by Dr. Thomson from Dr. Holmes) is almost purely a

magnesian silicate; it was a "congeries of imperfect crystals, and looked like anthophyllite;' G.=2·707.

Pyr., etc.—In the closed tube traces of water; otherwise unchanged. B.B. in the forceps becomes opaque white, but does not fuse. In borax dissolves, giving a chrome-green glass.

Obs.—The original kupfferite, from a graphite mine in the Tunkinsk Mts., is a chromiferous amphibole. The analyses here given are from a mineral of similar kind from near Miask, in the Ilmen Mts. The former has not been analyzed. Kokscharof has also found it near the Sanarka river, Urals.

Named after the Russian physicist Kupffer.

246. ANTHOPHYLLITE. Anthophyllit (fr. Norway) *Schumacher*, Verzeichn., 96, 1801. Antophyllit *Karst.*, Tab., 32, 1808. Anthogrammit *Breith.*, Char., 29, 1820. Antholith *Breith.*, Uib., 38, 1830.

Orthorhombic. $I \wedge I=125°$ to 125° 25′. Observed planes: I, $i\text{-}\bar{\imath}$, $i\text{-}\breve{\imath}$. Cleavage: $i\text{-}\bar{\imath}$ perfect, I less so, $i\text{-}\breve{\imath}$ difficult. Commonly lamellar, or fibrous massive; fibres often very slender.

H.=5·5. G.=3·1—3·2. Lustre somewhat pearly upon a cleavage-surface. Color brownish-gray, yellowish-brown, brownish-green, sometimes submetallic. Streak uncolored or grayish. Translucent to subtranslucent. Brittle. Double refraction positive; optical axes in the brachydiagonal section.

Comp.—$\dot{\mathrm{Fe}}\,\ddot{\mathrm{Si}}+3\,\dot{\mathrm{Mg}}\,\ddot{\mathrm{Si}}=(\frac{1}{4}\,\dot{\mathrm{Fe}}+\frac{3}{4}\,\dot{\mathrm{Mg}})\,\ddot{\mathrm{Si}}$=Silica 55·5, magnesia 27·8, protoxyd of iron 16·7 =100. Analyses: 1, L. Gmelin (Leonh. Orykt., 515, 1826); 2, Vopelius (Pogg., xxiii. 355); 3, Pisani (Descl. Min., i., 536):

		$\ddot{\mathrm{Si}}$	$\ddot{\overline{\mathrm{Al}}}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Mn}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{H}}$
1.	Kongsberg	56	3	18	4	23	2	——=101 Gmelin.
2.	"	56·74	——	13·94	2·38	24·35	——	1·67=99·08 Vopelius.
3.	"	56·16	2·65	14·13	0·91	23·19	1·51	2·38=100·93 Pisani.

Gedrite of Dufrenoy (Ann. d. M., III. x. 582, 1836) has a different composition from that of anthophyllite; but it is still referred here by Descloizeaux on the ground of *optical identity* and similarity of cleavage.

Analyses: 1, Dufrenoy (l. c.); 2, 3, Pisani (L'Institut, 1861, 190):

	$\ddot{\mathrm{Si}}$	$\ddot{\overline{\mathrm{Al}}}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{H}}$
1.	38·81	9·31	45·83	4·13	0·67	2·30=101·05 Dufrenoy.
2.	42·86	16·52	18·82	15·51	1·90	4·50=100·11 Pisani.
3.	43·58	17·07	15·96	18·30	0·75	3·92=99·58 Pisani.

Pisani's analyses afford the O. ratio for $\dot{\mathrm{R}}$, $\ddot{\overline{\mathrm{R}}}$, $\ddot{\mathrm{Si}}$, $\dot{\mathrm{H}}$, 11 : 8 : 23½ : 3½.

Pyr., etc.—B.B. fuses with great difficulty to a black magnetic enamel; with the fluxes gives reactions for iron; unacted upon by acids.

Obs.—Occurs in mica schist with hornblende and mica in thin and long plates and fibres near Kongsberg in Norway, and with gray cobalt near Modum.

This species, originally instituted upon the Norwegian mineral analyzed by Gmelin and Vopelius, and regarded as distinct by many later authors, including Mohs, but united to hornblende by others, has recently been proved to be an independent species by Descloizeaux (Min., i. 75), whose optical examinations have shown that the crystals are *orthorhombic* instead of monoclinic. Only the mineral of the Norwegian localities above mentioned is at present here included, the so-called anthophyllite from Fiskennes in Greenland (occurring with sapphirine), from Bavaria, Finland, and other Norwegian localities, besides the *cummingtonite*, of Cummington, Mass., being true *hornblende* in optical characters. Descloizeaux has later announced (C. R., lxii., 987) that some anthophyllite is monoclinic. The *gedrite* is from the valley of Héas, near Gèdres, France, and contains microscopic black spinels (*picotite*).

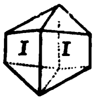
Named from *anthophyllum*, *the clove*, in allusion to the clove-brown color, as Schumacher states.

246A. Piddingtonite, Haidinger (Ber. Ak. Wien, xli., 251, 1860). The ash-gray mass of t meteorite of Shalka, in Bancoorah, consisting in part of grains having two easy cleavages inclin to one another 100°, with H.=6·5; G.=3·412, Haid., 3·66, Piddington; and fracture resinous, a containing small imbedded grains of chromite. Von Hauer obtained S̈i 57·66, Ä̶l *tr.*, Ḟe 20· Ṁg 19·00, Ċa 1·53=98·84, which is nearly the composition of anthophyllite. The meteorite w first described by H. Piddington in the J. Asiat. Soc. Bengal, xx. 299, 1852.

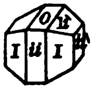
247. AMPHIBOLE. Skörl (=Schörl) pt. *Wall.*, 1747 (excluding Amiantus, Bergkork, etc. a Asbestus). Skörl pt., Strälskörl (=Strahlstein) *Cronst.*, Min., 1758 (excl. Asbestus=Amianth and Bergkork, id. Hornblende *Wern.*, Bergm. J., 1789 (excl. Strahlstein and Asbest). Ho blende *Karst.*, Tab., 1791 (excl. Strahlstein, Tremolit, and Asbest). Id. (excl. also Smaragdit) *Karst.* Tab., 1800, 1808; id. *Ullmann*, 1814, and *Jameson*, 1817. Amphibole (incl. Actinote) Tr., 1801 (excl. Grammatite=Tremolite and Asbeste). Amphibole (incl. Actinote and Gramm tite) *H.*, Tabl., 1809 (excl. Asbeste). Heterotyp (incl. Asbestus, Bronzite, Hypersth., Antho with other varieties) *Hausm.*, Handb., 1813. Hornblende *Jameson*, Syst., 1820 (excl. Actinol Tremolite, Asbestus, Carinthine).

Monoclinic. $C=75° 2'$, $I \wedge I=124° 30'$, $O \wedge 1\text{-}\grave{i}=164° 10'$, $a:b:c$ 0·5527 : 1 : 1·8825. Observed planes: *O*; vertical, *I*, *i-i*, *i*-3, *i-ì*, *i*-3̀; c nodome, 2-ì, 4-ì; hemidome, 1-*i*, 2-*i*, –1-*i*; hemioctahedral planes in zo *O* : *I*, 1, 2, –1; id. in zone 1 : *i-ì*, 3-3̀, 5-5̀, –3-3̀.

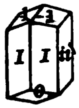
223



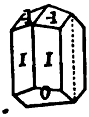
224



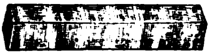
225



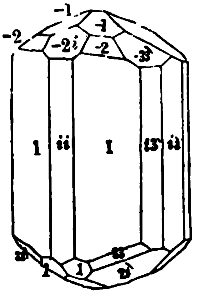
226



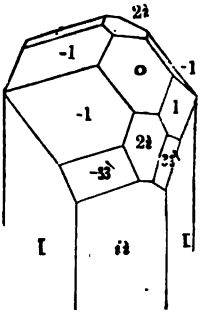
227



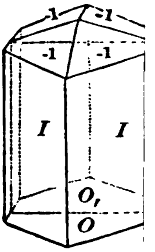
228



229



230



O ∧ 1-*i*=155° 33′
O ∧ 1-*i*=149
O ∧ 2-*i*=124 56
O ∧ *i-i*=104 58
O ∧ –1=152 36
O ∧ 1=145 35
O ∧ 2=121 29

O ∧ 2-*i*=150° 26′
O ∧ *i-ì*=90
O ∧ *I*=103 12
i-ì ∧ *i*-3=99 57
i-ì ∧ *i*-3̀=147 39
i-3̀ ∧ *i*-3̀=115 18
i-ì ∧ –3-3̀=124 14

i-ì ∧ 3-3̀=130°15′
2-ì ∧ 2-ì, ov. *O*,=120
–1 ∧–1=154 26
1 ∧ 1=148 28
2 ∧ 2=131 36
–3-3̀ ∧ –3-3̀=111 32
3-3̀ ∧ 3-3̀=99 30

Crystals sometimes stout, often long and bladed. Cleavage: *I* high perfect; *i-i*, *i-ì*, sometimes distinct. Lateral planes often longitudinal striated. Twins: composition-face *i-i*, as in f. 226 (simple form f. 225), a 230. Imperfect crystallizations: fibrous or columnar, coarse or fine, fib often like flax; sometimes lamellar; also granular massive, coarse or fi and usually strongly coherent, but sometimes friable.

H.=5—6. G.=2·9—3·4. Lustre vitreous to pearly on cleavage-faces; fibrous varieties often silky. Color between black and white, through various shades of green, inclining to blackish-green. Streak uncolored, or paler than color. Sometimes nearly transparent; usually subtranslucent—opaque. Fracture subconchoidal, uneven. Bisectrix, in most varieties, inclined about 60° to a normal to *O*, and 15° to a normal to *i-i*; and double refraction negative. See exceptions, p. 235.

Comp., Var.—$\dot{\mathrm{R}}\ddot{\mathrm{Si}}$, and $(\dot{\mathrm{R}}^{3}\,\bar{\mathrm{R}})$ $(\ddot{\mathrm{Si}}, \dddot{\mathrm{Al}}^{\frac{2}{3}})$ as for pyroxene. Alumina is present in most amphibole, and when so it usually replaces silica. $\dot{\mathrm{R}}$ may correspond to two or more of the bases $\dot{\mathrm{M}}\mathrm{g}$, $\dot{\mathrm{C}}\mathrm{a}$, $\dot{\mathrm{F}}\mathrm{e}$, $\dot{\mathrm{M}}\mathrm{n}$, $\dot{\mathrm{N}}\mathrm{a}$, $\dot{\mathrm{K}}$, $\dot{\mathrm{H}}$; and $\bar{\mathrm{R}}$ to $\dddot{\mathrm{Al}}$, $\bar{\mathrm{F}}\mathrm{e}$, or $\bar{\mathrm{M}}\mathrm{n}$. $\bar{\mathrm{F}}\mathrm{e}$ sometimes replaces silica, like $\dddot{\mathrm{Al}}$. Rammelsberg made out the general conformity of amphibole to the pyroxene formula by discovering that the iron in both species was often partly sesquioxyd (Pogg., ciii. 284, and Min. Ch., 468). Yet the analyses do not all accord with this view, part giving the ratio 1 : 2¼, unless the water is made basic. Much amphibole, especially the aluminous, contains some fluorine. The base lime is absent from some varieties, or nearly so.

The name *Amphibole*, proposed by Haüy, has the precedence, because Haüy first rightly appreciated the species, as he had done for pyroxene, and gave it, and not any of its varieties, the name. In his Traité, in 1801, he brought together *hornblende* and *actinolite;* and by 1809 he had added to the group the third prominent variety, *tremolite;* while in all other works not taking their views from him, these three minerals still stood as distinct species. *Asbestus* was annexed to the series by Hausmann in 1813, though kept separate long afterward by many other authors.

The *varieties* of amphibole are as numerous as those of pyroxene, and for the same reasons; and they lead in general to similar subdivisions.

I. CONTAINING LITTLE OR NO ALUMINA.

1. *Magnesia-Lime Amphibole;* TREMOLITE. (Tremolit *Pini, de Saussure*, Voy. Alpes, iv. § 1923, 1796. Grammatite *H.*, Tr., iii. 1801. Kalamit [fr. Normark, Sw.) *Wern.*, Tasch. Min., x. 169, 1816. Calamite. Raphilite *Thom.*, Min., i. 153, 1836. Sebesit [fr. Sebes, Transylvania] in Breith. Handb., 539, 1847. Nordenskiöldit, Kenng., Ber. Ak. Wien, xii. 297, 1854.)

Colors white to dark-gray. In distinct crystals, either long bladed or short and stout; long and thin columnar, or fibrous; also compact granular massive. $I \wedge I = 124^{\circ}\ 30$. H.=5·0—6·5. G. 2·9—3·1. Sometimes transparent and colorless. Contains magnesia and lime with little or no iron; formula $(\dot{\mathrm{C}}\mathrm{a}\ \dot{\mathrm{M}}\mathrm{g})\ \ddot{\mathrm{Si}}$. Named *Tremolite* by Pini, from the locality at Tremola in Switzerland.

Grammatite (from γραμμη, *a line*) alludes to a line in the direction of the longer diagonal seen by Haüy on transverse sections of some crystals. It was substituted for tremolite by Haüy, without reason, and is a very bad substitute.

Nordenskiöldite, from Ruscula, near Lake Onega, is tremolite (Kenngott and v. Hauer, l. c.).

Raphilite, from Lanark in Canada, is tremolite in its grayish-white or but slightly greenish color, and its low specific gravity (G.=2·85, Thomson; 2·845, Hunt). But both Hunt's and Thomson's analyses give over 5·30 p. c. of protoxyd of iron. In a letter to the author (dated Sept. 21, 1864) Hunt states that he obtained in one of his trials, from material which he had purified from mixed $\dot{\mathrm{C}}\mathrm{a}\ddot{\mathrm{C}}$, only 3·15 of protoxyd of iron, with $\dot{\mathrm{C}}\mathrm{a}$ 12·05 and $\ddot{\mathrm{Si}}$ 57·20; and he adds that he regards this as nearer the true composition of the mineral.

1 *a*. NEPHRITE pt. (Pietra di hijada [fr. Mexico or Peru] *Span.* Lapis nephriticus *A. Clutius*, Dissert., 1627; *C. Bartholinus*, Opusc., 1628; *de Boot*, Gemm., 1609. Lapis Indicus *Aldrovandus*, Met., p. 706. Talcum nephriticum *Linn.*, 1768. Jade, Pierre néphrétique, *d'Argenville*, Oryct., 184, 1755; *Sage, de Lisle, etc.* Nephrit *Wern.*, Ueb. Cronst., 185, 1780. Kidney Stone. Nierenstein, Beilstein, *Germ.*)

Nephrite is in part a tough, compact, fine-grained tremolite, having a tinge of green or blue, and breaking with a splintery fracture and glistening lustre. H.=6—6·5. G.=2·96—3·1. Named from a supposed efficacy in diseases of the kidney, from νεφρός, *kidney*. It occurs usually associated with talcose or magnesian rocks.

Nephrite or jade was brought in the form of carved ornaments from Mexico or Peru soon after the discovery of America. Del Rio, in his Mexican Mineralogy (1795), mentions no Mexican locality. A similar stone comes from China and New Zealand. A nephrite-like mineral, called *bowenite*, from Smithfield, R. I., having the hardness 5·5, is serpentine in composition. The jade of de Saussure is the *saussurite* (see under ZOISITE) of the younger de Saussure, earlier named *lemanite* by Delametherie. Another aluminous jade has been called *jadeite* (q. v.) by Damour. The Easton mineral is a mixture, and has been named *pseudonephrite* (q. v.).

2. *Magnesia-Lime-Iron Amphibole;* ACTINOLITE (Strälkorl pt. *Cronst.*, l. c. Strahlstein *Germ.* Actynolite *Kirw.*, Min., i. 167, 1794. Actinolite (correct orthogr.). Schorl vert du Zillerthal

Zillerthite, *Delameth.*, T. T., ii. 357, 1797. Actinote *H.*, Tr., iii 1801). Color bright-green and grayish-green. In crystals, either short or long-bladed, as in tremolite; columnar or fibrous; granular massive. G.=3—3 2. Sometimes transparent. Contains magnesia and lime, with some protoxyd of iron, but seldom more than 6 p. c.; formula $(\dot{C}a, \dot{M}g, \dot{F}e)\,\ddot{S}i$. The variety in long bright-green crystals is called *glassy actinolite;* the crystals break easily across the prism. The fibrous and radiated kinds are often called *asbestiform actinolite* and *radiated actinolite.* Actinolite owes its green color to the iron present.

Named actinolite from 'ακτίς, *a ray*, and λίθος, *stone*, as translation of the German *strahlstein* or *radiated stone.* Name changed to *actinote* by Haüy, without reason.

Tremolite graduates into *actinolite* through an increase in the proportion of iron, though generally easily distinguishable by its color. *Asbestus* has usually a grayish-white or greenish-white color, although actinolite in the proportion of iron; and the *raphilite* (see preceding page) appears to shade into actinolite in composition. Tremolite does not differ in color from the aluminous variety, *edenite*, from Edenville, N. Y. (p. 235).

3. *Magnesia-Iron Amphibole;* ANTHOLITE (Anthophyllite pt. (p. 231). Antholith pt. *Kenng.*, Ueb. 1859, 68, 1860). Structure as in anthophyllite. Color gray to brown; G.=3·1—3·2. Contains much magnesia, with some iron, and little or no lime. Formula $(\dot{M}g, \dot{F}e)\,\ddot{S}i$. Graduates into *kupfferite*, p. 230.

4. *Magnesia-Lime-Manganese Amphibole;* RICHTERITE. A variety from Paisberg is here included (anal. 34), described by Igelström, and affording the formula $(\dot{M}g, \dot{M}n, \dot{C}a, \dot{K}, \dot{N}a)\,\ddot{S}i$, and containing 8 to 9 p. c. of alkali, which may possibly be a result of alteration. *I* ∧ *I*=124°; color pale-yellowish to brown. Igelström considers the *richterite* of Breithaupt (B. H. Ztg., xxiv. 364, 1865) the same mineral, as it has the same general aspect and similar composition, excepting half less manganese; Breithaupt describes it as occurring in acicular crystals, affording the prismatic angle 133° 38′ (which is within 5′ of *I* ∧ *i-i* of pyroxene); with G.=2·826; color isabella-yellow, rarely pale yellowish-brown; B.B. very fusible. It resembles the kokscharoffite from L. Baikal, though unlike it in composition (p. 242).

5. *Iron-Magnesia Amphibole;* CUMMINGTONITE (*Dewey*, Am. J. Sci., viii. 59, 1824. Anthophyllite pt. Not Cummingtonite [=Rhodonite] *Ramm.*). Color gray to brown. Usually fibrous or fibro-lamellar, often radiated. G.=3·1—3·32. Contains much iron, with some magnesia, and little or no lime. Formula $(\dot{F}e, \dot{M}g)\,\ddot{S}i$. Named from the locality, Cummington, Mass.

6. *Iron-Manganese Amphibole;* DANNEMORITE (Jern-och-manganoxidulrik Hornblende *A. Erdmann*, Dannemora Jernm., 52, 1851. Dannemorit *Kenng.*, Ueb. 1855, 61, 1856). Color yellowish-brown to greenish-gray. Columnar or fibrous, like tremolite and asbestus. Contains iron and manganese; formula $(\dot{F}e, \dot{M}n)\,\ddot{S}i$. In thin pieces B.B. fuses to a dark slag. *Asbeferrite* of Igelström (B. H. Ztg., xxvi. 23, 1867) is similar; it is grayish-white to ash-gray, and like a gray asbestus; in acids not soluble (anal. 39). The proportion of Mn is not stated, and it may be cummingtonite.

7. *Iron Amphibole;* GRÜNERITE (Pyroxene ferrugineux (fr. Collobrières) *Grüner*, C. R., xxiv. 794; Grünerit *Kenng.*, Min., 69, 1853). Asbestiform, or lamellar-fibrous. Lustre silky; color brown; G.=3·713. Formula $\dot{F}e\,\ddot{S}i$. Optical properties those of amphibole, according to Descloizeaux (Min., i. 59).

Appendix. 8. ASBESTUS ('Αμίαντος λίθος *Dioscor.*, v. 155. [Not ἄσβεστος [=Quicklime] *Dioscor.*, v. 133.] Asbestos, Linum vivum, Amiantus, *Plin.*, xix. 4, xxxvi. 31. Lapis Carystius (fr. Carystum) *Pausanias.* Lana montana. Amiantus, Asbestus, *Agric.*, Foss., 253, 1546; *Wall.*, Min., 140, 143, 1747 (Caro montana or Bärgkött=Mountain leather, and Suber montanum or Bärgkoark=Mountain cork, being included.) Asbestus, Amianthus, Carystine (=Mtn. leather and cork), *Hill*, Foss., 166, 1771. Kymatin *Breith.*, Uib. 1830, Char., 113, 1832. Byssolite (fr. Bourg d'Oisans) *Saussure.* Voy. Alpes, § 1696; Asbestöide (ib.) *Vauq. & Macquart*, Bull. Soc. Philom. No. 54, 1797; Amianthoide (ib.) *Delameth.*, T. T., ii. 364, 1797). Tremolite, actinolite, and other varieties of amphibole, excepting those containing much alumina, pass into fibrous varieties, the fibres of which are sometimes very long, fine, flexible, and easily separable by the fingers, and look like flax. These kinds, like the corresponding of pyroxene. are called *asbestus* (fr. the Greek for *incombustible.*) Pliny supposed it a vegetable product, although good for making *incombustible* cloth, as he states. The amianthus of the Greeks and Latins was the same thing; the word meaning *undefiled*, and alluding to the ease of cleaning the cloth by throwing it into the fire. The colors vary from white to green and wood-brown. The name *amianthus* is now applied usually to the finer and more silky kinds. Much that is so called is *chrysotile*, or fibrous serpentine, it containing 12 to 14 p. c. of water. *Mountain leather* is a kind in thin flexible sheets, made of interlaced fibres; and *mountain cork* (bergkork) the same in thicker pieces; both are so light as to float on water, and they are often hydrous. *Mountain wood* (Bergholz, Holzasbest, *Germ.*) is compact fibrous, and gray to brown in color, looking a little like dry wood.

Byssolite (Amianthoid, asbestoid) fr. Bourg d'Oisans in Dauphiny, is of an olive-green color, coarse and stiff fibrous, and has G.=3·0; it is a fibrous variety of the *iron-manganese amphibole*, according to Vauquelin & Macquart (l. c.). It occurs associated with a black oxyd of manganese

II. Aluminous.

9. *Aluminous Magnesia-Lime Amphibole.* (a) **Edenite.** (Edenit *Breith.*, Handb., 558, 1847). Color white to gray and pale-green, and also colorless; G.=3·0—3·059, Ramm.; 2·9, Breith. Resembles anthophyllite and tremolite. Formula $(\dot{M}g, \dot{C}a)(\ddot{S}i, \dddot{A}l)$. Named from the locality at Edenville, N. Y. To this variety belong various pale-colored amphiboles, having less than five p. c. of oxyds of iron. Breithaupt makes the edenite *triclinic* in B. H. Ztg., xxiv. 428, and he says that this is confirmed by Dauber. On an examination of crystals, the author sees no reason for adopting this conclusion.

(b) **Smaragdite** *Saussure* (Voy. Alpes, iv. § 1313, 1362, 1796. Diallage verte pt. *H.*, 1801; Green Diallage pt. Diallagon *Ullmann*, Tab., 90, 1814). A thin-foliated variety, of a light grass-green color, resembling much common green diallage. According to Boulanger it is an aluminous magnesia-lime amphibole, containing less than 3½ p. c. of protoxyd of iron, and is hence related to edenite and the light green Pargas mineral. Descloizeaux observes (Min., i. 90) that it has the cleavage, and apparently the optical characters, of amphibole. H.=5; G.=3, Vauq.; 3·10, Boulanger. It forms, along with whitish or greenish saussurrite, a rock. The original mineral is from Corsica, and the rock is the *corsilyte* of Pinkerton, and the *verde di Corsica duro* of the arts.

A similar smaragdite from Bacher consists, according to Haidinger, of alternate laminæ of amphibole and pyroxene in twin composition.

The *euphotide* of the Alps resembles corsilyte in containing a smaragdite-like mineral (*green diallage*). But Hunt states that the mineral has the cleavage of pyroxene, which our own examinations have not succeeded in confirming.

10. *Aluminous Magnesia-Lime-Iron Amphibole.* (a) **Pargasite**; (b) **Hornblende.** (Corneus fissilis pt., Corneus solidus pt., C. crystallisatus pt, Hornbürg, Skiörl pt., *Wall.*, Min., 138, 139, 147. Skörl pt., Basaltes pt., Bolus particulis squamosis pt., *Cronst.*, 70, 82, 1758. Schorl opaque rhomboidal pt, Schorl argileux pt., *de Lis'e*, Crist., ii. 389 (pl. iv, f. 97, 99), 424, 1783. Basaltische Hornblende *Wern.*, Bergm. J., 1789 (incl. also augite). Basaltische H. (augite excl.) *Wern.*, 1792, and later; *Karst.*, Tab., 1800. Pargasit *Steinheil*, 1814, Tasch., Min. 1815, 301. Amphibolit *Breith.*, Char., 1823, Uib., 34, 1830. Diastatit (fr. Wermland) *Breith.*, Char, 134, 1832. Syntagmatit (fr. Vesuvius), Wallerian, *Breith.*, B. H. Ztg., xxiv. 428, 1865.

Colors bright, dark, green, and bluish-green to grayish-black and black. $I \wedge I$=124° 1′—124° 25′; G.=3·05—3·47. *Pargasite* is usually made to include green and bluish-green kinds, occurring in stout lustrous crystals, or granular; and *hornblende* the greenish-black and black kinds, whether in stout crystals or long bladed, columnar, fibrous, or massive granular. But no line can be drawn between them. Pargasite occurs at Pargas, Finland, in bluish-green and grayish-black crystals.

Optical characters in general the same as for tremolite and actinolite (p. 233). But in one black crystal of hornblende (fr. Bilin ?) Descloizeaux found one bisectrix to be parallel to the plane *i-i*, and the other normal to it. Again, in the bluish or black pargasite, from Pargas, the bisectrix is inclined 32° 58′ to a normal to *O*, and 108° to a normal to *i-i*; and double refraction is *positive.* Descloiseaux observes that these distinctions are not sufficient to warrant the separation of these minerals.

(a) *Diastatite* is a black hornblende from Nordmark in Wermland, stated by Breithaupt to have $I \wedge I$=120° 20′, and G.=3·08—3·11. (b) *Syntagmatite* is the Vesuvius black hornblende, analyzed by Rammelsberg (No. 29), in which he found $I \wedge I$=124° 8′, G.=3·2.2.

(c) According to Breithaupt, $I \wedge I$ in two hornblendes from Greenland is 123° 59′ and 124° 0′, with G.=3·462 and 3·383; two from Arendal in Norway, 124° and 124° 1½′, with G.=3·301 and 3·279; one from Persberg in Sweden, 124°, with G.=3·818; two from Schmalzgrube, near Marienberg in Saxony, 124° 5′ and 124° 11′, with G.=3·333 and 3·290; one from Rhonsberg in Bohemia, 124° 6′, with G.=3·352. The preceding are of Breithaupt's *Amphibolus ferrosus.*

For a basaltic hornblende, from Wetterau or Bilin (*A. basalticus* Br.) analyzed by Bonsdorff and Struve (Anal. 17, 21), Breithaupt gives $I \wedge I$=124° 39′ 38″, and G.=3·17—3·25; for one from the zircon-syenite of Laurvig and Fredriksvärn in Norway (*A. saxosus* Br.) $I \wedge I$=124° 7′, and G.=2·26—2·29; for one of greenish-black color from Ersby near Pargas in Finland, analyzed by Hisinger and Bonsdorff. anal. 10, 11 (*A. medius* Br.), $I \wedge I$=124° 15′, and G.=3·14—3·17; for one of green to greenish-black color, from Saualpe in Carinthia, analyzed by Clausbruch, anal. 20 (*A. Carinthinus* Br., and *Carinthine* W.), $I \wedge I$=124° 22′, and G.=3·08—3·10; for one from Pargas, occurring in limestone with chondrodite, etc., analyzed by Bonsdorff and Gmelin (*A. pargasites* Br., or *Pargasite*), $I \wedge I$=124° 10′, and G.=3·06—3·08; for one of greenish-black to blackish-green color, from Kongsberg in Norway, analyzed by Kudernatsch (*A. macrodiagonalis* Br.), $I \wedge I$=124° 26′ and G.=3·06—3·08

Diastatite of Breithaupt (*A. diastaticus*), in its angle $I \wedge I = 120° 20'$, if this be not an accid irregularity, diverges widely from true hornblende. Breithaupt has called a velvet-black l blende from Nordmark in Wermland *Hemiprismatischer Amphibol* (Char., 135, 1832; Handb 546); it is stated to have $I \wedge I = 124° 26'$, and to be *triclinic*, the angle between the macrod nal and the left face of a clinodome being 27° 40′, and that for the right face 27° 54, an cleavages parallel to the prismatic planes I, I', unequal. G.=3·16–3·18. The analys Bonsdorff and Hisinger, Nos. 11, 28, he refers here. He has recently named it *Hemiprism Wallerianus* or *Wallerian*. Breithaupt also observes that his *A. medius* (see above) has un cleavages, and is probably related to the wallerianite. The grayish to colorless hornbl from Edenville, called by him *Edenite* (see p. 235), he also refers to his genus *Hemiprismati*

11. *Aluminous Iron-Lime Amphibole;* NORALITE *Dana.* Color black.

12. *Aluminous Iron-Manganese Amphibole;* GAMSIGRADITE *Breith.* (B. H. Ztg., xx. 51. Color velvet-black. G.=3·12. Named from the locality, Gamsigrad in Servia, where it with white feldspar a rock called *timazyte.*

Mangan-amphibol of Hermann (Cummingtonite *Rammelsberg*, and Hermannite *Kenngott*) is ing but rhodonite of Cummington, Mass., erroneously analyzed.

I. CONTAINING LITTLE OR NO ALUMINA.

1. *Tremolite: Magnesia-Lime Amphibole.* Analyses: 1, 2, Bonsdorff (Schw. J., xxxi. 414, 123); 3, Michaelson (Œfv. Ak. Stockh., 1863, 196): 4, Damour (Ann. Ch. Phys., III. xvi. Richter (Pogg., lxxxiv. 353); 6, Rammelsberg (Pogg., ciii. 295); 7, Lechartier (Bull. Soc. Ch iii. 381); 8, 9, Rammelsberg (l. c.); 10, Beudant (Ann. d. M., II. v. 307); 11, Rammelsberg (12, id. (J. pr. Ch, lxxxvi. 347).

2. *Actinolite: Magnesia-Lime-Iron Amphibole.* 13, Bonsdorff (l. c); 14, Seybert (Am. J. Sc 833); 15, Huht (Am. J Sci., II. xii, 213, Phil. Mag., IV. i. 322); 16, Furuhjelm (Arppe, U sökn, p. 69, Ramm. Min. Ch., 471); 17, 18, Rammelsberg (l. c.); 19, Richter (l. c.); 20, Pi (Berz. Jahresb., xxvii. 252); 21, v. Merz (Viert. Ges. Zurich, 1861, Kenng., 1860); 22, Sch (ib, vii. 20, Kenng., 1861, 68; 23, Michaelson (Œfv. Ak. Stockh., 1863, 199); 24, Murray (R 2d Suppl, 60); 25, Bonsdorff (l. c.); 26, Rammelsberg (1st Suppl, 73); 27, Meitzendorf (lii. 626); 28, Scheerer (Pogg, lxxxiv. 331); 29, Richter (ib.); 30, Scheerer (l. c).

3. *Antholite: Magnesia-Iron Amphibole.* 31, Thomson (Rec. Gen. Sci., xvii); 32. Beck Min., 1850, 692); 33, Lappe (Pogg., xxxv. 486).

4. *Magnesia-Lime-Manganese Amphibole.* 34, Igelström (Œfv. Ak. Stockh. 1867, 12, B. H. 1867, 21); 35, Michaelson (l. c.)

5. *Cummingtonite: Iron-Magnesia Amphibole.* 36, 37, Smith & Brush (Am. J. Sci., II. xvi

6. *Dannemorite: Iron-Manganese Amphibole.* 38, Erdmann (Dannemora Jern-Upsala, Stock 1851, 51); 39, Igelström (B. H. Ztg., xxvi. 23).

7. *Grünerite: Iron Amphibole.* 40, Grüner (C. R, xxiv. 794).

8. *Nephrite.* 41, Rammelsberg (Pogg., lxii. 148); 42, 43, Schafhäutl (Ann. Ch. Pharm., 838); 44, 45, Damour (Ann. Ch. Phys., III. xvi.); 46, 47, Scheerer (Pogg., lxxxiv. 379); 4 L. R. v. Fellenberg (Nat. Ges. Bern, 1865, 112):

1. TREMOLITE: *Magnesia-Lime Amphibole.*

		$\ddot{\text{Si}}$	$\dddot{\text{Al}}$	$\dot{\text{Fe}}$	$\dot{\text{Mn}}$	$\dot{\text{Mg}}$	$\dot{\text{Ca}}$	$\dot{\text{H}}$
1. Wermland, *w.*		59·75	*tr.*	0·50	——	25·00	14·71	0·10, F 0·90=100 86
2. Fahlun, *w.*		60·10	0·42	1·00	0·47	24·31	12 73	0 15, F 0·78=99 96
3. " *pale green*		57·32	1·09	1·18	0·85	24·70	13·61	0·20, F 0·35=99·30
4. St. Gothard, *w.*		58·07	——	1·82	——	24·46	12·99	——=97·34 Damour,
5. " *w.*		60·60	0 32	0·50	——	25·43	11·85	1·20 (& F)=99·90 Ric
6. " *w.*	$(\frac{3}{2})$	58·55	——	——	——	26·63	13·90	0·34 (& F)=99·42 Ra
7. " *w.*	([illegible])	59·02	0·35	2·81		24·07	12·53	1·62=100·40 Lechar
8. Sweden, *ywh.*		58·87	1·77	——	——	28·19	11·00	0·18 (& F)=100·01 R
9. Maneetsok, Gd., *ywh.*		54·71	——	2·41	——	23·92	15·06	3·33 (& F)=99·43 Ra
10. Cziklowa		59·5	1·4	——	——	26 8	12·3	——=100 Beudant.
11. Gouverneur, N. Y., *w.*		57·40	0·38	1·36	——	24·69	13·89	0·40 (& F)=99·12 Ra
12. Gulsjö		57·62	——	0·84	——	26·12	14·90	——=99·48 Ramm

2. ACTINOLITE; *Magnesia-Lime-Iron Amphibole.*

		S̈i	Äl	Ḟe	Ṁn	Ṁg	Ċa	Ḣ
13.	Taberg, *glassy*	59·75	——	3·95	0·31	21·10	14·25	——, F 1·16=100·52 B.
14.	Concord, Pa.	56·33	1·67	4·30	——	24·00	10·67	1·03=98 Seybert.
15.	*Raphilite*	55·30	0·40	6·30	*tr.*	22·50	13·36	0·30, Ṅa 0·80, K 0 25=99·21 Hunt.
16.	Degerö, Finl.	58·25	1·33	6·65	——	20·55	12·40	——=99·18 Furuhjelm.
17.	Zillerthal, *cryst.*	55·50	——	6·25	——	22·56	13·46	1·29=99·06 Ramm.
18.	Arendal, *gy.-gn.*	56·77	0·97	5·88	——	21·48	13·56	2·20=100·86 Ramm.
19.	Reichenstein	58·89	0·67	3·79	——	23·37	9·57	3·60=99·89 Richter.
20.	Helsingfors, *gy.-gn.*	57·20	0·20	11·75	1·15	9·49	21·20	——=100·95 Pipping.
21.	Riffelberg	57·25	0·22	6·67	0·63	21·81	12·10	——, F 0·83=99·81 Merz.
22.	Fleschhorn	58·18	3·17	11·27	——	16·57	11·59	——, F 0·29=101·07 Sch.
23.	Orrijärfvi, *dk.-gn.*	55·01	1·69	3·46	0·51	23·85	13·60	1·02, F̶e 0·56, Ṅa 0·48, K̇ 0·38=100·56 Michaelson.
24.	Taberg, *Asbestus*	59·50	——	8·60	——	19·30	12·65	——=100·05 Murray.
25.	Tarentaise "	58·20	0·14	3·08	0·21	22·10	15·55	0·14, F 0·6=99·45 B.
26.	*Kymatin* "	57·98	0·58	6·32	——	22·38	12 95	——=100·21 Ramm.
27.	Zillerthal "	55·87	——	4·31	1·12	20·33	17·76	——=99·39 Meitzendorf.
28.	Tyrol "	57·50	——	3·88	——	23·09	13·42	2·36=100·25 Scheerer.
29.	Reichenstein "	55·85	0·56	5·22	——	23·99	11·66	2·15, Ċu 0·40 Richter.
30.	Zillerthal, *Rock Cork*	57·20	——	4·37	——	22·85	13·39	2·43=100·24 Scheerer.

3. ANTHOLITE; *Magnesia-Iron Amphibole;* Asbestiform.

31.	Tyrol, *Asbestus*	54·92	1·64	12·60	——	26·08	——	5·28=100·52 Thomson.
32.	Staten Id., "	55·20	——	11·82	——	30·78	——	2·25=100 Beck.
33.	Koruk "	58·48	——	9·22	0·88	31·38	0·04	——=100 Lappe.

4. RICHTERITE; *Magnesia-Lime-Manganese Amphibole.*

34.	Paisberg	52·23	——	1·35	11·37	21·03	5·20	——, Ṅa, K̇ 8·82=100 I.
35.	Longban, Finl.	54·15	0·52	1·77	5·09	20·18	6·06	0·12, F̶e 2·80 Ṅa 2·77, K̇ 6·37=99·33 Michaelson.

5. CUMMINGTONITE; *Iron-Magnesia Amphibole.*

36.	Cummington	51·09	0·95	32·07	1·50	10·29	*tr.*	3·04, Ṅa 0·75, K̇ *tr.*=99·69 S. & B.
37.	"	50·74	0·89	33·14	1·77	10·31	*tr.*	3·04, Ṅa 0·54, K̇ *tr.*=100·43 S. & B.

6. DANNEMORITE; *Iron-Manganese Amphibole.*

38.	Dannemora	48·89	1·46	38·21	8·46	2·92	0·73	——=100·67 Erdmann.
39.	Brunsjö, *Asbeferrite*	46·25	——	40 40		10·88		2·47=100 Igelström

7. GRUNERITE; *Iron Amphibole.*

40.	Collobrières	43·9	1·9	52·2	——	1·1	0·5	——=99·6 Grüner.

8. NEPHRITE.

41.	China	54·68	——	2·15	1·39	26·01	16·06	0·68=100·97 Ramm.
42.	"	58·91	1·32	2·43	0·82	22 42	12·28	0·25, K̇ 0·80=99·23 S.
43.	"	58·88	1·56	2·53	0·80	22·39	12·15	0·27, K̇ 0 80=99·74 S.
44.	"	58·46	——	1·15	——	27·09	12·06	——=98·76 Damour.
45.	"	58·02	——	1·12	——	27·19	11·82	——=98·15 Damour.
46.	"	57·28	0·68	1·37	——	25·91	12·39	2·55=100·18 Scheerer.
47.	N. Zealand	57·10	0·72	3·39	——	23 29	13 48	2·50=100·48 Scheerer.
48.	Swiss Lake-hab.	(⅜) 56·83	——	6·70	0·58	20·35	13·02	3·18=100 66 Fell.
49.	" "	56·14	0·48	4·66	1·13	22·68	11·12	3·72=99·93 Fell.

In anal. 3, G.=2·99; anal. 6 and 8, G.=2·93; anal. 11, G.=3·0; anal. 12, G.=3·003; anal. 17, G.=3·067; anal. 18, G.=3·026; anal. 19, G.=3·004; anal. 20, G.=3·166; anal. 23, G.=3·08 anal. 41, G.=2·96; anal. 44, 45, G.=2·97.

II. ALUMINOUS VARIETIES.

1. EDENITE: *Magnesia-Lime Amphibole.* Analyses: 1, Rammelsberg (Pogg, ciii. 441) Cajander (J. pr. Ch., xlii. 454); 3, Rammelsberg (l. c.); 4, C. Gmelin (Ak. H. Stockh. 1816 Bonsdorff (Schw. J., xxxi. 414, xxxv. 123); 6, 7, Rammelsberg (l. c.); 8, Bonsdorff (l. c.).

2. *Pargasite* and *Hornblende.* 9, T. S. Hunt (Rep. G. Can., 1863, 466); 10, Bonsdorff (l. 11, 12, Hisinger (Schw. J., xxxi. 289); 13, Suckow (Die Verwitt., 143); 14, Delesse (Ann. d xvi. 323, 1849); 15, Kudernatsch (Pogg., xxxvii 585); 16, Kussin (Ramm., Min. Ch., 492); Bonsdorff (l. c.); 18, Henry (G. Rose, Reise Ural, i. 383); 19, Hisinger (l. c.); 20, Clausb (Ramm., 1st Suppl., 72); 21, Struve (Pogg., vii. 350); 22, Rammelsberg (ib., lxxxiii 458); 24, Waltershausen (Vulk. Gest., 111); 25, Delesse (Mem. Soc. d'emul. du Doubs, 1847); Sharples (Am. J. Sci., II. xlii 271); 27, Kudernatsch (l. c.); 28, Bonsdorff (l. c.); 29–35, melsberg (Pogg., ciii. 444); 36, Delesse (Ann. d. M., xvi. 323); 37–40, Rammelsberg (l. c); Puzyrevsky (Jahrb. Min., 1856, 352); 42, Moberg (J. pr. Ch , xlii. 454); 43, Waltershausen (l 44, Hisinger (l. c.); 45, Deville (Et. G. Teneriffe, 1843).

3. NORALITE; *Aluminous Iron-Lime Amphibole.* 46, 47, Klaproth (Beitr., v. 150); 48, melsberg (l. c., 447); 49, Schultz (Ramm. Min. Ch., 996).

4. GAMSIGRADITE; *Aluminous Iron-Manganese Amphibole.* 50, Müller (B H. Ztg., xx. 53).

5. SMARAGDITE. 51, T. S. Hunt (Am. J. Sci., II. xxvii. 348); 52, Boulanger (Ann. d. M., 159):

1. EDENITE; *Aluminous Magnesia-Lime Amphibole.*

	$\ddot{\text{Si}}$	$\dddot{\text{Al}}$	$\dddot{\text{Fe}}$	$\dot{\text{Fe}}$	$\dot{\text{Mn}}$	$\dot{\text{Mg}}$	$\dot{\text{Ca}}$	$\dot{\text{Na}}$	$\dot{\text{K}}$	$\dot{\text{H}}$	F	
1. Edenville, *gy.*	51·67	5·75	2·86	——	——	23·37	12·42	0·75	0·84	0·46	——	=98·12
2. Storgord, Finl.	39·37	15·37	——	2·39	——	21·46	17·61	——	——	——	——	=96·20
3. Pargas, *gn.*	46·12	7·56	——	2·27	——	21·22	13·70	2·48	1·29	1·10	2·76	=98·50
4. " *pale-gn.*	51·75	10·93	——	3·97	——	18 97	10·04	1·83	——	——	——	=97·49
5. " "	46·26	11·48	——	3·48	0 36	19·03	13·96	0·61	——	——	2·86,	ga 0·43=98·47 Bonsd
6. Monroe, *bh.-gy.*	45·93	12·37	——	4·55	*tr.*	21·12	12·22	2·24	0 98	0·59	——	=100·3
7. Saualpe, *bn.*	49·33	12·72	1·72	4·63	——	17·14	9 91	2·25	0·63	0·29	0·21	=99·13
8. Aker, *gy.*	47·21	13·94	——	2·28	0·57	21·86	12·73	——	——	0·44	0·9	=99·93

2. PARGASITE *and* HORNBLENDE; *Aluminous Magnesia-Lime-Iron Amphibole.*

a. Containing not over 10 p. c. of oxyd of iron

	$\ddot{\text{Si}}$	$\dddot{\text{Al}}$	$\dddot{\text{Fe}}$	$\dot{\text{Fe}}$	$\dot{\text{Mn}}$	$\dot{\text{Mg}}$	$\dot{\text{Ca}}$	$\dot{\text{Na}}$	$\dot{\text{K}}$	$\dot{\text{H}}$	F	
9. Madawaska R.	55·05	4·50	——	5·85	——	20·95	13·44	——	——	0·35	——	=100·1
10. Pargas	45·69	12·18	——	7·32	0·22	18·79	13·68	——	——	——	1·42	=99·45
11. "	41·50	15·75	——	7·75	0·25	19·40	14·09	——	——	0·50	——	=97·24
12. Lindbo	45·37	13·82	——	7·74	1·50	16·34	13·92	——	——	0·22	——	=98·91
13. Fillefjeld, Norw.	45·37	14·81	——	8·74	1·50	14·33	14 91	——	——	——	——	=99·66
14. Thillot, *gn.*	50·04	8·95	——	9·59	0·20	18·02	11·48	0·81	0 06	0·59	——,	$\dddot{\text{Cr}}$ 0· 100 Dele
15. Kienrudgrube	49·07	9·24	——	9·77	——	20·29	10·33	——	——	——	——	=98·70

b. Containing over 10 p. c. of oxyd of iron and under 20 p. c.

	$\ddot{\text{Si}}$	$\dddot{\text{Al}}$	$\dddot{\text{Fe}}$	$\dot{\text{Fe}}$	$\dot{\text{Mn}}$	$\dot{\text{Mg}}$	$\dot{\text{Ca}}$	$\dot{\text{Na}}$	$\dot{\text{K}}$	$\dot{\text{H}}$	F	
16. Zsidovacz	46·01	10·49	——	10·03	3·46	15 09	13·80	——	——	——	——	=98 88
17. Wetterau	42·24	13·92	——	14·59	0·83	13·74	12·24	——	——	——	——	=97·06
18. Kaltajuva	45·18	11·34	——	16·16	——	17·55	9·87	——	——	——	——	=100·1
19. Slätmyran	47·62	7·38	——	15·78	0·32	14·81	12·69	——	——	——	——	=98·60
20. Carinthia	46·03	8·37	——	17·44	——	18·48	10·23	——	——	——	——	=100·5
21. Bilin, Bohem.	40·08	17·59	——	12·32	——	13·50	11 01	0·89	0·18	0 18	1·04	=98·57
22. Härtlingen	42·52	11·00	——	16·59	——	13·45	12·25	1·71	1·92	——	——,	$\ddot{\text{Ti}}$ 1· 100 45 Ra
23. Etna	39·75	15·29	——	14·40	1·06	13·01	12·99	——	——	1·02	——	=97·52
24. "	40·91	18·68	——	17·49	*tr.*	13·19	13·44	——	——	0·85	——	=99·56
25. Servanco	47·40	7·15	——	15·40	——	15·27	10·83	2·95		1·00	——	=100 D
26. Birmingham, Pa.	47·77	7·69	——	15·41	0·26	15·28	13·16	——	——	——	——	=99·57
27. La Preso (Bormio)	45 31	11·88	——	15·93	——	14·28	10·49	——	——	——	——,	$\ddot{\text{Ti}}$ 0· 98·55 Kudernat
28. Nordmark, Werm.	48·83	7·48	——	18·75	1·15	13·61	10·16	——	——	0·50	0 41	=100 8

	S̈i	A̶l	F̶e	Ḟe	Ṁn	Ṁg	Ċa	Ṅa	K̇	Ḣ	F
29. Vesuvius	39·92	14·10	6·00	11·03	0·30	10·72	12·62	0·55	3·37	0·37	—=98·78 R.
30. Härtlingen	42·52	11·00	8·30	9·12	——	13·45	12·25	1·71	1·92	——	—, T̈i 1·01=101·28 Ramm.
31. Cernosin	40·65	14·31	5·81	7·18	——	14·06	12·55	1·64	1·54	0·26	—, T̈i 0·80=99·10 Ramm.
32. Honnef	41·01	13·04	5·38	10·75	——	13·48	9·31	1·26	1·79	0·79	—, T̈i 1·53=98·34 Ramm.
33. Steuzelberg	39·62	14·92	10·28	7·67	0·24	11·32	12·65	1·12	2·18	0·48	—, T̈i 0·19=99·67 Ramm.
34. Bosgolovsk	44·24	8·85	5·13	11·80	——	13·46	10·82	2·08	0·24	0·39	0·25=98·27 R.
35. Pargas	41·26	11·92	4·83	9·92	*tr.*	13·49	11·95	1·44	2·70	0·52	1·70=99·73 R.

c. Containing over 20 p. c. of oxyds of iron and manganese united.

	S̈i	A̶l	F̶e	Ḟe	Ṁn	Ṁg	Ċa	Ṅa	K̇	Ḣ	F
36. Faymont	41·99	11·66	——	22·22	——	12·59	9·55	1·02		1·47	—=100 D.
37. Arendal	43·18	10·01	6·97	14·48	0·29	9·48	11·20	2·16	1·30	0·37	—=94·44 R.
38. Philipstadt	37·84	12·05	4·37	12·38	0·68	12·16	14·01	0·75	2·63	0·80	—=97·67 R.
39. Fredericksvärn	40·00	8·00	10·10	11·04	1·03	11·51	10·26	2·72	2·53	0·60	—, T̈i 0·80=98·59 R.
40. "	40·00	7·37	10·45	13·38	1·85	7·51	11·28	5·25		0·54	—, T̈i 1·07=98·70 Ramm.
41. Norway	37·34	12·66	10·24	9·02	0·75	10·35	11·43	4·18	2·11	1·85	—=99·93 P.
42. Kimito, Finl.	43·23	11·73	——	26·81	1·61	7·04	9·72	—	—	—	—=100·14 M.
43. Etna, V. di Bove	43·84	9·27	——	21·79	——	11·70	12·05	—	—	0·84	—=99·49 W.
44. Garpenberg	53·50	4·40	——	22·52	0·35	11·35	4·65	—	—	0·60	—=97·10 H.
45. Teneriffe	46·23	9·25	——	29·34	——	5·06	9·37	—	—	—	—=99·25 D.

3. Noralite; *Aluminous Iron-Lime Amphibole.*

	S̈i	A̶l	F̶e	Ḟe	Ṁn	Ṁg	Ċa	Ṅa	K̇	Ḣ	F
46. Nora, Westm'nl'd	42·00	12·00	——	30·00	0·25	2·25	11·00	—	*tr.*	0·75	—=98·25 K.
47. Fulda, Hesse	47·00	26·00	——	15·00	——	2·00	8·00	—	—	0·5	—=98·00 K.
48. Brevig	42·27	6·31	6·62	21·72	1·13	3·62	9·68	3·14	2·65	0·48	—, T̈i 1·01=98·63 Ramm.
49. Huttenthal	46·13	14·96	2·95	21·37	——	1·79	10·04	0·87	0·18	1·12	—=99·41 S.

4. Gamsigradite; *Aluminous Iron-Manganese Amphibole.*

	S̈i	A̶l	F̶e	Ḟe	Ṁn	Ṁg	Ċa	Ṅa	K̇	Ḣ	F
50. Gamsigrad	46·58	13·63	——	12·29	6·00	8·44	8·83	3·17	1·00	—	—=99·94 M.

5. Smaragdite.

	S̈i	A̶l	F̶e	Ḟe	Ṁn	Ṁg	Ċa	Ṅa	K̇	Ḣ	F
51. Alps, *pale gn.*	54·30	4·54	——	3·87	——	19·01	13·72	2·80	—	0·30	—, Ṅi *tr.*, C̈r 0·61=99·15 Hunt.
52. Corsica	40·80	12·60	——	3·20	1·40	11·20	23·00	—	—	5·2	—, C̈r 2·00=99·40 Boulanger.

In anal. 1, G.=3·059; anal. 3, G.=3·104; anal. 6, G.=3·123; anal. 7, G.=3·102, $I \wedge I$=124° 8'–124° 12'; anal. 8, called grammatite; anal. 9, G.=3·054, High Falls of the Madawaska, Can.; anal. 14, G.=3·059; 15, from near Kongsberg; anal. 16, G.=3·136; anal. 21, in basalt; 22, in trachyte; anal. 26, G.=3·114, in syenite; anal. 29, G.=3·282, in a block from Somma; anal. 30, G.=3·270, in basaltic tufa; anal. 31, G.=3·225, in basaltic wacke; anal. 32, G.=3·277; anal. 33, G.=3·266, in trachyte; anal. 34, G.=3·214; anal. 35, G.=3·215; 36, in diorite; anal. 37, G.=3·276; anal. 38, G.=3·378; anal. 39, 40, G.=3·287, $I \wedge I$=124° 7', in zircon-syenite; anal. 41, G.=3·28, in zircon-syenite; anal. 48, G.=3·428, often called Ægirine; anal. 49, G.=3·25, with magnetite; anal. 51, from euphotide of Alps; anal. 52, from euphotide of Finmalto, Corsica, G.=3·10.

In the Vesuvius amphibole (*syntagmatite* Breith.) Mitscherlich found F̶e 9·96 and Ḟe 19·30; in the Härtlingen, respectively, 6·63 and 6·45; in the Wolsberg 13·25 and 2·59; in the Arendal, 5·69 and 14·65.

The *smaragdite* of Corsica afforded Vauquelin, in an imperfect analysis (Beud. Min., ii. 134), S̈i 50·0, A̶l 21·0, Ṁg 6·0, Ċa 13·0, oxyd of iron 5·5, C̈r 7·5, Ċu 1·5=104·5

An *actinolite rock* from St. Francis, Canada, afforded T. S. Hunt (Rep. G. Can., 1863, 466
52·30, $\bar{\mathrm{A}}\mathrm{l}$ 1·30, $\dot{\mathrm{M}}\mathrm{g}$ 21·50, $\dot{\mathrm{C}}\mathrm{a}$ 15·00, $\dot{\mathrm{F}}\mathrm{e}$ 6·75, $\dot{\mathrm{N}}\mathrm{i}$ *tr.*, ign. 3·10=99·95.

The *Byssolite* of Saussure, Dauphiny, as analyzed by Vauquelin and Macquart (J. Soc. Phil
No. 54), afforded $\ddot{\mathrm{S}}\mathrm{i}$ 47, $\dot{\mathrm{F}}\mathrm{e}$ 20, $\dot{\mathrm{M}}\mathrm{n}$ 10·0, $\dot{\mathrm{M}}\mathrm{g}$ 9·3, $\dot{\mathrm{C}}\mathrm{a}$ 11·3=95·6. Occurs with a black oxyd
manganese.

The analysis by Thomson (Ann. Lyc. N. H. N. York, iii. 50), referred by Shepard to *boltonit*
shown by B. Silliman, Jr. (Am. J. Sci., II. viii. 391), to pertain probably to an actinolite f
Bolton.

The fluorine in many hornblendes is supposed to exist as fluorid of calcium, and this ingredi
according to Bonsdorff, may constitute 1 part in 5 of the mineral.

Pyr., etc.—The observations under pyroxene apply also to this species, it being impossibl
distinguish the varieties by blowpipe characters alone.

Isomorphous and Dimorphous relations to Pyroxene.—The analogy in composition between
oxene and hornblende has been abundantly illustrated. They have the same general form
and under this formula there is but one difference of any importance, viz., that lime is a promi
ingredient in *all* the varieties of pyroxene, while it is wanting, or nearly so, in some of those
hornblende.

The analogy between the two species in crystallization, or their essential isomorphism,
pointed out by G. Rose in 1831, who showed that the forms of both were referrible to one
the same fundamental form. The prism *I* of hornblende corresp
in angle to *i*-2 of pyroxene; that is, if the horizontal axes of
latter species be *b*: *c*, those of the former will be *b*: 2*c*. Calcula
from the angle *I* ∧ *I* in pyroxene, 87° 5′, the angle of *i*-2 is preci
124° 30′, or the angle *I* ∧ *I* in hornblende. The annexed table
hibits the symbols of the planes in hornblende as they would be
the augite type.

O				
−1-*i*		−1-2		−1-*i*
			−$\frac{3}{2}$-$\frac{3}{2}$	
i-*i*	*i*-6	*i*-2	*i*-$\frac{3}{2}$	*i*-*i*
2-*i*		2-2		
1-*i*		1-2		1-*i*

But while thus isomorphous in axial relations or form, they
also *dimorphous*. For (1) the cleavage in pyroxene is parallel to
prism of 87° 5′, and in hornblende to that of 124½°. (2) The oc
ring secondary planes of the latter are in general diverse from t
of the former, so that the crystals differ strikingly in habit or sys
of modifications. Moreover, in pyroxene columnar and fine fib
forms are uncommon; in hornblende, exceedingly common. (3)
several chemical compounds under pyroxene have *one-tenth* hi
specific gravity than the corresponding ones under hornblende;
is, a compound (as, for example, $(\frac{1}{2}\,\dot{\mathrm{C}}\mathrm{a}+\frac{1}{2}\,\mathrm{Mg})^3\,\ddot{\mathrm{S}}\mathrm{i}^2$) having G.=
under the former, has approximately, G.=2·95 under the latter.

Again, twins occur composed part of amphibole and part of
oxene, a fact bearing on the isomorphism and dimorphism of
species.

Obs.—Amphibole occurs in many crystalline limestones, and metamorphic granitic and sc
tose rocks, and sparingly in serpentine, and volcanic or igneous rocks. Tremolite, the magne
lime variety, is especially common in limestones, particularly magnesian or dolomitic; actino
the magnesia-lime-iron variety, in steatitic rocks; and brown, dark-green, and black hornble
in chlorite schist, mica schist, gneiss, and in various other rocks of which it forms a constit
part. Asbestus is often found in connection with serpentine.

Hornblende-rock, or *amphibolyte*, consists of massive hornblende of a dark greenish-black or b
color, and has a granular texture. Occasionally the *green* hornblende, or actinolite, occur
rock-masses, as at St. Francis, in Canada.

Hornblende-schist has the same composition as amphibolyte, but is schistose or slaty in st
ture. It often contains a little feldspar. In some varieties of it the hornblende is in par
minute needles.

Diabase is a fine-grained, compact hornblende-rock, tough and heavy.

Aphanyte (or *corneine*) is like diabase, but is without distinct grains (whence the name, f
ἀφανής, *unmanifest*), and breaks with a smooth flint-like fracture.

Syenite is a granite-like rock, containing hornblende along with quartz and orthoclase felds
Dioryte is a similar rock, grayish-white to nearly black in color, consisting of hornblende
albite. *Hornblendic* or *syenitic gneiss* has the same constitution as syenite, but differs in havi
gneissoid or semischistose structure.

Hornblendic granite contains hornblende in addition to the ordinary constituents of gran
quartz, feldspar, and mica. *Gneiss* and *mica schist* are often *hornblendic* in the same way.
hornblende in mica schist is usually in prisms, either stout or acicular, which sometimes
aggregated in sheaf-like tufts. The *fasciculite* of Hitchcock is merely this tufted hornblende.

The dark-green antique porphyry contains hornblende in its compact, diabase-like mass, an
therefore called *diabase-porphyry*. G.=2·9–3·0.

Hornblende is often disseminated in black prismatic crystals through trachyte, and also through other igneous rocks, especially the feldspathic kinds.

Euphotide consists of a whitish or greenish compact base of varying constitution, with imbedded *smaragdite*. The euphotide of Corsica has been called *corsilyte* (p. 235). The *saussurite*, as shown by Hunt (Am. J. Sci., xxviii. 386), is either compact *lime-epidote*, as that of the Alps. compact *meionite*, as that of Mt. Genèvre, or compact *feldspar*; these different kinds being distinguishable by their specific gravity.

The compact tremolite called *nephrite* is found in talcose rock or schist, and granular limestone

Aussig and Teplitz in Bohemia, Tunaberg in Sweden, and Pargas in Finland, afford fine specimens of the dark-colored hornblendes. *Actinolite* occurs at Saltzburg and Greiner in the Zillerthal; *tremolite* at St. Gothard, in granular limestone or dolomite, the Tyrol, the Bannat, Gulsjö in Sweden, etc. *Calamite* occurs at Normarken in Sweden, in prisms in serpentine. *Asbestus* is found in Savoy, Saltzburg, the Tyrol; also in the island of Corsica, where it is so abundant that Dolomieu employed it in packing his minerals. *Rock cork* is obtained in Saxony, Portsoy, and Leadhills, where also mountain leather occurs. Oisans, in France, affords a variety of amianthus, composed of fibres having some degree of elasticity; it is the *amianthoide* of Haüy.

In the United States, in *Maine*, black crystals occur at Thomaston, at Moultenboro in syenite; pargasite at Phipsburg and Parsonsfield; radiated or asbestiform actinolite at Unity; tremolite at Thomaston and Raymond. In *N. Hamp.*, black crystals at Franconia. In *Vermont*, glassy and radiated actinolite in the steatite quarries of Windham, Readsboro', and New Fane. In *Mass.*, white crystals at Lee (1½ m. S.W. of the meeting-house), and at Newberg; glassy and radiated actinolite at Middlefield and Blanford; radiated actinolite at Carlisle, Pelham, Windsor, Lee, and Great Barrington; black crystals at Chester; asbestus at Brighton, Sheffield, Pelham, Newbury, Dedham; cummingtonite at Cummington and Plainfield. In *Conn.*, in large flattened white crystals and in bladed and fibrous forms (tremolite) in dolomite, Canaan, between the Falls and the post-office, and also at other places in Litchfield Co.; asbestus at West Farms, Winchester, and Wilton, and with mountain leather formerly at the Milford serpentine quarries. In *N. York*, in good black crystals at Willsboro', presenting interesting forms; also near the bridge at Potsdam, St. Lawrence Co.; near Greenwood Furnace, and in Warwick, Orange Co. (f. 229); dark green crystals near Two Ponds, and also 1 m. N., 2½ m. N., and 1 m. S., of Edenville, together with gray or hair-brown crystals and tremolite, sphene, and chondrodite, in granular limestone; of various forms and colors, and often in large and perfect crystals, near Amity; in dark green crystals, with ilmenite, at the Stirling mines, Orange Co.; in short green crystals at Gouverneur, sometimes 2 or 3 in. in diameter, along with apatite; in Rossie, 2 m. N. of Oxbow, the variety pargasite in neat bright green crystals; glassy and radiated actinolite near a hamlet called Pecksville, in Fishkill; radiated at Brown's serpentine quarry, 3 m. N.W. of Carmel, Putnam Co.; in large white crystals at Diana, Lewis Co.; radiated and bladed tremolite at Dover, Kingsbridge, the Eastchester quarries, Hastings, and near Yonkers, in Westchester Co.: at Knapp's quarry, Patterson, in Putnam Co., and on the banks of Yellow lake and elsewhere in St. Lawrence Co.: asbestus, near Greenwood Furnace; Rogers's farm in Patterson; Colton rock and Hustis's farm in Phillipstown, Putnam Co.; near the Quarantine in Richmond Co., where the fibres are two to three feet long. In *N. Jersey*, tremolite or gray amphibole in good crystals at Bryam, and other varieties of the species at Franklin and Newton; radiated actinolite at Franklin; tremolite at Franklin; asbestus and mountain leather at Brunswick. In *Penn.*, actinolite in Providence, at Mineral Hill, in Delaware Co.; at Unionville; at Kennott, Chester Co., often in fine crystals; tremolite with asbestus at Chestnut Hill near the Wissahiccon, near Philadelphia, at London Grove, Chester Co.; nephrite at Easton. In *Maryland*, actinolite and asbestus at the Bare Hills in serpentine; asbestus at Cooptown. In *Virginia*, actinolite at Willis's Mt., in Buckingham Co.; asbestus at Barnet's Mills, Fauquier Co.

Alt.—The alterations of amphibole are similar to those of pyroxene (see page 220). The fibrous and diallage-like varieties are especially liable to take up water, owing to the finely or thinly divided state of the mineral. Talc, steatite, serpentine, chlorite, biotite, pinite, chabasite, limonite, magnetite, iron ochre, are among the reported results of alteration.

At Ilmenau, a magnesia-mica, a chlorite, and also (as an after product from the chlorite) iron-ochre, occur as pseudomorphs after hornblende (v. Fritsch, ZS. Geol. Ges., xii. 104). *Groppite*, and perhaps *rosite*, as suggested to the author by L. Sæmann (4th edit., p. 287), may be altered pargasite. Genth describes the asbestiform or fibrous serpentine of Texas and Providence, Pa., and the *baltimorite* as altered asbestus, and a chrysolite of Delaware Co., Pa., as altered actinolite Am. J. Sci., II. xxxiii. 203).

The following are analyses of altered amphiboles: 1, Smith & Brush (Am. J. Sci. II. xvi. 49); , Thomson (Min., i. 209); 3, C. A. Joy (Ann. Lyc. N. H. N. Y., viii. 123); 4, 5, Beck (Min. N. Y., 07); 6, Suckow (Die Verwitt. Min., 143); 7, Delesse (Ann. d. M., IV. x. 317); 8, Wichage Ramm. Min. Ch., 499); 9, Madrell (Pogg., lxii. 142); 10, Schultz (Ramm. Min. Ch., 499); 11, T Hunt (Phil. Mag., IV., ii. 65, and Rep. G. Can. 1863, 491):

	S⃛i	A̶⃛l	Ḟe	Ṁn	Ṁg	Ċa	Ṅa	Ḣ
1. *Hyd. anthophyllite*, N.Y.	§ 58·33	*tr.*	8·76	—	29·34	—	0·88	2·26, K̇ *tr.*=99·57 S
2. " "	54·98	1·56	F̶e 9·83	1·20	13·88	—	—	11·45, K̇ 6·80=99·2
3. " "	46·43	—	9·38	1·38	28·80	5·06	—	8·58=99·63 Joy.
4. Warwick	35·00	32·33	—	—	20·70	10 80	—	—=98·83 Beck.
5. "	34·66	25·33	—	—	25·22	5·09	—	9·09=99·39 Beck.
6. Fillefjeld, Nor.	40·32	17·49	F̶e 18·26	2·14	9·23	5·37	—	8·00=100·81 Suck
7. Vosges	43·64	12·50	5·19	0·93	17·74	9·10	—	10·90=100 Delesse
8. Siebengebirge	34·87	10·73	F̶e 20·48	—	4·90	4·78	3·63	20·24=100 Wiehag
9. Wolfsberg	44·03	14·31	F̶e 25·55	—	2·33	10·08	—	3·44=99·74 Madre
10. Catançaro	46·08	11·81	14·10	—	10·72	8 74	0·93	3·03, F̶e 1·77=98·8
11. *Loganite*	33·28	13·30	F̶e 1·92	—	35·50	—	—	16·00=100 T. S. H

Anal. 4, 5, crystals having the angles of hornblende, steatitic in feel and hardness; 6, clay-li 7, from a micaceous porphyry at Traits-de-Roche, small prisms: 8. from trachyte at Margaret kreuz; 9, large crystals, G.=2·94, from Wolfsberg, near Cernosin in Bohemia; 10, soft green brown crystals; 11, associated with pale-green serpentine, phlogopite, and apatite, in Lauren crystalline limestone, and having the form and cleavage of hornblende, though edges rounded; about 124°.

The *hydrous anthophyllite* of New York Island occurs in place near the corner of 59th street 10th avenue, and also in many places in boulders. The variations in the analyses, as well a the aspect of the material, show that it is a result of the alteration of an asbestiform tremolite

247A. **Waldheimite.** (Amphibol ähnliches Min. von Waldheim *A. Knop*, Ann. Ch. Pha cx. 363, 1859; Waldheimit *Ramm.*, Min. Ch., 780, 1860.) An amphibole-like mineral, w contains much *soda*, and is peculiar also in its excess of silica, both suggesting that it may amphibole altered by the alkaline process. It occurs in veins an inch thick, and resembles ac olite. H.=5; G.=2·957; color leek-green; translucent. Composition, according to Knop Hoffmann, the silica in each being a mean of two determinations (Ann. Ch. Pharm., cx. 363):

S⃛i	A̶⃛l	Ḟe	Ṁn	Ṁg	Ċa	Ṅa
58·71	1·52	5·65	0·25	10·01	11·53	12·38=100·05 Knop.
58·45	1·92	5·53	0·51	11·12	10·28	12·61=100·42 Hoffmann.
58·45	1·74	5·79	0·32	10·83	10·76	12·93=101·12 Hoffmann.

It lost 0·5 p. c. by ignition. The oxygen ratio for Ṙ, R̶⃛, S⃛i is 11·84 : 0·80 : 31·24.

From serpentine at Waldheim in Saxony. The large amount of soda present suggests a tion to arfvedsonite. It is to be observed that the *excess of silica* occurs along with an unu proportion of *alkali.*

247B. **Kokscharoffite.** (Kokscharowit *N. Nordenskiöld*, Bull. Soc. Nat. Moscow, xxx. 1857.) Like tremolite in appearance. *I* ∧ *I*=124°—124° 5′, Kokscharof. In aggregations prisms, with acute edges replaced. Cleavage: *I*, two, equal, very distinct. H.=5—5·5. 2·97. Lustre subadamantine to vitreous. Colorless, dirty-white; brown to dark-brown impurity. Subtranslucent. Fracture splintery.

An analysis by Hermann (J. pr. Ch., lxxxviii. 197) afforded:

S⃛i	A̶⃛l	Ḟe	Ṁg	Ċa	Ṅa	K̇	ign.
45·99	18·20	2·40	16·45	12·78	1·53	1·06	0·60=99·01

Giving the O. ratio for Ṙ, R̶⃛, S⃛i 11·19 : 8·50 : 24·52; or, for Ṙ+R̶⃛, S⃛i 19·69 : 24·52=1 : 1·25; Ṙ : R̶⃛+S⃛i 11·19 : 33·02. It appears to be, like edenite, a magnesia-lime amphibole, but wit very large proportion of alumina; and, moreover, part of the alumina must be basic if it co under the usual amphibole formula.

In a closed tube only traces of water. B.B. in the forceps fuses easily to a white translu pearl, coloring the flame yellow; with borax a clear colorless glass.

Occurs associated with lapis-lazuli near L. Baikal, in Siberia. Named after the Russian mi alogist, Kokscharof.

247C. **Schefferite** *Breith.* (B. H. Ztg., xxiv. 429). Breithaupt has referred to schefferite Michaelson a mineral of the same locality—Longban, with rhodonite—which differs fron widely in composition, if the analyses may be trusted. Moreover, it occurs in crystals, w the true schefferite is known only massive. The following are its characters:

Monoclinic; *I* ∧ *I*=120° 45′; basal plane (*x*) on *i-i*=147° 30′, or 32½° to the axis. The cry has the planes *I*, *i-i*, *i-i*, the basal plane referred to, and a hemidome on the acute angle in fr Cleavage: rather distinct in one direction, perhaps also parallel to *x*. Mostly massive, fine gr lar. H.=5—5·5. G.=3·433—3·436. Lustre vitreous. Color chestnut to clove and redd brown. Streak pale yellowish-gray. Subtranslucent to opaque.

Composition according to Dr. Winkler (l. c.):

$\ddot{\mathrm{S}}\mathrm{i}$	$\bar{\mathrm{A}}\mathrm{l}$	$\bar{\mathrm{F}}\mathrm{e}$	$\dot{\mathrm{M}}\mathrm{n}$	$\dot{\mathrm{N}}\mathrm{i}$	$\dot{\mathrm{M}}\mathrm{g}$	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\mathrm{K}}$
49·50	1·42	25·43	6·78	0·20	4·27	7·75	0·19

The iron was ascertained to be all sesquioxyd. The analysis afforded also 3·08 $\dot{\mathrm{C}}\mathrm{a}\,\ddot{\mathrm{C}}$, and 0·03 $\dot{\mathrm{M}}\mathrm{n}\,\ddot{\mathrm{C}}$. It requires further study.

248. ARFVEDSONITE. *Brooke*, Ann. Phil., v. 381, 1823. Arfwedsonit. Soda-hornblende.

Probably monoclinic. $I \wedge I = 123°\ 55'$, Brooke; 123° 50′, v. Kobell; 123° 30′, Breithaupt; about 124° 40′, Brevig mineral, Descloizeaux. Cleavage: perfect parallel to I; imperfect to $i\text{-}\grave{\imath}$. Also cleavable massive.

H.=6. G.=3·44, Brooke; 3·329—3·340, Breithaupt; 3·589, Rammelsberg. Lustre vitreous. Color pure black; in thin scales, deep green, Greenland, or brown, Brevig. Streak grayish-green. Opaque except in very thin splinters. Fracture imperfectly conchoidal.

Comp.—$2\,\dot{\mathrm{R}}^3\ddot{\mathrm{S}}\mathrm{i}^2 + 3\,\bar{\mathrm{F}}\mathrm{e}\,\ddot{\mathrm{S}}\mathrm{i}^3$, Ramm., $=(\frac{2}{5}\,\dot{\mathrm{R}}^3 + \frac{3}{5}\,\bar{\mathrm{F}}\mathrm{e})\,\ddot{\mathrm{S}}\mathrm{i}^3$, which, making $\dot{\mathrm{R}} = \frac{1}{2}\,\dot{\mathrm{F}}\mathrm{e} + \frac{1}{2}\,\dot{\mathrm{N}}\mathrm{a}$, =Silica 50·5, sesquioxyd of iron 26·9, protoxyd of iron 12·1, soda 10·5=100. $3\,\dot{\mathrm{R}}^3\ddot{\mathrm{S}}\mathrm{i}^2 + 2\,\bar{\mathrm{F}}\mathrm{e}\,\ddot{\mathrm{S}}\mathrm{i}^3$, v. Kobell, $=(\frac{3}{5}\,\dot{\mathrm{R}}^3 + \frac{2}{5}\,\bar{\mathrm{R}})\,\ddot{\mathrm{S}}\mathrm{i}^3$. Analyses: 1, Thomson (Min., i. 483); 2, v. Kobell (J. pr. Ch., xiii. 3, and xci. 449); 3, Rammelsberg (Pogg., ciii. 292, 306); 4, Plantamour (J. pr. Ch., xxiv. 300):

	$\ddot{\mathrm{S}}\mathrm{i}$	$\bar{\mathrm{A}}\mathrm{l}$	$\bar{\mathrm{F}}\mathrm{e}$	$\dot{\mathrm{F}}\mathrm{e}$	$\dot{\mathrm{M}}\mathrm{n}$	$\dot{\mathrm{M}}\mathrm{g}$	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\mathrm{N}}\mathrm{a}$	$\dot{\mathrm{K}}$	Cl	ign.
1. Greenland	50·51	2·49	35·14	——	7·46	——	1·56	——	——	——	0·96=98·12 T.
2. "	49·27	2·00	14·58	23·00	0·62	0·42	1·50	8·00	*tr.*	0·24	——=98·17 K.
3. "	51·22	*tr.*	23·75	7·80	1·12	0·90	2·08	10·58	0·68	——	0·16=98·29 R.
4. Brevig	46·57	3·41	——	24·38	2·07	5·88	5·91	7·79	2·96, $\ddot{\mathrm{T}}\mathrm{i}$ 2·02=100·99 Pl.		

In the above analyses the degree of oxydation of the iron was determined only in those by Rammelsberg and v. Kobell. A. Mitscherlich has obtained (J. pr. Ch., lxxxvi. 11) for the Greenland A., $\bar{\mathrm{F}}\mathrm{e}$ 25·37, $\dot{\mathrm{F}}\mathrm{e}$ 5·93.

Pyr., etc.—B.B. fuses at 2 with intumescence to a black magnetic globule; colors the flame yellow (soda); with the fluxes gives reactions for iron and manganese. Not acted upon by acids.

Obs.—Occurs in black hornblende-like crystals at Kangerdluarsuk in Greenland, with sodalite, eudialyte, and feldspar; also in zircon-syenite in Norway, at Brevig, and in beds of magnetite at Arendal. Reported also from Horberigberg, near Oberbergen, with ittnerite and ilmenite. The Brevig mineral, analyzed by Plantamour, has been referred to *ægirine*. The angle given determines its relation to the amphibole sub-group.

249. CROCIDOLITE. Blau-Eisenstein (fr. S. Africa) *Klapr.*, Mag. Berl. Ges. N. Fr., v. 72, 1811, Beitr., vi. 237, 1815. Krokydolith *Hausm.*, Gel. Anz. Gött., 1585, 1831. Blue Asbestus.

Fibrous, asbestus-like; fibres long but delicate, and easily separable. Also massive or earthy.

H.=4. G.=3·2—3·265. Lustre silky. Color and streak lavender-blue or leek-green. Opaque. Fibres somewhat elastic.

Comp.—The analyses by Stromeyer afford nearly $\dot{\mathrm{R}}^6\ddot{\mathrm{S}}\mathrm{i}^5 + 2\,\dot{\mathrm{H}}$; but the degree of oxydation of the iron is undetermined. Analyses: 1, 2, Stromeyer (Pogg., xxiii. 153); 3, Delesse (Ann. d. M., III. x. 317):

	$\ddot{\mathrm{S}}\mathrm{i}$	$\dot{\mathrm{F}}\mathrm{e}$	$\bar{\mathrm{M}}\mathrm{n}$	$\dot{\mathrm{M}}\mathrm{g}$	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\mathrm{N}}\mathrm{a}$	$\dot{\mathrm{H}}$
1. Africa, *fibrous*	50·81	33·88	0·17	2·32	0·02	7·03	5·58=98·81 Stromeyer.
2. " *earthy*	51·64	34·38	0·02	2·64	0·05	7·11	4·01=99·85 Stromeyer.
3. Vosges	53·02	25·62	$\dot{\mathrm{M}}\mathrm{n}$ 0·50	10·14	1·10	5·69	2·52, $\dot{\mathrm{K}}$ 0·39, Cl 0·51, $\bar{\mathrm{P}}$ 0·17=99·66.

Pyr., etc.—In the closed tube yields a small amount of alkaline water. B.B. fuses easily with intumescence to a black magnetic glass, coloring the flame yellow (soda). With the fluxes gives reactions for iron. Unacted upon by acids.

Obs.—Occurs in South Africa, in the Grigna country, beyond the Great Orange river, 70 up from the Cape of Good Hope; in a micaceous porphyry at Wakembach in the Vosges (3); at Stavern, Norway, in zircon-syenite, along with arfvedsonite, to which it is closely rel and of which, as has been suggested, it may be a fibrous or asbestiform variety; at Gollin Salzburg, in gypsum with blue quartz; at Ruka, near Domaschow in Moravia, with a ferrugi dolomite; in Greenland, both fibrous and earthy. In the African, the fibres of the fibrous se or masses make an angle of about 106° with the opposite surfaces of the seam, according to H mann; and the same author states (Handb., 743, 1847) that a cylinder of it $\frac{1}{100}$ of an inch i ameter, supported 91 Hanoverian pounds before breaking, while one of asbestus, $\frac{7}{100}$ of an in diameter, broke with a weight of 6 ounces.

The Stavern mineral, referred here by Hausmann, is the Faseriger Siderit *Leonh.*, Gehl. J 101, and Fasriges Eisenblau *Hausm.*, Handb., 1076, 1813.

Named from κροκις (or κροκύς), *woof*, in allusion to its fibrous structure.

250. WICHTISITE. Wichtyne *Laurent*, Ann. Ch. Phys., lix. 107, 1835. Wichtisit *Hausm*

Massive; cleavage parallel to the sides of a rhombic prism, nearly r angular, according to Laurent.

Scratches glass. G.=3·03. Color black. Lustre dull. Fracture an lar, or flat conchoidal.

Comp.—$(\frac{1}{2}\dot{\mathrm{R}}^3+\frac{1}{2}\ddot{\bar{\mathrm{R}}})\ddot{\mathrm{Si}}^3$. Analyses: 1, Laurent (l. c.); 2, Strömborg (Arppe Finska Min.,

$\ddot{\mathrm{Si}}$	$\ddot{\bar{\mathrm{A}}}\mathrm{l}$	$\ddot{\bar{\mathrm{F}}}\mathrm{e}$	$\dot{\mathrm{F}}\mathrm{e}$	$\dot{\mathrm{M}}\mathrm{g}$	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\mathrm{N}}\mathrm{a}$
56·3	13·3	4·0	13·0	8·0	6·0	3·5=99·1 Laurent.
54·24	14·27	—	15·62	3·86	5·65	3·88, $\dot{\mathrm{M}}\mathrm{n}$ 2·70=100·22 Strömborg.

B.B. fuses to a black enamel and becomes magnetic. Not attacked by acids.

From Wichtis in Finland. Dufrénoy observes that a specimen examined by him ha cleavage.

Gmelin has analyzed a mineral from a basaltic rock near Wetterau (Jahrb. Min., 1840, having G.=2·705, and not acted upon by acids, which has essentially the composition of w tisite, it affording $\ddot{\mathrm{Si}}$ 56·80, $\ddot{\bar{\mathrm{A}}}\mathrm{l}$ 15·32, $\dot{\mathrm{F}}\mathrm{e}$ 12·06, $\ddot{\bar{\mathrm{M}}}\mathrm{n}$ 3·72, $\dot{\mathrm{C}}\mathrm{a}$ 4·85, $\dot{\mathrm{M}}\mathrm{g}$ 5·05, $\dot{\mathrm{K}}$ 0·34, $\dot{\mathrm{N}}\mathrm{a}$ 3·14, responding closely to $(\frac{1}{2}\dot{\mathrm{R}}^3+\frac{1}{2}\ddot{\bar{\mathrm{A}}}\mathrm{l})\ddot{\mathrm{Si}}^3$. Rammelsberg includes the analysis among those of oxene, but speaks of the composition as anomalous; unlike the augites, the alumina does replace any of the silica.

251. GLAUCOPHANE *Hausmann*, Gel. Anz. Gött., 195, 1845. Orthorhombic or monoclinic. indistinct long thin six-sided prisms, made up of the planes *I* and *i*-ĭ, and longitudinally stri Also granular massive. H.=5·5. G.=3·103—3·113. Lustre vitreous to pearly. Color lavender-blue, bluish-black, grayish. Streak-powder grayish-blue. Translucent to opaque. tle. Powder slightly magnetic.

Comp.—$(\frac{3}{8}\dot{\mathrm{R}}^3+\frac{5}{8}\ddot{\bar{\mathrm{R}}})\ddot{\mathrm{Si}}^3$. Analysis by Schnedermann (J. pr. Ch., xxxiv. 238):

$\ddot{\mathrm{Si}}$ 56·49 $\ddot{\bar{\mathrm{A}}}\mathrm{l}$ 12·23 $\dot{\mathrm{F}}\mathrm{e}$ 10·91 $\dot{\mathrm{M}}\mathrm{n}$ 0·50 $\dot{\mathrm{M}}\mathrm{g}$ 7·97 $\dot{\mathrm{C}}\mathrm{a}$ 2·25 $\dot{\mathrm{N}}\mathrm{a}$ with *tr.* $\dot{\mathrm{K}}$ 9·28=9

B.B. becomes yellowish-brown, and melts easily and quietly to an olive-green glass. An reaction with the fluxes. In acids partly soluble.

Occurs at the island of Syra, one of the Cyclades, in mica slate, along with garnet, hornble and mica. The name is from γλαυκός, *bluish-green*, and φαίνω, *I appear.*

252. SORDAVALITE. Sordawalit *N. Nordenskiöld*, Finl. Min., 86, 1820.

Massive; no cleavage apparent.

H.=2·5. G.=2·53—2·58. Lustre vitreo-resinous, or like bitum Streak liver-brown. Color grayish or bluish-black. Opaque. Fract conchoidal. Brittle.

Comp.—Analyses: 1, Nordenskiöld (l. c.); 2, Wandesleben (N. Jahrb. Pharm., i. 32):

	$\ddot{\mathrm{Si}}$	$\ddot{\bar{\mathrm{A}}}\mathrm{l}$	$\dot{\mathrm{F}}\mathrm{e}$	$\dot{\mathrm{M}}\mathrm{g}$	$\dddot{\bar{\mathrm{P}}}$	$\dot{\bar{\mathrm{H}}}$
1.	49·40	13·80	18·17	10·67	2·68	4·38=99·10 Nordenskiöld.
2.	47·70	16·65	$\ddot{\bar{\mathrm{F}}}\mathrm{e}$ 21·32	10·21	2·26	——=98·14 Wandesleben.

Supposed by Berzelius to be a silicate mixed with some phosphate of magnesia, the silicate corresponding to $(\frac{1}{3}\,(\dot{\rm Mg},\ \dot{\rm Fe})^3+\frac{1}{3}\,\bar{\ddot{\rm Al}})\,\ddot{\rm Si}^3$, which is essentially the formula of wichtisite; but the second analysis makes the iron sesquioxyd.

B.B. alone, it is difficultly fusible to a blackish globule. With borax it forms a green glass. Partly soluble in muriatic acid. Becomes reddish on exposure to the atmosphere.

Forms thin layers on trap, near the town of Sordavala in Finland; at Bodenmais in Bavaria, it is associated with pyrrhotite. It resembles pit-coal in appearance.

253. TACHYLYTE.

Tachylyt (fr. Säsebühl) *Breith.*, Kastn. Arch. Nat., vii. 112, 1826.

Massive without cleavage, looking like obsidian or gadolinite.

H.=6·5. G.=2·565–2·593. Lustre between vitreous and resinous. Color pitch-black, velvet-black to grayish-black. Brittle. In powder attractable by the magnet.

Comp.—**Analysis**: Schnedermann (Studien d. G. B. B. Fr., v. 100):

$\ddot{\rm Si}$	$\bar{\ddot{\rm Al}}$	$\dot{\rm Fe}$	$\dot{\rm Mn}$	$\dot{\rm Mg}$	$\dot{\rm Ca}$	$\dot{\rm Na}$	$\dot{\rm K}$	$\dot{\bar{\rm H}}$
55·74	12·40	13·06	0·19	5·92	7·28	3·88	0·60	2·73

Pyr., etc.—B.B. fuses easily with intumescence to a brown slag or opaque glass.

Obs.—Found at Säsebühl, between Dransfeld and Göttingen, in basalt and wacke.

Named from ταχύς, *quick*, and λυτός, *dissolved*, in allusion to the fusibility.

253A. HYALOMELAN *Hausm.*, Handb., 545, 1847. Gmelin referred to tachylyte a mineral from a porous volcanic rock in the Vogelsgebirge, to which Hausmann has since applied the name *hyalomelan*. It is similar in aspect, structure, and hardness; G.=2·7144. Gmelin's analysis (Pogg., xlix. 234) afforded:

$\ddot{\rm Si}$	$\bar{\ddot{\rm Al}}$	$\dot{\rm Fe}$	$\dot{\rm Mn}$	$\dot{\rm Mg}$	$\dot{\rm Ca}$	$\dot{\rm Na}$	$\dot{\rm K}$	$\ddot{\rm Ti}$	$\dot{\bar{\rm H}}$ & Am
50·22	17·84	10·27	0·40	3·37	8·25	5·18	3·87	1·42	0·50=101·32

It affords approximately 3 $\dot{\rm R}$, $\bar{\ddot{\rm Al}}$, $4\frac{1}{2}$ $\ddot{\rm Si}$. But little reliance can be placed on results with such amorphous minerals. The species may be the same with tachylyte. Hausmann places near here the *slaggy augite* of Karsten, having G.=2·666, from a limestone bed near Guiliana, Sicily, from which Klaproth obtained (Beitr., iv. 190) $\ddot{\rm Si}$ 55·00, $\bar{\ddot{\rm Al}}$ 16·50, $\bar{\ddot{\rm Fe}}$ 13·75, $\bar{\ddot{\rm Mn}}$ *tr.*, $\dot{\rm Mg}$ 1·75, $\dot{\rm Ca}$ 10·00, $\dot{\bar{\rm H}}$ 1·50.

A similar mineral in appearance is found on the north shore of Lake Superior; and also in a trap dike at Johnsburg, Warren Co., N.Y.

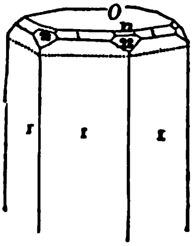
254. BERYL.

Σμάραγδος pt. [rest Chrysocolla, Malachite, etc., and other green stones] *Theophr.* Βήρυλλος *Gr.* Smaragdus pt. [rest as above] + Beryllus (Chrysoberyllus, Chrysoprasius incl.) *Plin.*, xxxvii. 16–20. Emerald; Beryl; Aquamarine. Smaragdus + Beryll *Wall.*, Min., 117, 122, 1747. Smaragdus + Bloagrön Topas (=Beryll, Aquamarin) *Cronst.*, Min., 44, 1758. Emeraude (incl. Emerald and Beryl or "Aigue-marine," and Chrysolite du Brésil) *de Lisle*, Crist., 135, 1772, ii. 245, 1783; *H.*, J. d. M., iv. 72, 1798, Tr., ii. 1801. Schmaragd + Beril *Wern.*, the two as distinct sp. until 1811. A silicate of alumina with lime *Achard*, Edelst., 47, 1779; *Bergm.*, Opusc., ii. 96, 1782; and others. A silicate of alumina and GLUCINA *Vauq.*, J. d. M., iv., 1798, vii. 97, 1800; *Klapr.*, Beitr., iii. 221, 1802. Davidsonite (fr. near Aberdeen) *Thomson*, Min., i. 247, 1836. Goshenite *Shep.*, Min., i. 143, 1844.

Hexagonal. $O \wedge 1=150°\ 3'$; $a=0·499$. Occurring planes: O; vertical, I, i-2, i-$\frac{3}{2}$; hexag. pyramids, 1, $\frac{3}{2}$, 2, $\frac{15}{2}$; 1-2, 2-2; dihexag. pyr., in zone, 1-2: I, 3-$\frac{3}{2}$, 4-$\frac{4}{3}$, 12-$\frac{12}{11}$; id. in other zones, 2-$\frac{3}{2}$, 2-$\frac{8}{7}$, 6-$\frac{6}{5}$, 14-$\frac{14}{13}$.

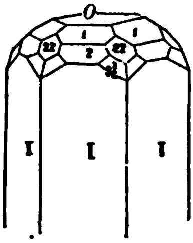
$O \wedge \frac{3}{2}=139° 10'$ $O \wedge 1\text{-}2=116° 37'$ $I \wedge 2\text{-}2=127° 43$
$O \wedge 2=130\ 58$ $O \wedge 2\text{-}2=135\ 4$ $I \wedge 3\text{-}\frac{3}{2}=142\ 11$
$O \wedge 2\text{-}\frac{8}{7}=130\ 58$ $O \wedge I=90$ $I \wedge 4\text{-}\frac{4}{3}=151$
$O \wedge 3\text{-}\frac{3}{2}=123\ 16$ $I \wedge I=120$ $I \wedge 8\text{-}\frac{8}{7}=165\ 30$

231



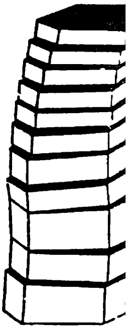
Haddam, Ct.

232



Siberia.

233



Monroe, Ct

Cleavage: basal imperfect; lateral indistinct. Occasionally coarse colum and large granular.

H.=7·5—8. G.=2·63—2·76. Lustre vitreous, sometimes resino Color emerald-green, pale green, passing into light-blue, yellow, and whi Streak white. Transparent—subtranslucent. Fracture conchoidal, even. Brittle. Double refraction feeble; axis negative.

Var.—This species is one of the few that occur only in crystals, and that have no essen variations in chemical composition. There are, however, two prominent groups dependent color, the color varying as chrome or iron is present; but only the merest trace of either ex in any case. The crystals are usually oblong prisms.

1. *Emerald.* Color bright emerald-green, owing to the presence of chromium. G.=2·67, Muso, Lewy; 2·63, fr. Pinzgau, Hofmeister; 2·710—2·759, fr. Ural, Kammerer. Hardness a li less than for beryl, according to the lapidaries.

2. *Beryl.* Colors those of the species, excepting emerald-green, and due mainly to iron. G 2·694—2·695, transparent, colorless, fr. Ural; 2·681—2·694, id., yellowish, id.; 2·702—2·710, green, id.; 2·725, id., rose-red, id.; all by Kokscharof. On cryst., see Kokscharof, Min. Rus i. 147, ii. 356, iii. 72, iv. 125; Hessenberg, Min. Not., v. 28. The varieties of beryl depending color are of importance in the arts, when the crystals are transparent enough to be of value gems. The principal kinds are: (*a*) colorless; (*b*) bluish-green, called *aquamarine*, a name s gested, though not used, by Pliny, where he says of it, "qui viriditatem puri maris imitantur;" apple-green; (*d*) greenish-yellow to iron-yellow and honey-yellow (apparently *chrysoberyllus* Pliny and ancient jewelry): (*e*) pale yellowish-green (probably the *chrysoprasius* Plin., and perh his *chrysolithus* in part, as also in more modern times); (*f*) clear sapphire-blue (*hyacinthozontes* Plin.); (*g*) pale sky-blue (*aeroïdes* Plin.); (*h*) the pale violet or reddish (*améthiste basaltine* S Min., 231); (*i*) the opaque brownish-yellow, of waxy or greasy lustre. The above names Pliny are mentioned in his account of beryl. The *oriental emerald* of jewelry is emerald-colo sapphire. *Davidsonite* is nothing but greenish-yellow beryl from near Aberdeen; and *goshenit* a colorless or white variety from Goshen, Mass. (anal. 16).

Comp.—$(\frac{1}{2}\dot{B}e^3+\frac{1}{2}\ddot{A}l)\ddot{S}i^2$=Silica 66·8, alumina 19·1, glucina 14·1=100. Analyses: 1, menil (Schw. J., xxxix. 487); 2, Berzelius (Schw. J., xvi. 265, 277); 3, 4, Moberg (Act. Soc. Fe ii. 81); 5, Scheerer (Pogg., xlix. 533); 6, Bornträger (Jahrb. Min., 1851, 185); 7, W. Mayer (674); 8, 9, Müller (J. pr. Ch., lviii. 180); 10, Hofmeister (ib., lxxxi. 1); 11, C. Gmelin (Pogg 180); 12, Mallet (Ramm. Min. Ch., 555, and 5th Suppl., 66); 13, Haughton (J. G. Soc., xviii. 4 14, Heddle (Phil. Mag., xii. 386); 15, Schneider (Ramm. Min. Ch., 555); 16, Mallet (Am J. S

II. xvii. 180); 17, Klaproth (Beitr., iii. 215); 18, Schlieper (Ramm. 2nd Suppl., 34); 19, Lewy Ann. Ch. Phys., III. liii. 5); 20, Hofmeister (l. c.):

		$\ddot{\text{Si}}$	$\dddot{\text{Al}}$	$\dddot{\text{Be}}$	$\dddot{\text{Fe}}$
1. Ural	*Beryl*	67 00	16·50	14·50	1·00, $\dot{\text{Ca}}$ 0·50=99·50 Dumenil.
2. Broddbo	"	68·35	17·60	13·13	0·72, $\ddot{\text{Ta}}$ 0·72=100·52 Berzelius.
3.*Tamela	"	66·61	16·51	12·75	3·03, $\ddot{\text{Ta}}$ 0·10=99·00 Moberg.
4. Somero	"	67·36	16·46	12·75	1·50=98·35 Moberg.
5. Fossum	"	67·00	19·64	12·56	0·53, $\dot{\text{Ca}}$ 0·18=99·91 Scheerer.
6. Heidelberg	"	66·90	18·15	12·20	2·95=100·20 Bornträger.
7. Zwiesel	"	66·56	17·82	12·66	2·48, $\dot{\text{Mn}}$ 0·11=99·58 Mayer.
8. Tirschenrath	"	66·8	19·9	13·1	0·9 =100·7 Müller.
9. Schwarzenbach	"	67·4	20·0	12·0	0·3 =99·7 Müller.
10. Rosenbach	"	65·51	20·71	11·46	1·33, $\dot{\text{Ca}}$ 0·23, $\dot{\text{Mg}}$ 0·12=99·36 Hofmeister.
11. Limoges	"	67·54	17·63	13·51	——=98·68 Gmelin.
12. Killiney	"	66·13	17·87	13·09	1·62=99·51 Mallet.
13. Donegal, I.	"	65·52	17·22	13·74	1·53, $\dot{\text{Ca}}$ 0·43, $\dot{\text{Mg}}$ 0·13, $\dot{\text{H}}$ 0·90=99·47 Hn.
14. *Davidsonite*	"	67·70	15·64	12·52	$\dot{\text{Fe}}$ 0·25, $\dot{\text{Mg}}$ 3·10, $\dot{\text{H}}$ 0·16=99·27 Heddle.
15. Australia	"	67·6	18·8	12·3	0·9 =99·6 Schneider.
16. Goshen, Mass.	"	66·97	17·22	12·92	2·03, $\dddot{\text{Mn}}$ *tr.*=99·13 Mallet.
17. Muso,	*Emerald*	68·50	15·75	12·50	1·00, $\dddot{\text{Cr}}$ 0·30, $\dot{\text{Ca}}$ 0·25=98·30 Klaproth.
18. "	"	69·51	14·49	15·41	——, $\dot{\text{Mg}}$, $\dot{\text{Ca}}$ 1 64=101·05 Schlieper.
19. "	" (?)	67·85	17·95	12·40	——, $\dddot{\text{Cr}}$ *tr.*, $\dot{\text{Mg}}$ 0·90, $\dot{\text{Na}}$ 0·70=99·80 Lewy.
20. Heubachth.	"	66·22	16·36	12·79	1·63, $\dot{\text{Ca}}$ 0·78, $\dot{\text{Mg}}$ 0·83=98·61 Hofmeister.

In anal. 10, G.=2·65; anal. 13, G.=2·686, from Sheskina-roan in Donegal Co.

The union of emerald and beryl in one species, which Pliny says was suggested in his time, was first recognized on crystallographic grounds by De Lisle, and more satisfactorily through measurements of angles by Haüy; and chemically by Vauquelin.

Pyr., etc.—B.B. alone unchanged or becomes clouded; at a high temperature the edges are rounded, and ultimately a vesicular scoria is formed. Fusibility=5·5 (Kobell). Glass with borax, clear and colorless for beryl, a fine green for emerald. Slowly soluble with salt of phosphorus without leaving a siliceous skeleton. A yellowish variety from Broddbo and Finbo yields with soda traces of tin. Unacted upon by acids.

According to Lewy, the emerald of Muso becomes white at a red heat, and loses, as a mean result 1·66 of water and 0·12 of organic matter, the latter consisting of 0·03 to 0·05 of hydrogen and 0·09 to 0·06 of carbon.

Obs.—Emeralds occur in clay slate, in isolated crystals or in nests (not in veins), near Muso, etc. 75 m. N.N.E. of Bogota, N. Granada, a rock containing Cretaceous fossils in its limestone* concretions. A perfect hexagonal crystal from this locality, 2 in. long, is in the cabinet of the Duke of Devonshire; it measures across its three diameters 2¼ in., 2⅛ in., 1⅞ in., and weighs 8 oz. 18 dwts.; owing to flaws, it is but partially fit for jewelry. Emeralds of less beauty, but much larger, occur in Siberia, on the river Tokowoia, N. of Katherinenberg, along with phenacite, chrysoberyl, apatite, rutile, etc., imbedded in mica schist. One specimen in the Royal collection measures 14¼ in. long and 12 broad, and weighs 16¾ lbs. troy; another is 7 in. long and 4 broad, and weighs 6 lbs. troy. Mount Zalora, in Upper Egypt, affords a less distinct variety, and was the only locality which was known to the ancients. Occurs about Heubachthal in Salzburg, in mica schist.

Transparent beryls are found in Siberia, Hindostan, and Brazil. In Siberia they occur at the emerald mine mentioned, at Mursinka and Schaitanka, near Katherinenberg; near Miask with topaz; in the mountains of Adun-Tschilon with topaz, and elsewhere; in Hindostan at Canjargum; and in Brazil on Rio San Matteo. Some Siberian transparent crystals exceed a foot in length. The most splendid aquamarine of which we have any account belongs to Don Pedro, and is from Brazil; it approaches in size, and also form, the head of a calf, and exhibits a crystalline structure only on one side; the rest is water-worn; and it weighs 225 oz. troy, or more than 18¾ lbs.: the specimen is transparent and without a flaw. Beautiful crystals also occur at Elba; the tin mines of Ehrenfriedersdorf in Saxony, and of Schlackenwald in Bohemia. Other localites are, the Mourne Mts., Ireland, Co. of Down; also Killiney near Dublin; yellowish-green at Rubislaw, near Aberdeen, Scotland (davidsonite), and elsewhere in Aberdeenshire; in small bluish crystals at St. Michael's Mount in Cornwall; Limoges in France; Finbo and Broddbo in Sweden; Tamela and Somero in Finland; Fossum in Norway; Pfitscher-Joch, Tyrol; Bodenmais and Rabenst in Bavaria; in Australia, and elsewhere.

---

* Lewy found the limestone to consist of $\dot{\text{Ca}}\ddot{\text{C}}$ 47·8, $\dot{\text{Mg}}\ddot{\text{C}}$ 16·7, $\dot{\text{Mn}}\ddot{\text{C}}$ 0·5, $\ddot{\text{Si}}$ 24·4, $\dddot{\text{Al}}$ 5·5, $\dddot{\text{Be}}$ 0·5, $\dot{\text{Fe}}$ 2·6, pyrite 0·6, alkali 2·7=101·2.

Beryls of gigantic dimensions have been found in the United States, in *N. Hamp.*, at Acwo and Grafton, and in *Mass.*, at Royalston; but they are mostly poor in quality. One beryl fr Grafton weighs 2,900 lbs.; it is 32 in. through in one direction and 22 in another transverse, a is 4 f. 3 in. long. Another crystal from this locality, according to Prof. Hubbard, measures 45 by 24 in its diameters, and a single foot in length by calculation weighs 1,076 lbs., making it in nearly 2¼ tons. At Royalston, one crystal exceeded a foot in length; the smaller crystals often limpid, and a yellowish variety forms a gem resembling chrysolite; the colors are mos aquamarine, grass-green, and yellowish-green; one locality is in the southeast part of Royalst near the school-house, on the land of Mr. Clarke; the best crystals are imbedded in quartz; a s better is situated 4 m. beyond the old one in South Royalston; some crystals of a sky-blue co in white quartz are beautiful.

Other localities are in *Maine*, at Albany; at Norway; Bethel; Hebron; in Pa large, with black tourmaline and mica; at Bowdoinham and Topham, pale green or yellowi white, in veins of graphic granite; at Georgetown, Parker's island, mouth of Kennebec. In *Hamp.*, at Wilmot; at Compton, as good as at Royalston. In *Mass.*, at Barre, excellent specime at Pearl Hill in Fitchburg, at Goshen (goshenite), and at Chesterfield. In *Conn.*, at Haddam, i feldspar vein in gneiss, on the east side of the river, the crystals having the terminations fo twelfth of an inch transparent (fig. 231, the dotted line indicating the limit of the transparent p tion); also at the chrysoberyl locality; the Middletown feldspar quarry; in Chatham, near cobalt mine, in granite; at Monroe, in a granite vein, the crystals often consisting of displa pieces separated by quartz (fig. 233); at Madison, in beautiful crystals. In *Penn.*, at Leiperv and Chester, crystals sometimes 10 to 12 in. long and 1¼ in diameter, with black tourmaline; Mineral Hill.

Kokscharof obtained from Ural beryls for the angle *O* ∧ 1, 150° 3′ 24″.

The species *dioptase* and *pyrosmalite* are homœomorphous with beryl, and have the same oxyg ratio between the bases and silica, if the water and chlorine be excluded.

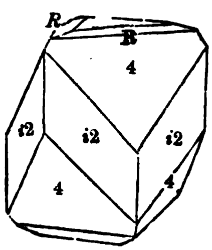
Alt.—Kaolin, mica, limonite, and quartz, occur as pseudomorphs after beryl, the last two substitution, the others by alteration.

The change to kaolin is the same essentially as in feldspar. An altered beryl, from Tirsch reuth afforded H. Müller (J. pr. Ch., lviii. 182) $\ddot{\mathrm{Si}}$ 58·8, $\dddot{\mathrm{Al}}$ 24·7, $\mathrm{\bar{F}e}$ 2·6, $\mathrm{\bar{B}e}$ 10·2, $\dot{\mathrm{H}}$ 2·5. Anoth from Vilate, near Chanteloube, gave Damour (Bull. G. Fr., II. vii. 224) $\ddot{\mathrm{Si}}$ 45·61, $\dddot{\mathrm{Al}}$ 38·86, $\mathrm{\bar{F}e}$ 0 $\mathrm{\bar{B}e}$ 1·10, $\dot{\mathrm{H}}$ 14.04=100·55, corresponding to the common kaolin formula $\dddot{\mathrm{Al}}\,\ddot{\mathrm{Si}}^2+2\dot{\mathrm{H}}$.

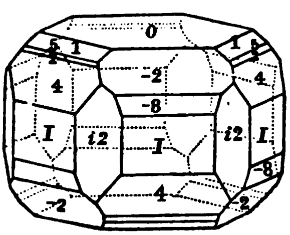
255. EUDIALYTE. Eudialyt *Stromeyer*, Gel. Anz. Gött. 1819, 1998. Eudyalite *impro orthography*. Eukolit *Scheerer*, Pogg. lxxii. 561, 1847. Eucolite.

Rhombohedral. $R \wedge R=126° 25'$, $O \wedge R$ (or 1)$=148° 38'$, $a=0·5279$ Observed planes: *O*; prisms, *I*, *i*-2; rhombohedrons, 1 (or *R*), $\frac{5}{2}$, 4, - -2, $-\frac{4}{5}$; pyramid, $\frac{8}{3}$-2; scalenohedrons, 4^3, 4^3.

234



235



$O \wedge 2=129' 22°$
$O \wedge 4=112\ 18$
$O \wedge 8=101\ 35$
$O \wedge i\text{-}2=90$
$O \wedge I=90$
$i\text{-}2 \wedge 4^3=166\ 1$
$i\text{-}2 \wedge 4=143\ 15$
$4 \wedge 4=73\ 30$
$2 \wedge 2=95\ 56$
$I \wedge i\text{-}2=150$

Cleavage: *O* very perfect, *R* imperfect; in eucolite *i*-2 perfect. Al massive reniform.

H=5·5. G=2·9—3·01; 2·9036, Stromeyer; 2·898, Levy; 2·906, Damou 3·007, Eucolite, Damour; 3·01, id., Scheerer. Lustre vitreous. Co rose-red, bluish-red, brownish-red. Streak uncolored. Translucent to subtranslucent. Fracture subconchoidal, splintery. Double refraction strong; axis in eudialyte positive; in eucolite negative.

Comp.—$(\frac{2}{3}\dot{\mathrm{R}}^2+\frac{1}{3}\ddot{\mathrm{Zr}})\ddot{\mathrm{Si}}^2=2(\dot{\mathrm{R}}^2)\ddot{\mathrm{Si}}^2+\ddot{\mathrm{Zr}}\ddot{\mathrm{Si}}^2$, Damour. Analyses: 1, Pfaff (Schw. J., xxix. 1); 2, 3, Stromeyer (Gilb. Ann., lxiii. 379); 4, Rammelsberg (Pogg., lxiii. 142); 5, Damour (C. R. xliii., 197) 6, Scheerer (Pogg., lxxii. 561); 7, Damour (l. c.):

	$\ddot{\mathrm{Si}}$	$\ddot{\mathrm{Zr}}$	$\ddot{\mathrm{Ta}}$	$\overline{\mathrm{Fe}}$	$\overline{\mathrm{Mn}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Na}}$	$\dot{\mathrm{La}}$	$\dot{\mathrm{Ce}}$	Cl	$\dot{\mathrm{H}}$
1. *Eudialyte*	54·10	11·58	——	7·86	2·93	10·80	11·40	——	——	0·30	1·66, Cu 0·92=101·55 Pf.
2. “	53·33	11·10	——	6·75	2·06	9·78	13·82	——	——	1·00	1·80=99·68 Strom.
3. “	52·48	10·90	——	6·86	2·57	10·14	13·92	——	——	1·00	1·80=99·71 Strom.
4. “	49·92	16·88	——	$\dot{\mathrm{Fe}}$ 6·97	$\dot{\mathrm{Mn}}$ 1·15	11·11	12·28	——	——	1·19	0·37, $\dot{\mathrm{K}}$ 0·65=100·52 Ramm.
5. “	50·38	15·60	0·35	“ 6·37	“ 1·61	9·23	13·10	——	——	1·48	1·25=99·87 Dam'r.
6. *Eucolite*	47·85	14·05		$\overline{\mathrm{Fe}}$ 8·24	“ 1·94	12·06	12·31	——	2·98	——	0·94=100·37 Sch'r.
7. “	45·70	14·22	2·35	$\dot{\mathrm{Fe}}$ 6·83	“ 2·85	9·66	11·59	1·11	2·49	1·11	1·83=99·24 Dam'r.

Damour obtained for the oxygen ratio of $\dot{\mathrm{R}}$, $\overline{\mathrm{R}}$, $\ddot{\mathrm{Si}}$ in both eudialyte and eucolite (the $\ddot{\mathrm{Ta}}$ being included with the $\ddot{\mathrm{Si}}$, and the $\overline{\mathrm{Ce}}$ with the $\ddot{\mathrm{Zr}}$ as sesquioxyd), 2 : 1 : 6, corresponding to the above formula.

Pyr., etc.—In the closed tube affords water. B.B. fuses at 2·5 to a light green opaque glass, coloring the flame yellow (soda). With the fluxes gives reactions for iron and manganese. With muriatic acid gelatinizes, and the dilute acid solution imparts a deep orange to turmeric paper even after the iron in solution has been reduced to colorless protochlorid by boiling with metallic tin (reaction for zirconia).

Obs.—Eudialyte found at Kangerdluarsuk, n West Greenland, associated with arfvedsonite and sodalite, or imbedded in compact white feldspar; the crystals are usually small, but sometimes an inch or more in length. First named Grönlandischer Hyazinth by Trommsdorff, Crell's Ann. i. 433. 1801.

Eucolite is from islands of the Langesund fiord in Norway, where it occurs in hexagonal prisms and reniform masses. Eudialyte has been reported as occurring at Magnet Cove, in Arkansas, in imperfect rounded crystals, of a rich crimson to peach-blossom-red color, in feldspar, with elæolite (Shepard).

On cryst see B. & M.; also Lang., Phil. Mag., IV. xxv. 436, from whose paper fig. 235 is copied.

The name, from *εὖ*, *easily*, and *διαλύω*, *to dissolve*, alludes to its easy solubility in acids. Discovered by C. Giesecke; called Grönlandischen Hyazinth by Trommsdorff in Crell's Ann., i. 433.

---

256. POLLUCITE. Pollux *Breith.*, Pogg., lxix. 439.

Isometric. Cubic, with trapezohedral planes, like analcime. Cleavage: in traces. Massive.

H.=6·5. G.=2·901. Lustre vitreous and bright on surface of fracture, but sometimes dull and gum-like externally. Colorless. Transparent. Index of refraction for the red rays 1·515, blue 1·527; no double refraction; Descl.

Comp.—Probably $(\dot{\mathrm{R}}^3, \overline{\mathrm{Al}})\ddot{\mathrm{Si}}^3+\frac{1}{2}\dot{\mathrm{H}}$, in which $\dot{\mathrm{R}}$=cæsium mainly, and $\dot{\mathrm{R}}^3 : \overline{\mathrm{Al}}=1 : 2\frac{1}{2}$. Analysis: Pisani (C. R., lviii., 714):

$\ddot{\mathrm{Si}}$	$\overline{\mathrm{Al}}$	$\overline{\mathrm{Fe}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Cs}}$	$\dot{\mathrm{Na}}$, $\dot{\mathrm{Li}}$	$\dot{\mathrm{H}}$
44·03	15·97	0·68	0·68	34·07	3·88	2·40=101·71

giving the oxygen ratio for $\dot{\mathrm{R}}$, $\overline{\mathrm{R}}$, $\ddot{\mathrm{Si}}$, $\dot{\mathrm{H}}$, 3·16 : 7·63 : 23·48 : 2·13. Plattner obtained (Pogg., lxix 443), before the discovery of cæsium, $\ddot{\mathrm{Si}}$ 46·20, $\overline{\mathrm{Al}}$ 16·39, $\overline{\mathrm{Fe}}$ 0·86, $\dot{\mathrm{K}}$ 16·51, Na (with a little $\dot{\mathrm{Li}}$), 1·43, $\dot{\mathrm{H}}$ 2·32=92·75; and Brush shows (Am. J. Sci., II. xxxviii. 115) that if the cæsium were mistaken for potash, it would give 35·69 $\dot{\mathrm{Cs}}$, and reduce the soda (if obtained by difference) to 1·72 p. c., and that thus the results are as close to Pisani's as could be expected, considering the amount of material used. Plattner's analysis thus changed would read $\ddot{\mathrm{Si}}$ 46·20, $\bar{\mathrm{Al}}$ 16·39, $\bar{\mathrm{Fe}}$ 0·86, $\dot{\mathrm{Cs}}$ 35·69, $\dot{\mathrm{Na}}$ 1·72, $\dot{\mathrm{H}}$ 2·32=103·18.

Pyr., etc.—In the closed tube becomes opaque and yields water. In the forceps whitens, fuses with difficulty, coloring the flame yellow. In muriatic acid slowly decomposes, with a separation of pulverulent silica; and the filtrate from the silica gives an abundant precipitate of the platin-chlorid of cæsium when treated with bichlorid of platinum.

Obs.—Occurs in the island of Elba, with petalite (castorite). Named from Pollux (the genitive of which is Pollucis), of heathen mythology.

II. UNISILICATES.

ARRANGEMENT OF THE SPECIES.

A. Unisilicates of elements mostly in the protoxyd (or alpha) state.

1. CHRYSOLITE GROUP. Orthorhombic; I ∧ I=91°—95°: O ∧ 1-ĭ=124°—129°.

		Ratio.		
257.	**Forsterite**	1:1	$\dot{Mg}^2\ddot{Si}$	$Si\|\Theta_4\|Mg_2$
258.	**Monticellite**	1:1	$(\frac{1}{2}\dot{Ca}+\frac{1}{2}\dot{Mg})^2\ddot{Si}$	$Si\|\Theta_4\|(\frac{1}{2}Ca+\frac{1}{2}Mg)_2$
259.	**Chrysolite**	1:1	$(\dot{Mg},\dot{Fe})^2\ddot{Si}$	$Si\|\Theta_4\|(Mg,Fe)_2$
260.	**Fayalite**	1:1	$\dot{Fe}^2\ddot{Si}$	$Si\|\Theta_4\|Fe_2$
261.		1:1	$(\frac{3}{4}\dot{Fe}+\frac{1}{4}(\dot{Mn},\dot{Mg}))^2\ddot{Si}$	$Si\|\Theta_4\|(\frac{3}{4}Fe+\frac{1}{4}(Mn,Mg))_2$
262.	**Tephroite**	1:1	$\dot{Mn}^2\ddot{Si}$	$Si\|\Theta_4\|Mn_2$
263.	**Knebelite**	1:1	$(\frac{1}{2}\dot{Mn}+\frac{1}{2}\dot{Fe})^2\ddot{Si}$	$Si\|\Theta_4\|(\frac{1}{2}Mn+\frac{1}{2}Fe)_2$
264.	**Leucophanite**	1:1$\frac{2}{3}$, a	$(\frac{1}{2}(\dot{Ca},\dot{Na})+\frac{1}{2}\dot{Be})^2\ddot{Si}+\frac{2}{3}\ddot{Si}$	$Si\|\Theta_4\|(\frac{1}{2}(Ca,Na_2)+\frac{1}{2}Be)_2$
		b	$(\frac{3}{8}(\dot{Ca},\dot{Na})+\frac{3}{8}\dot{Be}+\frac{2}{8}\ddot{Si}^{\frac{3}{2}})^2\ddot{Si}$	$Si\|\Theta_4\|(\frac{3}{8}(Ca,Na_2)+\frac{3}{8}Be+\frac{2}{8}Si)_2$
265.	**Wöhlerite**	1:1 ?	$(\frac{2}{3}\dot{R}^2+\frac{1}{3}\ddot{Zr})\ddot{Si}[+\frac{1}{10}(\dot{Fe},\dot{Mn})\ddot{\ddot{C}}b]$	$Si\|\Theta_4\|(\frac{2}{3}R+\frac{1}{3}\gamma Zr)_2+\frac{1}{10}Q$

II. PHENACITE GROUP. Hexagonal; R ∧ R=116°—117°

266.	**Willemite**	1:1	$\dot{Zn}^2\ddot{Si}$	$Si\|\Theta_4\|Zn_2$
267.	**Phenacite**	1:1	$\dot{Be}^2\ddot{Si}$	$Si\|\Theta_4\|Be_2$
268.	**Meliphanite**	r=1:1$\frac{1}{4}$? a	$(\dot{R}^2,\bar{R})^2\ddot{Si}^2+\frac{3}{4}\ddot{Si}$	$Si\|(\Theta,F)_4\|(Na_2,R,{}^3R)_2+\frac{1}{4}Si\Theta^2$
		b	$(\frac{8}{9}(\dot{R}^2,\bar{R})+\frac{1}{9}\ddot{Si}^{\frac{3}{2}})^2\ddot{Si}^2$	$Si\|(\Theta,F)_4\|(\frac{8}{9}(Na_2R,{}^3R)+\frac{1}{9}\gamma Si)_2$

III. HELVITE GROUP. Isometric; related to the Garnet Group.

269.	**Helvite**	1:1+	$(\frac{1}{2}\dot{R}+\frac{1}{2}\dot{Be})^2\ddot{Si}[+\frac{1}{3}(Fe,Mn)S$	$Si\|\Theta_4\|(\frac{1}{2}R+\frac{1}{2}Be)_2+\frac{1}{3}Q$
270.	**Danalite**	1:1+	$(\frac{1}{2}\dot{R}+\frac{1}{2}\dot{Be})^2\ddot{Si}[+\frac{1}{3}ZnS]$	$Si\|\Theta_4\|(\frac{1}{2}R+\frac{1}{2}Be)_2+\frac{1}{3}Q$

B. Unisilicates of elements in the protoxyd and other states combined; rarely of elements in the protoxyd or deutoxyd state alone. Contain magnesium and iron in the series of basic elements. Colors various.

IV. GARNET GROUP. Isometric.

	Ratio.		
271. GARNET	1:1:2	$(\frac{1}{2}\dot{\mathrm{R}}^3+\frac{1}{2}\ddot{\bar{\mathrm{R}}})^2\ddot{\mathrm{Si}}^3$	$\mathrm{Si}|\Theta_4|(\frac{1}{2}\bar{\mathrm{R}}+\frac{1}{2}\beta\bar{\mathrm{R}})_2$
A. GROSSULARITE		$(\frac{1}{2}\dot{\mathrm{Ca}}^3+\frac{1}{2}\ddot{\bar{\mathrm{Al}}})^2\ddot{\mathrm{Si}}^3$	$\mathrm{Si}|\Theta_4|(\frac{1}{2}\bar{\mathrm{Ca}}+\frac{1}{2}\beta\bar{\mathrm{Al}})_2$
B. PYROFE		$(\frac{1}{2}(\dot{\mathrm{Mg}},\dot{\mathrm{Fe}},\dot{\mathrm{R}})^3+\frac{1}{2}\ddot{\bar{\mathrm{Al}}})^2\ddot{\mathrm{Si}}^3$	$\mathrm{Si}|\Theta_4|(\frac{1}{2}(\bar{\mathrm{Mg}},\bar{\mathrm{Fe}},\bar{\mathrm{R}})+\frac{1}{2}\beta\bar{\mathrm{Al}})_2$
C. ALMANDITE		$(\frac{1}{2}\dot{\mathrm{Fe}}^3+\frac{1}{2}\ddot{\bar{\mathrm{Al}}})^2\ddot{\mathrm{Si}}^3$	$\mathrm{Si}|\Theta_4|(\frac{1}{2}\bar{\mathrm{Fe}}+\frac{1}{2}\beta\bar{\mathrm{Al}})_2$
D. SPESSARTITE		$(\frac{1}{2}(\dot{\mathrm{Mn}},\dot{\mathrm{Fe}})^3+\frac{1}{2}\ddot{\bar{\mathrm{Al}}})^2\ddot{\mathrm{Si}}^3$	$\mathrm{Si}|\Theta_4|(\frac{1}{2}(\bar{\mathrm{Mn}},\bar{\mathrm{Fe}})+\frac{1}{2}\beta\bar{\mathrm{Al}})_2$
E. ANDRADITE A.		$(\frac{1}{2}\dot{\mathrm{Ca}}^3+\frac{1}{2}(\ddot{\bar{\mathrm{Fe}}},\ddot{\bar{\mathrm{Al}}})^2\ddot{\mathrm{Si}}^3$	$\mathrm{Si}|\Theta_4|(\frac{1}{2}\bar{\mathrm{Ca}}+\frac{1}{2}\beta(\bar{\mathrm{Fe}}\ \bar{\mathrm{Al}}))_2$
B.		$(\frac{1}{2}(\dot{\mathrm{Ca}},\dot{\mathrm{Mn}})^3+\frac{1}{2}(\ddot{\bar{\mathrm{Fe}}},\ddot{\bar{\mathrm{Al}}}))^2\ddot{\mathrm{Si}}^3$	$\mathrm{Si}|\Theta_4|(\frac{1}{2}(\bar{\mathrm{Ca}},\bar{\mathrm{Mn}})+\frac{1}{2}\beta(\bar{\mathrm{Fe}},\bar{\mathrm{Al}}))_2$
C.		$(\frac{1}{2}(\dot{\mathrm{Ca}},\dot{\mathrm{Y}})^3+\frac{1}{2}\ddot{\bar{\mathrm{Fe}}})^2\ddot{\mathrm{Si}}^3$	$\mathrm{Si}|\Theta_4|(\frac{1}{2}(\bar{\mathrm{Ca}},\bar{\mathrm{Y}})+\frac{1}{2}\beta\bar{\mathrm{Fe}})_2$
F. BREDBERGITE		$(\frac{1}{2}(\frac{1}{2}\dot{\mathrm{Ca}}+\frac{1}{2}\dot{\mathrm{Mg}})^3+\frac{1}{2}\ddot{\bar{\mathrm{Fe}}})^2\ddot{\mathrm{Si}}^3$	$\mathrm{Si}|\Theta_4|(\frac{1}{2}(\frac{1}{2}\bar{\mathrm{Ca}}+\frac{1}{2}\bar{\mathrm{Mg}})+\frac{1}{2}\beta\bar{\mathrm{Fe}})_2$
G. OUVAROVITE		$(\frac{1}{2}\dot{\mathrm{Ca}}^3+\frac{1}{2}\ddot{\bar{\mathrm{Cr}}})^2\ddot{\mathrm{Si}}^3$	$\mathrm{Si}|\Theta_4|(\frac{1}{2}\bar{\mathrm{Ca}}+\frac{1}{2}\beta\bar{\mathrm{Cr}})_2$

V. VESUVIANITE GROUP. Tetragonal.

272 ZIRCON	1:1	$\ddot{\mathrm{Zr}}\ddot{\mathrm{Si}}$	$\mathrm{Si}|\Theta_4|\gamma\mathrm{Zr}_2$
273. VESUVIANITE	3:2:5	$(\frac{3}{5}(\dot{\mathrm{Ca}},\dot{\mathrm{Fe}})^3+\frac{2}{5}\ddot{\bar{\mathrm{Al}}})^2\ddot{\mathrm{Si}}^3$	$\mathrm{Si}|\Theta_4|(\frac{3}{5}(\bar{\mathrm{Ca}},\bar{\mathrm{Fe}})+\frac{2}{5}\beta\bar{\mathrm{Al}})_2$
274. MELILITE	2:1:3	$(\frac{2}{3}(\dot{\mathrm{Ca}},\dot{\mathrm{Mg}},\dot{\mathrm{Na}})^3+\frac{1}{3}(\ddot{\bar{\mathrm{Al}}},\ddot{\bar{\mathrm{Fe}}}))^2\ddot{\mathrm{Si}}^3$	$\mathrm{Si}|\Theta_4|(\frac{2}{3}(\mathrm{Na}_2,\bar{\mathrm{R}})+\frac{1}{3}\beta(\bar{\mathrm{Al}},\bar{\mathrm{Fe}}))_2$
275. ? SPHENOCLASE	2:1:4		

VI. EPIDOTE GROUP. Anisometric; *I* ∧ *I* not 120°, nor approximately so.

276. EPIDOTE	1:2:3	$(\frac{1}{3}\dot{\mathrm{Ca}}^3+\frac{2}{3}(\ddot{\bar{\mathrm{Al}}},\ddot{\bar{\mathrm{Fe}}}))^2\ddot{\mathrm{Si}}^3$	$\mathrm{Si}|\Theta_4|(\frac{1}{3}\bar{\mathrm{Ca}}+\frac{2}{3}\beta(\bar{\mathrm{Al}},\bar{\mathrm{Fe}}))_2$
A. KOELBINGITE			
277. PIEDMONTITE	1:2:3	$\frac{1}{3}\dot{\mathrm{Ca}}^3+\frac{2}{3}(\ddot{\bar{\mathrm{Mn}}},\ddot{\bar{\mathrm{Fe}}},\ddot{\bar{\mathrm{Al}}})^2\ddot{\mathrm{Si}}^3$	$\mathrm{Si}|\Theta_4|(\frac{1}{3}\bar{\mathrm{Ca}}+\frac{2}{3}\beta(\bar{\mathrm{Mn}},\bar{\mathrm{Fe}},\bar{\mathrm{Al}}))_2$
278. ALLANITE	1:1:2	$\frac{1}{2}(\dot{\mathrm{Ce}},\dot{\mathrm{Fe}},\dot{\mathrm{R}})^3+\frac{1}{2}(\ddot{\bar{\mathrm{Al}}},\ddot{\bar{\mathrm{Fe}}})^2\ddot{\mathrm{Si}}^3$	$\mathrm{Si}|\Theta_4|(\frac{1}{2}(\bar{\mathrm{Ce}},\bar{\mathrm{Fe}},\bar{\mathrm{R}})+\frac{1}{2}\beta(\bar{\mathrm{Al}},\bar{\mathrm{Fe}}))_2$
279. MUROMONTITE		$\ddot{\mathrm{Si}},\dot{\mathrm{Y}},\dot{\mathrm{Fe}},\ddot{\bar{\mathrm{Be}}},\dot{\mathrm{Ce}},\dot{\mathrm{La}}$	
A. BODENITE		$\ddot{\mathrm{Si}},\dot{\mathrm{Y}},\dot{\mathrm{Fe}},\dot{\mathrm{Ce}},\dot{\mathrm{La}},\dot{\mathrm{Ca}},\ddot{\bar{\mathrm{Al}}},\dot{\mathrm{H}}$	
B. MICHAELSONITE		$\ddot{\mathrm{Si}},\dot{\mathrm{Ca}},\dot{\mathrm{Ce}},\ddot{\mathrm{Zr}},\ddot{\bar{\mathrm{Be}}},\ddot{\bar{\mathrm{Fe}}},\dot{\mathrm{Na}},\dot{\mathrm{H}}$	
280. ZOISITE	1:2:3	$(\frac{1}{3}\dot{\mathrm{Ca}}^3+\frac{2}{3}\ddot{\bar{\mathrm{Al}}})^2\ddot{\mathrm{Si}}^3$	$\mathrm{Si}|\Theta_4|(\frac{1}{3}\bar{\mathrm{Ca}}+\frac{2}{3}\beta\bar{\mathrm{Al}})_2$
B. SAUSSURITE	1:2:3½?	$(\frac{1}{3}(\dot{\mathrm{Ca}},\dot{\mathrm{Na}})^3+\frac{2}{3}\ddot{\bar{\mathrm{Al}}})^2\ddot{\mathrm{Si}}^3+\frac{1}{2}\ddot{\mathrm{Si}}$	$\mathrm{Si}|\Theta_4|(\frac{1}{3}\bar{\mathrm{Ca}},\mathrm{Na}_2)+\frac{2}{3}\beta\bar{\mathrm{Al}})_2+\frac{1}{2}\ddot{\mathrm{Si}}$
280 A. JADEITE	1:2:6	$(\frac{1}{3}\dot{\mathrm{Na}}^3+\frac{2}{3}\ddot{\bar{\mathrm{Al}}})^2\ddot{\mathrm{Si}}^3+3\ddot{\mathrm{Si}}$	$\mathrm{Si}|\Theta_4|(\frac{1}{3}\mathrm{Na}_2+\frac{2}{3}\beta\bar{\mathrm{Al}})_2+\mathrm{Si}\,\Theta^2$
281. PARTSCHINITE	1:1:2	$(\frac{1}{2}(\dot{\mathrm{Mn}},\dot{\mathrm{Fe}})^3+\frac{1}{2}\ddot{\bar{\mathrm{Al}}})^2\ddot{\mathrm{Si}}^3$	$\mathrm{Si}|\Theta_4|(\frac{1}{2}(\bar{\mathrm{Mn}},\bar{\mathrm{Fe}})+\frac{1}{2}\beta\bar{\mathrm{Al}})_2$
282. GADOLINITE	1:1?	$\ddot{\mathrm{Si}},\dot{\mathrm{Y}},\dot{\mathrm{Ce}},\dot{\mathrm{Fe}},\ddot{\bar{\mathrm{Be}}}$	
283. MOSANDRITE	1:2:3?	$\ddot{\mathrm{Si}},\ddot{\mathrm{Ti}},\dot{\mathrm{Ce}},\dot{\mathrm{La}},\dot{\mathrm{Di}},\dot{\mathrm{Ca}},[\dot{\mathrm{H}}]$	
284. ILVAITE A.	3:2:5	$(\frac{3}{5}\dot{\mathrm{R}}^3+\frac{2}{5}\ddot{\bar{\mathrm{Fe}}})^2\ddot{\mathrm{Si}}^3$	$\mathrm{Si}|\Theta_4|(\frac{3}{5}(\bar{\mathrm{Ca}},\bar{\mathrm{Fe}})+\frac{2}{5}\beta\bar{\mathrm{Fe}})_2$
B.	3:2:5+	$(\frac{3}{5}\dot{\mathrm{R}}^3+\frac{2}{5}\ddot{\bar{\mathrm{Fe}}})^2\ddot{\mathrm{Si}}^3[+\frac{1}{3}\ddot{\bar{\mathrm{Fe}}}\dot{\mathrm{H}}]$	$\mathrm{Si}|\Theta_4|(\frac{3}{5}(\bar{\mathrm{Ca}},\bar{\mathrm{Fe}})+\frac{2}{5}\beta\bar{\mathrm{Fe}})_2[+\frac{1}{6}\mathrm{Q}]$

VII. AXINITE GROUP. Triclinic. Contain Boron.

235. AXINITE	2:4:1:7	$(\frac{2}{7}\dot{\mathrm{Ca}}^3+\frac{4}{7}(\ddot{\bar{\mathrm{Fe}}},\ddot{\bar{\mathrm{Al}}})+\frac{1}{7}\ddot{\bar{\mathrm{B}}})^2\ddot{\mathrm{Si}}^3$	$\mathrm{Si}|\Theta_4|(\frac{2}{7}\bar{\mathrm{Ca}}+\frac{4}{7}\beta(\bar{\mathrm{Fe}},\bar{\mathrm{Al}})+\frac{1}{7}\beta\mathrm{B})_2$
236. DANBURITE	1:3:4	$(\frac{1}{4}\dot{\mathrm{Ca}}^3+\frac{3}{4}\ddot{\bar{\mathrm{B}}})^2\ddot{\mathrm{Si}}^3$	$\mathrm{Si}|\Theta_4|(\frac{1}{4}\bar{\mathrm{Ca}}+\frac{3}{4}\beta\mathrm{B})_2$

VIII. IOLITE GROUP. Orthorhombic; *I* ∧ *I*=120°.

237. IOLITE	1:3:5	*a* $(\frac{1}{4}(\dot{\mathrm{Mg}},\dot{\mathrm{Fe}})^3+\frac{3}{4}\ddot{\bar{\mathrm{Al}}})^2\ddot{\mathrm{Si}}^3+\frac{3}{4}\ddot{\mathrm{Si}}$	$\mathrm{Si}|\Theta_4|(\frac{1}{4}(\bar{\mathrm{Mg}},\bar{\mathrm{Fe}})+\frac{3}{4}\beta\bar{\mathrm{Al}})_2+\frac{3}{4}\mathrm{Si}\Theta^2$
	r=1:1¼	*b* $(\frac{2}{9}(\dot{\mathrm{Mg}},\dot{\mathrm{Fe}})^3+\frac{6}{9}\ddot{\bar{\mathrm{Al}}}+\frac{1}{9}\ddot{\mathrm{Si}}^{\frac{3}{2}})^2\ddot{\mathrm{Si}}^3$	$\mathrm{Si}|\Theta_4|(\frac{2}{9}(\bar{\mathrm{Mg}},\bar{\mathrm{Fe}})+\frac{6}{9}\beta\bar{\mathrm{Al}}+\frac{1}{9}\gamma\mathrm{Si})_2$

IX. MICA GROUP. Plane angle of base of prism 120°; the forms either hexagonal or orthorhombic.

		Ratio.		
288.	PHLOGOPITE A.	7:4:11	$(\frac{7}{11}(\dot{\mathrm{Mg}}, \dot{\mathrm{K}})^3 + \frac{4}{11}\dddot{\mathrm{Al}})^2\ddot{\mathrm{Si}}^3$	$\mathrm{Si}\Vert\Theta_4\Vert(\frac{7}{11}(\mathrm{K}_2, \mathrm{Mg}) + \frac{4}{11}\beta\mathrm{Al})_2$
	B.	2:1:3	$(\frac{2}{3}(\dot{\mathrm{Mg}}, \dot{\mathrm{K}})^3 + \frac{1}{3}\dddot{\mathrm{Al}})^2\ddot{\mathrm{Si}}^3$	$\mathrm{Si}\Vert\Theta_4\Vert(\frac{2}{3}(\mathrm{K}_2, \mathrm{Mg}) + \frac{1}{3}\beta\mathrm{Al})_2$
289	BIOTITE	1:1:2	$\frac{1}{2}(\dot{\mathrm{Mg}}, \dot{\mathrm{K}})^3 + \frac{1}{2}(\dddot{\mathrm{Al}}, \dddot{\mathrm{Fe}})^2\ddot{\mathrm{Si}}^3$	$\mathrm{Si}\Vert\Theta_4\Vert(\frac{1}{2}(\mathrm{K}_2, \mathrm{Mg}) + \frac{1}{2}\beta(\mathrm{Al}, \mathrm{Fe}))_2$
290.	LEPIDOMELANE	1:3:4	$\frac{1}{4}(\dot{\mathrm{Fe}}, \dot{\mathrm{Mg}}, \dot{\mathrm{K}})^3 + \frac{3}{4}(\dddot{\mathrm{Al}}, \dddot{\mathrm{Fe}})^2\ddot{\mathrm{Si}}^3$	$\mathrm{Si}\Vert\Theta_4\Vert(\frac{1}{4}(\mathrm{K}_2, \mathrm{Fe}, \mathrm{Mg}) + \frac{3}{4}(\mathrm{Al}, \mathrm{Fe}))_2$
291.	ANNITE	1:2:3	$\frac{1}{3}(\dot{\mathrm{Fe}}, \dot{\mathrm{K}})^3 + \frac{2}{3}(\dddot{\mathrm{Al}}, \dddot{\mathrm{Fe}})^2\ddot{\mathrm{Si}}^3$	$\mathrm{Si}\Vert\Theta_4\Vert(\frac{1}{3}(\mathrm{K}_2, \mathrm{Fe}) + \frac{2}{3}\beta(\mathrm{Al}, \mathrm{Fe}))_2$
292.	ASTROPHYLLITE	10:3:4:17	$(\frac{10}{17}\dot{\mathrm{R}}^3 + \frac{3}{17}\bar{\mathrm{R}} + \frac{4}{17}(\ddot{\mathrm{Ti}}, \ddot{\mathrm{Zr}})^{\frac{3}{2}})^2\ddot{\mathrm{Si}}^3$	$\mathrm{Si}\Vert\Theta_4\Vert(\frac{10}{17}(\mathrm{R}_2, \mathrm{R}) + \frac{3}{17}\beta\mathrm{R} + \frac{4}{17}\gamma(\mathrm{Ti}, \mathrm{Zr}))_2$
293.	MUSCOVITE	r=1:1½	$a\ (\dot{\mathrm{R}}^3, \bar{\mathrm{R}})^2\ddot{\mathrm{Si}}^3 + \frac{1}{2}\ddot{\mathrm{Si}}$	$\mathrm{Si}\Vert\Theta_4\Vert(\mathrm{K}_2, \mathrm{Mg}, \beta(\mathrm{Al}, \mathrm{Fe}))_2 + \frac{1}{2}\mathrm{Si}\Theta^2$
			$b\ (\frac{5}{6}(\dot{\mathrm{R}}^3, \bar{\mathrm{R}}) + \frac{1}{6}\ddot{\mathrm{Si}}^{\frac{3}{2}})^2\ddot{\mathrm{Si}}^3$	$\mathrm{Si}\Vert\Theta_4\Vert(\frac{5}{6}(\mathrm{K}_2, \mathrm{Mg}, \beta(\mathrm{Al}, \mathrm{Fe})) + \frac{1}{6}\gamma\mathrm{Si})$
294.	LEPIDOLITE	r=1:1⅓	$a\ (\dot{\mathrm{R}}^3, \bar{\mathrm{R}})^2\ddot{\mathrm{Si}}^3 + \frac{1}{3}\ddot{\mathrm{Si}}$	$\mathrm{Si}\Vert\Theta_4\Vert(\mathrm{K}_2, \mathrm{Li}_2, \mathrm{Mn}, \beta\mathrm{Al})_2 + \frac{1}{3}\mathrm{Si}\Theta^2$
			$b\ (\frac{4}{5}(\dot{\mathrm{R}}^3, \bar{\mathrm{R}}) + \frac{1}{5}\ddot{\mathrm{Si}}^{\frac{3}{2}})^2\ddot{\mathrm{Si}}^3$	$\mathrm{Si}\Vert\Theta_4\Vert(\frac{4}{5}(\mathrm{R}_2, \mathrm{Mn}, \beta\mathrm{Al})_2 + \frac{1}{5}\gamma\mathrm{Si})_2$
295.	CRYOPHYLLITE	r=1:2	$a\ (\dot{\mathrm{R}}^3, \bar{\mathrm{R}})^2\ddot{\mathrm{Si}}^3 + 3\ddot{\mathrm{Si}}$	$\mathrm{Si}\Vert\Theta_4\Vert(\mathrm{K}_2, \mathrm{Li}_2, \mathrm{Fe}, \beta\mathrm{Al})_2 + \mathrm{Si}\Theta^2$
			$b\ (\frac{2}{3}((\dot{\mathrm{K}}, \dot{\mathrm{Li}}, \dot{\mathrm{Fe}})^3, \dddot{\mathrm{Al}}) + \frac{1}{3}\ddot{\mathrm{Si}}^{\frac{3}{2}})^2\ddot{\mathrm{Si}}^3$	$\mathrm{Si}\Vert\Theta_4\Vert(\frac{2}{3}(\mathrm{K}_2, \mathrm{Li}_2, \mathrm{Fe}, \beta\mathrm{Al}) + \frac{1}{3}\gamma\mathrm{Si})_2$

C. Unisilicates of elements in the protoxyd and other states combined. The series of basic elements including calcium, barium, sodium, and the other alkaline metals, and not iron or magnesium (these latter occurring only in traces and abnormally).

X. SCAPOLITE GROUP. Tetragonal. O. ratio for protoxyds and sesquioxyds 1 : 1 to 1 : 3, but mostly 1 : 2.

296.	SARCOLITE	1:1:2	$(\frac{1}{2}(\frac{9}{10}\dot{\mathrm{Ca}} + \frac{1}{10}\dot{\mathrm{Na}})^3 + \frac{1}{2}\dddot{\mathrm{Al}})^2\ddot{\mathrm{Si}}^3$	$\mathrm{Si}\Vert\Theta_4\Vert(\frac{1}{2}(\frac{9}{10}\mathrm{Ca} + \frac{1}{10}\mathrm{Na}_2) + \frac{1}{2}\beta\mathrm{Al})_2$
297.	MEIONITE	1:2:3	$(\frac{1}{3}(\frac{10}{11}\dot{\mathrm{Ca}} + \frac{1}{11}\dot{\mathrm{Na}})^3 + \frac{2}{3}\dddot{\mathrm{Al}})^2\ddot{\mathrm{Si}}^3$	$\mathrm{Si}\Vert\Theta_4\Vert(\frac{1}{3}(\frac{10}{11}\mathrm{Ca} + \frac{1}{11}\mathrm{Na}_2) + \frac{2}{3}\beta\mathrm{Al})_2$
298.	PARANTHITE	1:3:4	$(\frac{1}{4}\dot{\mathrm{Ca}}^3 + \frac{3}{4}\dddot{\mathrm{Al}})^2\ddot{\mathrm{Si}}^3$	$\mathrm{Si}\Vert\Theta_4\Vert(\frac{1}{4}\mathrm{Ca} + \frac{3}{4}\beta\mathrm{Al})_2$
299.	WERNERITE	1:2:4	$a\ (\frac{1}{3}(\dot{\mathrm{Ca}}, \dot{\mathrm{Na}})^3 + \frac{2}{3}\dddot{\mathrm{Al}})^2\ddot{\mathrm{Si}}^3 + \ddot{\mathrm{Si}}$	$\mathrm{Si}\Vert\Theta_4\Vert(\frac{1}{3}(\mathrm{Na}_2, \mathrm{Ca}) + \frac{2}{3}\beta\mathrm{Al})_2 + \frac{1}{2}\mathrm{Si}\Theta^2$
		r=1:1⅓	$b\ (\frac{3}{7}(\dot{\mathrm{Ca}}, \dot{\mathrm{Na}})^3 + \frac{3}{7}\dddot{\mathrm{Al}} + \frac{1}{7}\ddot{\mathrm{Si}}^{\frac{3}{2}})^2\ddot{\mathrm{Si}}^3$	$\mathrm{Si}\Vert\Theta_4\Vert(\frac{3}{7}(\mathrm{Na}_2, \mathrm{Ca}) + \frac{3}{7}\beta\mathrm{Al} + \frac{1}{7}\gamma\mathrm{Si})_2$
300.	EKEBERGITE	1:2:4½	$a\ (\frac{1}{3}(\dot{\mathrm{Ca}}, \dot{\mathrm{Na}})^3 + \frac{2}{3}\dddot{\mathrm{Al}})^2\ddot{\mathrm{Si}}^3 + \frac{3}{2}\ddot{\mathrm{Si}}$	$\mathrm{Si}\Vert\Theta_4\Vert(\frac{1}{3}(\mathrm{Na}_2, \mathrm{Ca}) + \frac{2}{3}\beta\mathrm{Al})_2 + \frac{3}{4}\mathrm{Si}\Theta^2$
		r=1:1½	$b\ (\frac{10}{13}(\dot{\mathrm{Ca}}^3, \dot{\mathrm{Na}}^3, \dddot{\mathrm{Al}}) + \frac{3}{13}\ddot{\mathrm{Si}}^{\frac{3}{2}})^2\ddot{\mathrm{Si}}^3$	$\mathrm{Si}\Vert\Theta_4\Vert(\frac{10}{13}(\mathrm{Na}_2, \mathrm{Ca}, \beta\mathrm{Al}) + \frac{3}{13}\gamma\mathrm{Si})_2$
301.	MIZZONITE	1:2:5½	$a\ (\frac{1}{3}(\dot{\mathrm{Ca}}, \dot{\mathrm{Na}})^3 + \frac{2}{3}\dddot{\mathrm{Al}})^2\ddot{\mathrm{Si}}^3 + 2\frac{1}{2}\ddot{\mathrm{Si}}$	$\mathrm{Si}\Vert\Theta_4\Vert(\frac{1}{3}(\mathrm{Ca}, \mathrm{Na}_2) + \frac{2}{3}\beta\mathrm{Al})_2 + \frac{5}{4}\mathrm{Si}\Theta^2$
		r=1:1⅝	$b\ (\frac{8}{33}(\dot{\mathrm{Ca}}, \dot{\mathrm{Na}})^3 + \frac{16}{33}\dddot{\mathrm{Al}} + \frac{9}{33}\ddot{\mathrm{Si}}^{\frac{3}{2}})^2\ddot{\mathrm{Si}}^3$	$\mathrm{Si}\Vert\Theta_4\Vert(\frac{24}{33}(\mathrm{Ca}, \mathrm{Na}_2, \beta\mathrm{Al}) + \frac{9}{33}\gamma\mathrm{Si})_2$
302.	DIPYRE	1:2:6	$a\ (\frac{1}{3}(\dot{\mathrm{Ca}}, \dot{\mathrm{Na}})^3 + \frac{2}{3}\dddot{\mathrm{Al}})^2\ddot{\mathrm{Si}}^3 + 3\ddot{\mathrm{Si}}$	$\mathrm{Si}\Vert\Theta_4\Vert(\frac{1}{3}(\mathrm{Ca}, \mathrm{Na}_2) + \frac{2}{3}\beta\mathrm{Al})_2 + \mathrm{Si}\Theta^2$
		r=1:2	$b\ (\frac{2}{9}(\dot{\mathrm{Ca}}, \dot{\mathrm{Na}})^3 + \frac{4}{9}\dddot{\mathrm{Al}} + \frac{3}{9}\ddot{\mathrm{Si}}^{\frac{3}{2}})^2\ddot{\mathrm{Si}}^3$	$\mathrm{Si}\Vert\Theta_4\Vert(\frac{2}{9}(\mathrm{Ca}, \mathrm{Na}_2) + \frac{4}{9}\beta\mathrm{Al} + \frac{3}{9}\gamma\mathrm{Si})_2$
303.	MARIALITE	1:2:6	$a\ (\frac{1}{3}(\dot{\mathrm{Na}}, \dot{\mathrm{Ca}})^3 + \frac{2}{3}\dddot{\mathrm{Al}})^2\ddot{\mathrm{Si}}^3 + 3\ddot{\mathrm{Si}}$	$\mathrm{Si}\Vert\Theta_4\Vert(\frac{1}{3}(\mathrm{Na}_2, \mathrm{Ca}) + \frac{2}{3}\beta\mathrm{Al})_2 + \mathrm{Si}\Theta^2$
		r=1:2	$b\ (\frac{2}{9}(\dot{\mathrm{Na}}, \dot{\mathrm{Ca}})^3 + \frac{4}{9}\dddot{\mathrm{Al}} + \frac{3}{9}\ddot{\mathrm{Si}}^{\frac{3}{2}})^2\ddot{\mathrm{Si}}^3$	$\mathrm{Si}\Vert\Theta_4\Vert(\frac{2}{9}(\mathrm{Na}_2, \mathrm{Ca}) + \frac{4}{9}\beta\mathrm{Al} + \frac{3}{9}\gamma\mathrm{Si})_2$

XI. NEPHELITE GROUP. Hexagonal. O. ratio for protoxyds and sesquioxyds 1 : 3.

	Ratio.		
304. **Nephelite**	1:3:4½	$(\frac{1}{4}(\dot{\text{Na}},\dot{\text{K}})^3+\frac{3}{4}\ddot{\bar{\text{A}}}\text{l})^2\ddot{\text{Si}}^3+\frac{3}{8}\ddot{\text{Si}}$	$\text{Si}\|\Theta_4\|(\frac{1}{4}(\text{Na}_2,\text{K}_2)+\frac{3}{4}\beta\bar{\text{A}}\text{l})_2+\frac{1}{8}\text{S}$
		$(\frac{4}{17}(\dot{\text{Na}},\dot{\text{K}})^3+\frac{12}{17}\ddot{\bar{\text{A}}}\text{l}+\frac{1}{17}\ddot{\text{Si}}^{\frac{3}{2}})^2\ddot{\text{Si}}^3$	$\text{Si}\|\Theta_4\|(\frac{4}{17}(\text{Na}_2,\text{K}_2)+\frac{12}{17}\beta\bar{\text{A}}\text{l}+\frac{1}{17}\gamma\text{Si})$.

XII. LEUCITE GROUP. Monometric. O. ratio for protoxyds and sesquioxyds 1 : 3.

305. **Sodalite**	1:3:4+	$(\frac{1}{4}\dot{\text{Na}}^3+\frac{3}{4}\ddot{\bar{\text{A}}}\text{l})^2\ddot{\text{Si}}^3[+\frac{1}{3}\text{Na Cl}]$	$\text{Si}\|\Theta_4\|(\frac{1}{4}\text{Na}_2+\frac{3}{4}\beta\bar{\text{A}}\text{l})_2+\frac{1}{3}\text{Na Cl}$
306. **Lapis Lazuli**			
307. **Hauynite**	1:3:4+	$(\frac{1}{4}\dot{\text{Na}}^3+\frac{3}{4}\ddot{\bar{\text{A}}}\text{l})^2\ddot{\text{Si}}^3[+\dot{\text{Ca}}\dddot{\text{S}}]$	$\text{Si}\|\Theta_4\|(\frac{1}{4}\text{Na}_2+\frac{3}{4}\beta\bar{\text{A}}\text{l})_2+\frac{1}{3}\text{Q}$
308. **Nosite**	1:3:4+	$(\frac{1}{4}\dot{\text{Na}}^3+\frac{3}{4}\ddot{\bar{\text{A}}}\text{l})^2\ddot{\text{Si}}^3[+\frac{1}{3}\dot{\text{Na}}\dddot{\text{S}}]$	$\text{Si}\|\Theta_4\|(\frac{1}{4}\text{Na}_2+\frac{3}{4}\beta\bar{\text{A}}\text{l})_2+\frac{1}{6}\text{Q}$.
309. **Leucite**	1:3:8	*a* $(\frac{1}{4}\dot{\text{K}}^3+\frac{3}{4}\ddot{\bar{\text{A}}}\text{l})^2\ddot{\text{Si}}^3+3\ddot{\text{Si}}$	$\text{Si}\|\Theta_4\|(\frac{1}{4}\text{K}_2+\frac{3}{4}\beta\bar{\text{A}}\text{l})_2+\text{Si}\Theta^2$
	r=1:2	*b* $(\frac{1}{6}\dot{\text{K}}^3+\frac{3}{6}\ddot{\bar{\text{A}}}\text{l}+\frac{2}{6}\ddot{\text{Si}}^{\frac{3}{2}})^2\ddot{\text{Si}}^3$	$\text{Si}\|\Theta_4\|(\frac{1}{6}\text{K}_2+\frac{3}{6}\beta\bar{\text{A}}\text{l}+\frac{2}{6}\gamma\text{Si})_2$

XIII. FELDSPAR GROUP. Monoclinic or triclinic. O. ratio for protoxyds and sesquioxyds 1 : 3.

310. **Anorthite**	1:3:4	$(\frac{1}{4}\dot{\text{Ca}}^3+\frac{3}{4}\ddot{\bar{\text{A}}}\text{l})^2\ddot{\text{Si}}^3$	$\text{Si}\|\Theta_4\|(\frac{1}{4}\bar{\text{C}}\text{a}+\frac{3}{4}\bar{\text{A}}\text{l})_2$
311. **Labradorite**	1:3:6	*a* $(\frac{1}{4}(\dot{\text{Ca}},\dot{\text{Na}})^3+\frac{3}{4}\ddot{\bar{\text{A}}}\text{l})^2+\frac{1}{2}\ddot{\text{Si}}^3$	$\text{Si}\|\Theta_4\|(\frac{1}{4}(\bar{\text{C}}\text{a},\text{Na}_2)+\frac{3}{4}\beta\bar{\text{A}}\text{l})_2+\frac{1}{2}\text{Si}\Theta^2$
	r=1:1½	*b* $(\frac{1}{5}(\dot{\text{Ca}},\dot{\text{Na}})^3+\frac{3}{5}\ddot{\bar{\text{A}}}\text{l}+\frac{1}{5}\ddot{\text{Si}}^{\frac{3}{2}})^2\ddot{\text{Si}}^3$	$\text{Si}\|\Theta_4\|(\frac{1}{5}(\bar{\text{C}}\text{a},\text{Na}_2)+\frac{3}{5}\beta\bar{\text{A}}\text{l}+\frac{1}{5}\gamma\text{Si})_2$
312. **Andesite**	1:3:8	*a* $(\frac{1}{4}(\dot{\text{Ca}},\dot{\text{Na}})^3+\frac{3}{4}\ddot{\bar{\text{A}}}\text{l})^2\ddot{\text{Si}}^3+3\ddot{\text{Si}}$	$\text{Si}\|\Theta_4\|(\frac{1}{4}(\bar{\text{C}}\text{a},\text{Na}_2)+\frac{3}{4}\beta\bar{\text{A}}\text{l})_2+\text{Si}\Theta_2$
	r=1:2	*b* $(\frac{1}{6}(\dot{\text{Ca}},\dot{\text{Na}})^3+\frac{3}{6}\ddot{\bar{\text{A}}}\text{l}+\frac{2}{6}\ddot{\text{Si}}^{\frac{3}{2}})^2\ddot{\text{Si}}^3$	$\text{Si}\|\Theta_4\|(\frac{1}{6}(\bar{\text{C}}\text{a},\text{Na}_2)+\frac{3}{6}\beta\bar{\text{A}}\text{l}+\frac{2}{6}\gamma\text{Si})_2$
313. **Hyalophane**	1:3:8	*a* $(\frac{1}{4}(\dot{\bar{\text{B}}}\text{a},\dot{\text{K}})^3+\frac{3}{4}\ddot{\bar{\text{A}}}\text{l})^2\ddot{\text{Si}}^3+3\ddot{\text{Si}}$	$\text{Si}\|\Theta_4\|(\frac{1}{4}(\bar{\text{B}}\text{a},\text{K}_2)+\frac{3}{4}\beta\bar{\text{A}}\text{l})_2+\text{Si}\Theta_2$
	r=1:2	*b* $(\frac{1}{6}(\dot{\bar{\text{B}}}\text{a},\dot{\text{K}})^3+\frac{3}{6}\ddot{\bar{\text{A}}}\text{l}+\frac{2}{6}\ddot{\text{Si}}^{\frac{3}{2}})^2\ddot{\text{Si}}^3$	$\text{Si}\|\Theta_4\|(\frac{1}{6}(\bar{\text{B}}\text{a},\text{K}_2)+\frac{3}{6}\beta\bar{\text{A}}\text{l}+\frac{2}{6}\gamma\text{Si})_2$
314. **Oligoclase**	1:3:9	*a* $(\frac{1}{4}(\dot{\text{Ca}},\dot{\text{Na}})^3+\frac{3}{4}\ddot{\bar{\text{A}}}\text{l})^2\ddot{\text{Si}}^3+3\frac{3}{4}\ddot{\text{Si}}$	$\text{Si}\|\Theta_4\|(\frac{1}{4}(\bar{\text{C}}\text{a},\text{Na}_2)+\frac{3}{4}\beta\bar{\text{A}}\text{l})_2+1\frac{1}{4}\text{Si}\Theta_2$
	r=1:2¼	*b* $(\frac{2}{13}(\dot{\text{Ca}},\dot{\text{Na}})^3+\frac{6}{13}\ddot{\bar{\text{A}}}\text{l})+\frac{5}{13}\ddot{\text{Si}}^{\frac{3}{2}})^2\ddot{\text{Si}}^3$	$\text{Si}\|\Theta_4\|(\frac{2}{13}(\bar{\text{C}}\text{a},\text{Na}_2)+\frac{6}{13}\beta\bar{\text{A}}\text{l}+\frac{5}{13}\gamma\text{Si})_2$
315. **Albite**	1:3:12	*a* $(\frac{1}{4}\dot{\text{Na}}^3+\frac{3}{4}\ddot{\bar{\text{A}}}\text{l})^2\ddot{\text{Si}}^3+6\ddot{\text{Si}}$	$\text{Si}\|\Theta_4\|(\frac{1}{4}\text{Na}_2+\frac{3}{4}\beta\bar{\text{A}}\text{l})_2+2\,\text{Si}\Theta^2$
	r=1:3	*b* $(\frac{1}{8}\dot{\text{Na}}^3+\frac{3}{8}\ddot{\bar{\text{A}}}\text{l}+\frac{4}{8}\ddot{\text{Si}}^{\frac{3}{2}})^2\ddot{\text{Si}}^3$	$\text{Si}\|\Theta_4\|(\frac{1}{8}\text{Na}_2+\frac{3}{8}\beta\bar{\text{A}}\text{l}+\frac{4}{8}\gamma\text{Si})_2$
316. **Orthoclase**	1:3:12	*a* $(\frac{1}{4}\dot{\text{K}}^3+\frac{3}{4}\ddot{\bar{\text{A}}}\text{l})^2\ddot{\text{Si}}^3+6\ddot{\text{Si}}$	$\text{Si}\|\Theta_4\|(\frac{1}{4}\text{K}_2+\frac{3}{4}\beta\bar{\text{A}}\text{l})+2\,\text{Si}\Theta^2$
	r=1:3	*b* $(\frac{1}{8}\dot{\text{K}}^3+\frac{3}{8}\ddot{\bar{\text{A}}}\text{l}+\frac{4}{8}\ddot{\text{Si}}^{\frac{3}{2}})^2\ddot{\text{Si}}^3$	$\text{Si}\|\Theta_4\|(\frac{1}{8}\text{K}_2+\frac{3}{8}\beta\bar{\text{A}}\text{l}+\frac{4}{8}\gamma\text{Si})_2$

Appendix. 317. **Eulytite.** 318. **Atelestite.**

In the preceding table the column of ratios contains the oxygen ratios for the *protoxyds* and *silica* or the *deutoxyds* and *silica*, where no sesquioxyd bases are present, as in the first, second, and third groups, and species 282; for the *protoxyds*, *sesquioxyds*, and *silica*, where the bases include elements in each of these three states, as in all the other groups. In species 285, the ratio is for the protoxyds, sesquioxyds, tritoxyds, and silica.

The letter r (species 268, 287, 293, etc.) signifies oxygen ratio between the bases and silica. This ratio is stated only when the silica is in excess above that of the unisilicate type, and it exhibits the amount of that excess. Q is used in the second column of formulas for any accessory constituents not silica; its value in each case may be derived from the part of the corresponding formula in the first column which is in brackets. In species 265 it stands for $(\dot{\rm Fe},\dot{\rm Mn})\ddot{\rm Cb}$ 284B, for $\ddot{\overline{\rm Fe}}\dot{\rm H}$; and so on.

Examples of an excess of silica occur in many of the above groups; namely, the Chrysoli group, in leucophanite; Phenacite group, in meliphanite; the Epidote group, in jadeite and pe haps in saussurite; the Iolite group; the Mica group, in muscovite, lepidolite, and cryophylli Scapolite group, in wernerite, ekebergite, mizzonite, dipyre, marialite; Nephelite group; Leuc group, in leucite; Feldspar group, in all the species excepting anorthite.

It has been shown that this excess of silica is often connected directly with the alkaline natu of the base, and increases with increased alkalinity, as if the former were determined by the latt The following are the ratios between the non-alkaline and alkaline portions of the base in t above mentioned groups, as decided from the mean of the analyses, together with the ratios the bases and silica:

		Bases		Silica	Non-alk.		Alk.
Chrysolite Gr.—	Chrysolite, etc.	1	:	1	all non-alk.		
	Leucophanite	1	:	1⅔	4⅓	:	1
Phenacite Gr.—	Phenacite, etc.	1	:	1	all non-alk.		
	Meliphanite	1	:	1⅓	6	:	1
Epidote Gr.—	Epidote	1	:	1	all non-alk.		
	Zoisite	1	:	1	all non-alk.		
	Saussurite	1	:	1⅙	6	:	1
	Jadeite	1	:	2	1	:	2
Mica Gr.—	Astrophyllite	1	:	1	6	:	1
	Phlogopite	1	:	1	3	:	1
	Biotite	1	:	1	3	:	1
	Lepidomelane	1	:	1	2—1	:	1
	Muscovite	1	:	1⅓	1	:	2—6
	Lepidolite	1	:	1½	1	:	3—12
	Cryophyllite	1	:	2	1	:	2⅓
Scapolite Gr.—	Sarcolite	1	:	1	9	:	1
	Meionite	1	:	1	10	:	1
	Paranthite	1	:	1	all non-alk.		
	Wernerite	1	:	1⅓	4	:	1
	Ekebergite	1	:	1½	2¼	:	1
	Mizzonite	1	:	1¾			
	Dipyre	1	:	2	1	:	1
	Marialite	1	:	2 (or 2⅙)	1	:	2
Nephelite Gr.—	Nephelite	1	:	1⅛			
Leucite Gr.—	Sodalite	1	:	1	all *soda.*		
	Leucite	1	:	2	all *potash.*		
Feldspar Gr.—	Anorthite	1	:	1	all non-alk.		
	Labradorite	1	:	1½	2	:	1
	Hyalophane	1	:	2	1⅓	:	1
	Andesite	1	:	2	1	:	1
	Oligoclase	1	:	2¼	1	:	2
	Albite	1	:	3	all alk.		
	Orthoclase.	1	:	3	all alk.		

In each of the groups in this table the increase in the proportion of silica is accompanied wi an increase in the proportion of alkalies. Iolite is an exception, as it contains, according to th analyses hitherto made, no alkalies. Sphenoclase (No. 275) is another, but the mineral is uncry tallized, and it is too little known to be considered in this connection.

The two formulas *a* and *b*, for the species containing this excess of silica, are those explaine on page 204, the *first* making the excess *accessory* silica, the *second* making *half* of the excess *basi*

In connection with the descriptions of the species beyond, only the formulas of the first of th two kinds are given in full.

257. FORSTERITE. *Levy*, Ann. Phil. II., vii. 59, 1824. Peridoto bianco *Scacchi*, Distrib. Sist. Min., 63, Napoli, 1842. White Olivine. Boltonite *Shep.*, Min., i. 78, 1835.

Orthorhombic. Form and angles as in chrysolite. Observed planes: O; vertical, $i\text{-}\bar{i}$, $i\text{-}\breve{i}$, I, $i\text{-}2$, $i\text{-}\breve{\tfrac{3}{2}}$, $i\text{-}\breve{\tfrac{5}{2}}$; domes, $1\text{-}\bar{i}$, $1\text{-}\breve{i}$, $\tfrac{1}{2}\text{-}\breve{i}$; octahedral, 1, $1\text{-}2$, $\tfrac{3}{2}\text{-}\breve{\tfrac{3}{2}}$. Cleavage: $i\text{-}\breve{i}$ and O. In attached crystals. Also in imbedded imperfect crystals, grains, or masses.

H.=6—7. G.=3·21—3·33. Lustre vitreous. Transparent—translucent. Color white, yellowish-white, wax-yellow, grayish, bluish-gray, greenish; sometimes becoming yellowish on exposure when not in distinct crystals. Streak uncolored.

Var.—1. *Forsterite*, white crystals from Vesuvius, H.=7; G.=3.243, Rammelsberg. 2. *Boltonite*, imbedded mineral of other tints, from Bolton, etc., Mass.; H.=6—6·5, G.=3.208—3·328, Smith; 3·21, Breith.

Comp.—$Mg^2\ddot{Si}$=Silica 42·86, magnesia 57·14=100. Analyses: 1, Rammelsberg (Pogg., cix. 568); 2, J. L. Smith (Am. J. Sci., II. xviii. 372); 3, G. J. Brush (ib., xxvii. 395):

	$\ddot{Si}$	$\ddot{\bar{Al}}$	$\dot{Mg}$	$\dot{Ca}$	$\dot{Fe}$	ign.	
1. *Forsterite*	42·41	——	53·30	——	2·33	——	= 98·04 Ramm.
2. *Boltonite* (⅔)	42·31	0·17	51·16	——	2·78	1·90	= 98·32 Smith.
3. "	42·82	*tr.*	54·44	0·85	1·47	0·76	=100·34 Brush.

Pyr., etc.—B.B. unaltered and infusible. Boltonite gives traces of moisture in the closed tube and becomes colorless. Decomposed by muriatic acid with separation of gelatinous silica in both forsterite and boltonite.

Obs.—Forsterite occurs in implanted crystals, with spinel and augite at Vesuvius. Boltonite is disseminated through a whitish crystalline limestone, at Bolton, Mass.; also at Roxbury and Littleton, Mass.; its imbedded masses or crystals are often over an inch through, and rectangular in section. Part of the boltonite is altered, and thence softer and hydrous, with the composition of villarsite (p.—).

On cryst., B. & M., Min., 318; Hessenberg, Min. Not., No. I., 22.

Forsterite was named by Levy after Mr. Forster, a patron of mineralogy.

Artif.—Artificial magnesia-chrysolite has been made by Ebelmen, by fusing together in a porcelain furnace a mixture of silica and magnesia, with carbonate of potash, or boric acid.

TITANIFEROUS CHRYSOLITE. A massive, reddish-brown mineral from the talcose schist of Pfunders in the Tyrol, having some resemblance to boltonite, and G.=3·25. Contains, according to Damour (Ann. d. M., IV. viii. 90), 3·5 to 5·3 of titanic acid, with 6 p. c. of protoxyd of iron. For analyses see Nos. 1 and 2 on page 257.

The condition of the titanium has not been satisfactorily ascertained. There is a deficiency of silica which it may supply. But if it exists in the mineral as titanic iron, the rest is a magnesian chrysolite, like boltonite, with but little $\dot{Fe}$ replacing $\dot{Mg}$.

258. MONTICELLITE. *Brooke*, Ann. Phil., 1831. Batrachit *Breith.*, Char., 307, 1832.

Orthorhombic, and isomorphous with chrysolite. Occurring planes, $i\text{-}\breve{i}$, $i\text{-}2$, I, $1\text{-}\breve{i}$, $2\text{-}2$. In crystals. Also massive, with two cleavages inclined to one another 115°, and another diagonal to this angle.

H.=5—5·5. G.=3·03—3·25. Lustre vitreous, slightly resinous in the massive variety. Colorless, yellowish-gray, pale greenish-gray, and whitish. Streak uncolored. Transparent to translucent. Fracture more or less conchoidal.

Var.—(1) *Monticellite*, in colorless to yellowish-gray crystals, from Vesuvius; G.=3·119—

3·245. (2) *Batrachite*, cleavable massive, of a pale greenish-gray color, or whitish; G.=3 0 Breith.

Comp.—$(\frac{1}{2}\dot{\mathrm{C}}\mathrm{a}+\frac{1}{2}\dot{\mathrm{M}}\mathrm{g})^2\ddot{\mathrm{S}}\mathrm{i}$=Silica 38·5, lime 35·9, magnesia 25·6=100. One-eighth of the I is replaced by $\dot{\mathrm{F}}\mathrm{e}$. Analyses: 1, Rammelsberg (Pogg., cix. 569); 2, id. (Pogg., li. 446):

	$\ddot{\mathrm{S}}\mathrm{i}$	$\dot{\mathrm{F}}\mathrm{e}$	$\dot{\mathrm{M}}\mathrm{g}$	$\dot{\mathrm{C}}\mathrm{a}$	ign.
1. *Monticellite*	37·89	5·61	22·04	34·92	——=100·46 Ramm.
2. *Batrachite*	37·69	2·99	21·79	35·45	1·27=99·19 Ramm.

Pyr., etc.—B.B. rounded only on the edges. Soluble in dilute muriatic acid to a clear soluti which on heating gelatinizes.

Obs.—Monticellite occurs in crystals imbedded in granular limestone with mica and augite, Mt. Somma. *Batrachite* is found in small masses containing black spinel, at Mt. Rinzoni in Tyrol.

Monticellite was named after the Italian mineralogist, Monticelli; *Batrachite* from βάτραχος, fr in allusion to the color.

259. CHRYSOLITE. Smaragdus?, Beryllus?, pt. *Vet.* Topazos? pt. *Plin.* Not Chrysolitl [=Topaz] *Plin.*, xxxvii. 42. Chrysolit, Gemma pellucidissima colore viridi subflavo in ig fugaci (description also says quadrangular, infusible, etc.), *Wall.*, Min., 118, 1747. Peri ordinaire [not the Oriental] *d'Argenville*, Orykt., 161, 1755. Gulgrön Topas=Chrysolit *Cron* Min., 43, 1758. Chrysolite ordinaire *de Lisle*, Crist., 230, 1772, ii. 271, 1783 [not Peridot Ceylan=Tourmaline ib., ii. 346]. Krisolith *Wern.*, Bergm. J., 373, 1789+Olivine (fr. bas [=Chrysolite des Volcans *Faujas*, Vivarais, 1778.] *Wern.*, ib., 55, 1790. Peridot *H.*, Tr., 1801. Hyalosiderit *Walchner*, Schw. J., xxxix. 65, 1823. Glinkit *Romanovski*, Bergjourn Russ., Oct. 1847; ident. with Chrysolite, *Beck*, Verh. Min. Ges. St. Pet., 244, 1847.

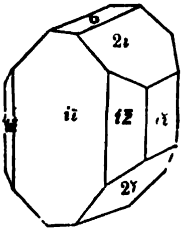
Orthorhombic. $I \wedge I$=94° 2′; $O \wedge 1\text{-}\bar{i}$=128° 28′; $a:b:c$=1·2588 : 1·0729.

$O \wedge 1\text{-}\breve{2}$=125° 45′.
$O \wedge 1$=120 10
$O \wedge \frac{3}{2}\text{-}\breve{\frac{3}{2}}$=114 48
$O \wedge \frac{1}{2}\text{-}\breve{i}$=149 36

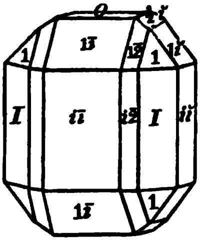
$O \wedge 1\text{-}\breve{i}$=130° 26½′
$1 \wedge 1$, mac.,=107 45
$1 \wedge 1$, br.,=101 32
$i\text{-}\breve{2} \wedge i\text{-}\breve{2}$, ov. $i\text{-}\bar{i}$,=130 2

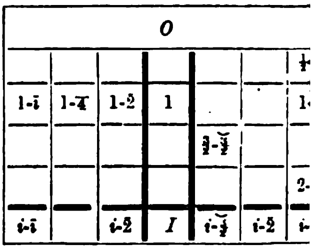
$i\text{-}\breve{\frac{3}{2}} \wedge i\text{-}\breve{\frac{3}{2}}$, ov. $i\text{-}\breve{i}$,=108° 5
$i\text{-}\breve{2} \wedge i\text{-}\breve{2}$, ov. $i\text{-}\breve{i}$,=123 3
$i\text{-}\bar{i} \wedge 1\text{-}\breve{2}$=137 21.
$\frac{1}{2}\text{-}\breve{i} \wedge \frac{1}{2}\text{-}\breve{i}$=119 12

236



237





Observed Planes.

Cleavage: $i\text{-}\breve{i}$ rather distinct. Massive and compact, or granular; usual in imbedded grains.

H.=6–7. G.=3·33–3·5. Lustre vitreous. Color green—common olive-green, sometimes brownish, grayish-red, grayish-green. Stre usually uncolored, rarely yellowish. Transparent—translucent. Fra ture conchoidal. Double refraction positive; obtuse bisectrix normal to i

Comp., Var.—$(\dot{\mathrm{M}}\mathrm{g}, \dot{\mathrm{F}}\mathrm{e})^2\ddot{\mathrm{S}}\mathrm{i}$, with traces at times of $\dot{\mathrm{M}}\mathrm{n}$, $\dot{\mathrm{C}}\mathrm{a}$, $\dot{\mathrm{N}}\mathrm{i}$. The amount of $\dot{\mathrm{F}}\mathrm{e}$ var much. When there are 9 $\dot{\mathrm{F}}\mathrm{e}$ to 50 $\dot{\mathrm{M}}\mathrm{g}$ (anal. 5, 7), the ratio of $\dot{\mathrm{F}}\mathrm{e}$ to $\dot{\mathrm{M}}\mathrm{g}$ is 1 : 10; when 16 to 43 $\dot{Mg}$ (anal. 22) nearly 1 : 5; when 22½ $\dot{Fe}$ to 39 $\dot{Mg}$ (anal. 26) nearly 1 : 3; when 28½ $\dot{Fe}$ to 32 $\dot{Mg}$, as in *hyalosiderite*, the ratio is 1 : 2, and the special formula $(\frac{2}{3}\dot{Mg}+\frac{1}{3}\dot{Fe})^2\ddot{Si}$, or $2\dot{Mg}^2\ddot{Si}+\dot{Fe}^2\ddot{Si}$. This species is ordinarily divided into

1. *Precious.* Of a pale yellowish-green color, and transparent, so as to be fit for jewelry; G.=3·441, 3·3514. Occasionally seen in masses as large as "a turkey's egg," but usually much smaller. It has long been brought from the Levant for jewelry, but the exact locality is not known. Well-defined crystals of chrysolite an inch across are very uncommon. The proportion of iron to magnesia may be either small or large, as in the following.

2. *Common; Olivine* of Werner. Dark yellowish-green to olive- or bottle-glass-green; G.=3·334, fr. Etna. Commonly disseminated in basalt and lavas, in grains, and also at times in large masses having a rectangular outline, showing that they are crystals, although made up apparently of grains; these masses sometimes weighing 30 lbs. Also constituting rocks.

Glinkite is pale-green chrysolite from talcose schist; G.=3·39—3·43, Herm. *Hyalosiderite* is a very ferruginous kind (anal. 27); the specimen analyzed was partially decomposed, being iridescent and submetallic in lustre.

Analyses: 1, 2, Damour (Ann. d. M., V. viii. 90); 3, Genth (Ann. Ch. Pharm., lxvi. 20); 4, id. (Am. J. Sci., II. xxxiii. 199); 5, Manice (ib., xxxi. 359); 6, 7, Stromeyer (Gel. Anz. Gött., 1824, 208; Pogg., iv. 193); 8, Walmstedt (Ak. H. Stockh., 1824, ii. 359, and Schw. J., xliv. 25); 9, Hauan (Verh. G. Reichs., 1867, 71); 10, Kjerulf (J. pr. Ch., lxv. 187); 11, Reuter (ZS. G., xvi. 342); 12, Madelung (ib.); 13, Waltershausen (Vulk. Gest., 117); 14, Rammelsberg (Min. Ch. 438); 15, Walmstedt (l. c.); 16, Stromeyer (l. c.); 17, Kalle (Ramm. Min. Ch., 438); 18, Damour (Bull. G. Soc., II. xix. 414); 19, Rammelsberg (l. c.); 20, Walmstedt (l. c.); 21, Deville (Et Geol. Canaries); 22, Lappe (Pogg., xliii. 669); 23, Schmid (Pogg., lxxxiv. 501); 24, W. v. Beck (Verh. Min. St. Pet., 1847); 25, Domeyko (Ann. d. M., IV. xiv. 187); 26, T. S. Hunt (Am. J Sci., II. xxix. 283); 27, Walchner (Schw. J., xxxix. 65):

	$\ddot{Si}$	$\dot{Fe}$	$\dot{Mn}$	$\dot{Mg}$
1. Pfunders, *bnh.-rd.*	36·30	6·00	0·60	49·65, $\ddot{Ti}$ 5·30, $\dot{H}$ 1·75=99·80 Damour.
2. " "	36·87	6·21	0·60	50·14, $\ddot{Ti}$ 3·51, $\dot{H}$ 1·71=99·04 Damour.
3. Hecla	43·44	6·93	——	49·31, $\ddot{Al}$ *tr.*, $\dot{Ni}$ 0·32, $\dot{Co}$ *tr.*=100 Genth.
4. Webster, N. C., *gnh.* (¾)	41·17	7·35	——	49·16, $\dot{Ca}$ 0·04, $\dot{Ni}$ 0·41, gangue 1·23, ign. 0·69 =100·05 Genth.
5. Thetford, Vt.	40 75	9·36	——	50·28=100·36 Manice.
6. Vogelsberg	40·09	8·17	$\ddot{Mn}$ 0·20	50·49, $\ddot{Al}$ 0·19, $\dot{Ni}$ 0·37=99·51 Stromeyer.
7. *Oriental Chrysolite*	39·73	9·19	" 0·09	50·13, $\ddot{Al}$ 0·22, $\dot{Ni}$ 0·32=99·68 Stromeyer.
8. Iserwiese	41·54	8·66	0 25	50·04, $\ddot{Al}$ 0·06=100·55 Walmstedt.
9. Norway. *a rock*	37·42	8·88	0·17	48·22, $\ddot{Al}$ 0·10, $\dot{Ni}$ 0·23 ign. 4·71=99·7 3Hauan.
10. Eifel, *wine-yw.*	42·21	8·91	——	49·29, $\ddot{Al}$ 0·18, $\ddot{Cr}$ 0·004, ign. 0·12=100·72 Kj'lf.
11. Dun Mtn., *Dunyte*	42·80	9·40	——	47·38, $\dot{Ni}$, $\dot{Co}$, $\dot{Na}$, *tr.* $\dot{H}$ 0·57=100·15 Reuter.
12. " " "	42·69	10·09	——	46·90, $\dot{Ni}$ *tr.*, $\dot{H}$ 0·49=100·17 Madelung.
13. Etna	41·01	10·06	——	47·27, $\ddot{Al}$ 0·64, $\dot{Ni}$ 0·20, $\dot{H}$ 1·04=100·22 Walt.
14. Petschau	44·67	10·76	——	41·84, $\ddot{Al}$ 0·23 $\dot{Ca}$ 2·35=99·85 Ramm.
15. Pallas meteorite	40·83	11·53	0·29	47·74, $\ddot{Al}$ *tr.*, $\dot{Ca}$ *tr.*=100·39 Walmstedt.
16. ———? *meteoric*	38·25	11·75	0·11	49·68=99·79 Stromeyer.
17. Vesuvius	40·35	12·34	——	46·70=99·39 Kalle.
18 Lake Lherz	40·59	13·73	1·60	43·13=99·05 Damour.
19. Carlsbad	39·34	14·85	——	45·81=100 Rammelsberg.
20. Mt. Somma	40·08	15·26	0·48	44·22, $\ddot{Al}$ 0·18=100·24 Walmstedt.
21. C. Verdes, Fogo I.	40·19	15·27	2·27	35·70, $\ddot{Al}$ 0·80, $\dot{Ca}$ 5·12=99·35 Deville.
22. Greenland	40·00	16·21	0·55[a]	43·09, $\ddot{Al}$ 0·06=99·91 Lappe.
23. Atacama, *meteoric*	36·92	17·21	1·81	43·16=99·10 Schmid.
24. *Glinkite* (⅔)	39·21	17·45	——	44·06=100·72 Beck.
25. Antuclo, Chili	40·70	19·60	——	39·70=100 Domeyko.
26. Near Montreal	37·17	22·54	——	39·68=99·30 Hunt.
27. *Hyalosiderite*	31·63	29·71	$\ddot{Mn}$ 0·48	32·40, $\ddot{Al}$ 2·21, $\dot{K}$ 2·79, Cr *tr.*=99·23 Walchner.

[a] With some $\dot{Ni}$.

Berzelius detected oxyd of tin in the olivine of the Pallas meteorite; Rummler a trace of arsenous acid A. Erdmann found a trace of fluorine in that of Elfdalen, and of Tunaberg. Walchner obtained in anal. 26 0·330 grms. of $\dot{Fe}$ (out of 1·040 grms. under analysis), from which he deduced 30·9 grms. of $\dot{Fe}$, or 29·71 p. c.

Pyr., etc.—B.B. whitens, but is infusible; with the fluxes gives reactions for iron. Hyalosiderite and other varieties rich in iron fuse to a black magnetic globule. Some varieties give reactions for titanic acid and manganese. Decomposed by muriatic and sulphuric acids with sepa tion of gelatinous silica. G. before ignition, 3·389; after, 3·378.

Obs.—A common constituent of some eruptive rocks; and also occurring in or among met morphic rocks, with talcose schist, hypersthene rocks, and serpentine; or as a rock formatio also a constituent of many meteorites. The eruptive rocks, basalt and basaltic lava, consist chrysolite (the variety *olivine*), along with labradorite or other feldspar, and augite. Thou usually in grains, it is sometimes in rectangular masses several inches thick.

A chrysolite rock occurring at L. Lherz, consisting largely of chrysolite, has been called *Lherzol* (See p. 147, under SPINEL). The *dunyte* of F. v. Hochstetter (ZS. G. Ges., xvi. 341) is the same roc according to Sandberger. The latter has a grayish-green color, and greasy and vitreous lustre, wi G.=3·295, and occurs with serpentine rock in Dun Mtn., near Nelson in New Zealand. Anoth similar rock from Moravia, called *picryte*, consists half of chrysolite, along with feldspar, diallag hornblende, and magnetite. Another from Norway (called *Olivinfels* in German, or olivine rock) h very nearly the composition of pure chrysolite (anal 9); G.=3·24—3·32, Kjerulf (l. c.); gran lar in texture; of olive to bottle-green color; it contains some talc, tremolite, and bronzite.

Occurs in eruptive rocks at Vesuvius, Sicily, Hecla, Sandwich Islands, and most volcanic i ands or regions; at Expailly in Auvergne; at Unkel, on the Rhine, crystals several inch long; at Kapfenstein in Lower Styria, in spheroidal masses; at Sasbach and Ihringen in Kaise stuhl, Switz.; near Freiburg, Baden, in dolerite, a variety containing much iron (*hyalosid ite*); in Thetford and Norwich, Vermont, in boulders of coarsely cryst. basalt, the crystals masses several inches through; in dolerite or basalt in Canada, near Montreal, at Rougemont a Mounts Royal and Montarville (anal. 26).

In talcose schist, found near Kyschtimsk, N. of Miask, and near Syssersk in the Ural, in gree ish imbedded nodules (*glinkite*, anal. 24); id. at Webster, in Jackson Co., N. C. (G.=3·28), alo with serpentine, pyrosclerite, and chromite; with chromite in Loudon Co., Va.; in Lancast Co., Pa, at Wood's mine, with serpentine and chromite (Genth); near Media, Delaware Co., P with hornblende, magnetite, and chromite. In hypersthene rock at Elfdalen.

Among the meteorites containing chrysolite, there are the Pallas from Siberia, others fro Atacama, Steinbach, etc.

On cryst., Kokscharof, Bull. Ak. St. Pet., ix. 235. Gives $1\text{-}\breve{2} \wedge 1\text{-}\breve{2}$, ov. $O,=71° 30'$, whence $1\text{-}\breve{2}=125° 45'$, $i\text{-}\breve{2} \wedge i\text{-}\breve{2}$, ov. $i\text{-}\breve{i},=49° 55'$, whence ov. $i\text{-}\bar{i}=130° 5'$.

Most of the crystals are fragile, and therefore unfit for use as gems.

Named from χρυσός, gold, and λίθος. The hyalosiderite, from ὕαλος, glass, and σίδηρος, iron.

The *Chrysolithus* of Pliny was probably our topaz; and his *topaz* our *chrysolite*. But Plin statement that "topazos" is the largest of all the precious stones, and that a statue 4 cubits hi was made of it, shows that he confounded together different stones, since solid chrysolite crysta are never as large as some topaz crystals, and two inches is an extraordinary magnitude. Th hardness mentioned, that it yields to the action of the file and wears with use, is right, and seen to prove that true chrysolite was included under the name of *topazion*. It came from an island the Red Sea, and was very highly valued. It is stated by Diodorus Siculus to have resembl glass, but to have had a remarkable golden appearance, especially conspicuous at night (King).

Alt.—Alteration of chrysolite often takes place through the oxydation of the iron; t mineral becomes brownish or reddish-brown and iridescent. It also splits into thin lamina the change goes on, sometimes so as to resemble a mica. A basalt thus changed was on pointed out to the author as a mica slate, although no further change had taken place than th here mentioned. *Chusite*, *Limbilite*, and *Sideroclepte* of Saussure (J. de Phys., 341, 1794), all fro Limburg in Brisgau, are chrysolite more or less altered. The process may end in leaving t cavity of the crystal filled with limonite or red oxyd of iron.

Under the action of carbonated waters, the iron is often carried off instead of being perox dized, and also some of the magnesia is removed at the same time; and thus may come *serpe tine*, *picrosmine*, which often retain the crystalline form of chrysolite. A further change m produce *steatite* and other magnesian species.

For analyses of altered chrysolite see Walmstedt, in Ak. H. Stockh., 1824, and Ramm. Mi Ch., 441; Rhodius in Ann. Ch. Pharm., lxiii. 116, and Ramm. Min. Ch., 441; Lewinstein Jahresb., 1860, 757; A. Madelung, Jahrb. G. Reichs., xiv. 1, Jahrb. Min., 1864, 628; W. Jun B. H. Ztg., xxii. 289.

260. FAYALITE. *C. G. Gmelin*, Pogg., li. 1839. Eisenperidot, Eisenglas, *Germ.* Ir Chrysolite. Anhydrous Silicate of Iron.

Massive, crystalline. Cleavage in two directions at right angles to on another.

H.=6·5. G.=4—4·14; 4·138, Fayal; 4·006, Ireland, Delesse. Lustre metalloid, somewhat resinous in the fracture. Color black, greenish, or brownish-black; sometimes iridescent. Opaque. Fracture imperfectly conchoidal. Attractable by the magnet.

Comp.—$\dot{Fe}^2\dddot{Si}$=Silica 29·5, protoxyd of iron 70·5=100. Analyses: 1, Gmelin (Pogg., li. [illegible]; 2, Fellenberg (ib.); 3, Rammelsberg (Min. Ch., 435); 4, Thomson (Min., i. 461); 5, Delesse (Bul. G. Fr., II. x. 568):

	$\dddot{Si}$	$\bar{\dddot{Al}}$	$\dot{Fe}$	$\dot{Mn}$	$\dot{Mg}$	$\dot{Ca}$	$\dot{Cu}$
1. Fayal	30·24	3·54	58·27	3 54	——	——	0·86, Fe S 2·33=98·78 Gmelin.
2. "	29·15	4·06	60·95	0·69	2·38	0·72	0·31, $\dot{Pb}$ 1·55=99·81 Fell.
3. "	28·27	3·45	63·80		*tr.*	0·45	1·29, Fe S 3·35=100·61 Ramm.
4. Slavcarrach	29·60	——	68·73	1·78	——	——	——=100·11 Thomson.
5. "	29·50	*tr.*	63·54	5·07	0·30	——	——=98·41 Delesse.

Pyr., etc.—Fuses readily to a black magnetic globule. Gelatinizes with acids.

Obs.—From the Mourne Mts., Ireland, at Slavcarrach, near Bryansford, in pegmatite; forms nodules in volcanic rocks at Fayal, of the Azores. Obsidian or volcanic glass often approaches fayalite in composition.

Artif.—Iron-chrysolite sometimes occurs in crystals as a furnace slag, as noticed by Hausmann in 1812, and later by Mitscherlich and others. The *vulkanisches Eisenglas* of Klaproth (Beitr., v. [illegible]), which afforded the above composition, was a slag according to G. Rose. It is a common product of the puddling furnace.

261. IRON-MANGANESE CHRYSOLITE. (*A. Erdmann*, Ak. H. Stockh., 1849; var. olivine, his Min., [illegible] 1853.) Near fayalite, but contains, besides protoxyd of iron, some protoxyd of manganese [illegible], with also a little magnesia, approaching thus hyalosiderite.

One of three agreeing analyses afforded Erdmann (l. c.):

$\dddot{Si}$	$\bar{\dddot{Al}}$	$\dot{Fe}$	$\dot{Mn}$	$\dot{Mg}$	$\dot{Ca}$
29·16	1·56	55·87	8·47	3·28	2·29=100·58.

It gives the formula, 6 $\dot{Fe}^2\dddot{Si}$+1 $\dot{Mn}^2\dddot{Si}$+$(\dot{Mg}, \dot{Ca})^2\dddot{Si}$, Rammelsberg. It occurs in a gneissoid rock called *Eulysyte*, consisting in part of augite and garnet, at Tunaberg in Sweden.

A *furnace-product*, which is a *lime-iron-manganese* chrysolite, has been observed in clove-brown crystals at an iron-furnace in Easton, Pa. An analysis afforded Dr. C. T. Jackson (Am. J. Sci., II. xx. 358), $\dddot{Si}$ 33·70, $\dot{Ca}$ 31·80, $\bar{\dddot{Fe}}$ 18·00, $\dot{Mn}$, $\bar{\dddot{Mn}}$ 14·90, $\bar{\dddot{Al}}$ 3·50=101·90. Taking the iron and manganese as protoxyd, as so regarded by Dr. Jackson, the formula is $(\dot{Ca}, \dot{Fe}, \dot{Mn})^2\dddot{Si}$.

262. TEPHROITE. Tephroit *Breith.*, Char., 278, 1823, 212, 329, 1832.

Orthorhombic. Crystalline-massive. Cleavage in three directions rectangular in intersection, one perfect, a second a little less so, the third imperfect, or rather indistinct.

H.=5·5—6. G.=4—4·12. Lustre somewhat adamantine. Color grayish flesh-red, reddish-brown, and rose-red, to ash-gray, smoky-gray. Streak pale gray. Darkens, on exposure, to brown and black. Translucent—subtranslucent. Optic-axial plane parallel to plane of perfect cleavage; divergence for red rays, 159° 1′; in oil, 84° 19′.

Var.—1. *Normal* (anal. 1–5). 2. *Magnesian*, or *picrotephroite* (anal. 6–9). G. of No. 6, a brown kind, 3·97; of No. 7, a red, 3·87. Resembles much a cleavable feldspar.

Comp.—$\dot{Mn}^2\dddot{Si}$=Silica 29·8, protoxyd of manganese 70·2=100; or $(\dot{Mn}, \dot{Mg})^2\dddot{Si}$. Analyses: 1. Thomson (Min., 1, 514); 2, Rammelsberg (Pogg., lxii 145); 3, H. Deville (Descl. Min., i. 38); 4, G. J. Brush (Am. J. Sci., II. xxxvii. 66); 5, Igelström (Œfv. Ak. Stockh., 1865, 228); 6, 7, P. [illegible]er and A. Hague (see No. 4); 8, Damour (Ann. d. M., VI. ii. 339); 9, Igelström (l. c.):

	$\dddot{Si}$	$\dot{Fe}$	$\dot{Mn}$	$\dot{Zn}$	$\dot{Mg}$	$\dot{Ca}$	ign.
1. Franklin	29·64	0·82	66·60	——	——	——	2·70=99·76 Thomson.
2. Sparta	28·66	2·92	68·88	——	——	——	——=100·46 Rammelsberg.

	$\ddot{\mathrm{Si}}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Mn}}$	$\dot{\mathrm{Zn}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$	ign.
3. Sparta	28·37	2·16	59·31	7·58	2·16	0·39	——=99·97 Deville.
4. "	30·19	1·09	65·39	0·27	1·38	1·04	0·37=99·93 Brush.
5. Paisberg, *red*	30·82	——	56·83	——	2·79	5·37	2·20=98·01 Igelström.
6. Sparta, *brown*	30·55	1·52	52·32	5·93	7·73	1·60	0·28=99·93 Collier.
7. " *red*	31·73	0·23	47·62	4·77	14·03	0·54	0·35=99·27 Hague.
8. Franklin	29·95	1·96	36·43	11·61	18·60	——	1·71=100·26 Damour.
9. Paisberg, *brown*	31·36	4·15	44·07	——	17·71	*tr.*	0·87, $\dot{\mathrm{Pb}}$, $\overline{\ddot{\mathrm{As}}}$, $\ddot{\mathrm{C}}$ *tr.*=98·16 Ige

Analysis No. 4 was of a specimen received from Breithaupt, as the original tephroite; Nos 7, from specimens obtained by Brush at Stirling Hill, in Sparta. The zinc in anal. 3–7 was doubtedly from mixed zincite, this mineral occurring as a thin scale or lamina in the direction the cleavage, and hence often covering cleavage surfaces (Brush). Anal. 7 corresponds to ($\frac{5}{9}$ $+\frac{4}{9}$ $\dot{\mathrm{Mg}}$) $\ddot{\mathrm{Si}}$; anal. 8, to ($\frac{1}{2}$ $\dot{\mathrm{Mn}}+\frac{1}{2}$ $\dot{\mathrm{Mg}}$) $\ddot{\mathrm{Si}}$; and in anal. 9, $\dot{\mathrm{Mn}}$: $\dot{\mathrm{Mg}}$=5 : 4.

Pyr., etc.—B.B. fuses at 3·5 to a black scoria. Gelatinizes perfectly in muriatic acid with evolving chlorine. With the fluxes gives reactions for manganese and iron. The magnes variety fuses at 4 (No. 6) to 6 (No. 7).

Obs.—Found at Stirling Hill in Sparta, N. J., with zincite, willemite, and franklinite. in cle able masses; also at Paisberg, in Wermland, Sweden, along with rhodonite and other manganes minerals; at Sjögrufvan, with hausmannite.

The name *tephroite* is from τεφρός. *ash-colored.* Breithaupt's original specimen was from collection of H. Heyer at Dresden.

262A. HYDROTEPHROITE. L. J. Igelström has described (Œfv. Ak. Stockh., 1865, 605 hydrous tephroite from Paisberg, which has a pale reddish color, a colorless streak, and H. = gelatinizes with acids and yields water. He obtained in an analysis $\ddot{\mathrm{Si}}$ 28·46, $\overline{\mathrm{Mn}}$ 0·49, $\dot{\mathrm{Mn}}$ 5 $\dot{\mathrm{Mg}}$ 11·89, $\dot{\mathrm{Ca}}$, $\dot{\mathrm{Fe}}$ *tr.*, $\dot{\mathrm{H}}$ 5·85=100·13, and corresponding to $(\dot{\mathrm{Mn}}, \dot{\mathrm{Mg}})^2 \ddot{\mathrm{Si}}+\frac{2}{3}\dot{\mathrm{H}}$. It may be altered tephroite.

A black silicate of manganese from Klapperud, Dalecarlia, having a submetallic lustre and y lowish-brown streak, afforded Klaproth (Beitr., iv. 137) $\ddot{\mathrm{Si}}$ 25·0, $\dot{\mathrm{Mn}}$ 55·8, $\dot{\mathrm{H}}$ 13·0=93·8=$\dot{\mathrm{Mn}}^3$ $+2\dot{\mathrm{H}}$, agreeing with the tephroite, excepting the water. Klaproth obtained 60 p. c. of $\overline{\mathrm{Mn}}$, whence the above is deduced by Berzelius.

263. KNEBELITE. Knebelit *Döbereiner*, Schw. J., xxi. 49, 1818.

Crystalline massive.

H.=6·5. G.=3·714, Döbereiner; 4·122, Erdmann. Lustre glistenin Color gray, spotted dirty-white, red, brown, and green; also grayish-bla to black. Opaque to translucent. Brittle; fracture subconchoidal.

Comp.—$(\frac{1}{2}\dot{\mathrm{Fe}}+\frac{1}{2}\dot{\mathrm{Mn}})^2\ddot{\mathrm{Si}}$=Silica 29·6, protoxyd of iron 35·5, protoxyd of manganese 34· 100. Analyses: 1, Döbereiner (Schw. J., xxi. 49); 2, A. Erdmann (Dannemora Jernmalmsf p. 54):

	$\ddot{\mathrm{Si}}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Mn}}$	$\dot{\mathrm{Mg}}$
1. Ilmenau	32·5	32·	35·	——=99·5 Döbereiner.
2. Dannemora	30·26	34·30	34·47	0·25, $\overline{\mathrm{Al}}$ 1·59=100·87 Erdmann.

Pyr., etc.—According to Döbereiner, unaltered B.B., but Erdmann's mineral fused easily to lustreless magnetic bead, and gave with the fluxes reactions for iron and manganese. Deco posed readily by muriatic acid with separation of gelatinous silica.

Obs.—The mineral analyzed by Döbereiner was from an unknown locality, but G. Suck (Kenng. Ueb. Min., 1855, 93) states, on the authority of Knebel, that it was found in gran near Ilmenau. The Dannemora mineral is grayish-black to black in large masses, light gray the thin edges, and is stated to cleave parallel to a prism of about 115°.

Named after Major von Knebel.

264. LEUCOPHANITE. Leukophan *Esmark*, Ak. H. Stockh., 1840, 191; Tamnau, Pog xlviii. 504. Leucophane. Leucofanite.

Orthorhombic. *I* ∧ *I* about 91° (90° to 93°, Greg; 91° 3′, B. & M. *O* ∧ 1-ī, calc.,=145° 52′. Approximate angles, *O* ∧ 2=117°–118° 3 *O* ∧ 2-ī=126° 25′. A plane *m-n* on *O*=140° 30′, on one plane *I*=12

30′, on other *I*=101° 30′, Greg. Crystals tabular and nearly rectangular. Cleavage: basal perfect; imperfect in another direction, inclined 126° 25′ to the base; and perhaps in a third, at right angles to *O*. Usually massive.

H.=3·5—4. G.=2·974. Lustre vitreous on a cleavage surface. Color pale dirty green to wine-yellow; thin fragments transparent and colorless. Powder white, and strongly phosphorescent, whether heated or struck. Electric when heated. Optically biaxial; bisectrix normal to the base, plane of axes the macrodiagonal; Descl.

Comp.—O. ratio for $\dot{R}$, $\bar{\bar{R}}$, $\ddot{Si}$=3 : 3 : 10; $(\frac{1}{2}(\dot{Ca}, \dot{Na})+\frac{1}{2}\bar{Be})^2 \ddot{Si}+\frac{2}{3}\ddot{Si}$; or else with half the excess of silica basic. Part of the oxygen replaced by fluorine. Analyses: 1, Erdmann (Ak. H. Stockh., 1840); 2, Rammelsberg (Pogg., xcviii. 257):

	$\ddot{Si}$	$\bar{Al}$	$\bar{Be}$	$\dot{Mn}$	$\dot{Ca}$	$\dot{Na}$	$\dot{K}$	F
1.	47·82	——	11·51	1·01	25·00	10·20	0·31	6·17=102·02 Erdmann.
2.	47·03	1·03	10·70	*tr.*	23·37	11·20	0·30	6·57=100·43 Ramm.

O. ratio, leaving out of view the fluorine, for $\dot{Ca}$, $\bar{Be}$, $\ddot{Si}$, from anal. 1, 3 : 3 : 10·6; from 2, 2 : 2·8 : 10·0.

Pyr., etc.—In the closed tube whitens and phosphoresces with a purple light. B.B. in the forceps phosphoresces and fuses with intumescence at 3 to a clear colorless glass, which becomes opaque-white on flaming; imparts an intense yellow color to the flame. Fused with salt of phosphorus in the open tube gives the reaction for fluorine.

Obs.—Leucophane occurs in syenite with albite, elæolite, and yttrotantalite, on the small rocky islet Lamöe, near the mouth of the Langesund fiord in Norway, where it was found by Esmark. It resembles somewhat a light-green variety of apatite.

Named from λευκός, *white*, and φαίνειν, *I appear*.

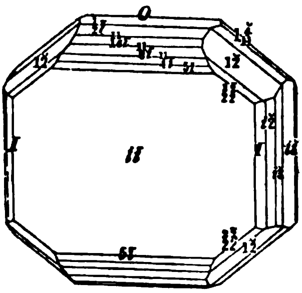
On cryst., see Greg, Phil. Mag., IV. ix. 510; Dana, Am. J. Sci., II. xxi. 205; Descl. Min., i. 144.

265. WÖHLERITE. Wöhlerit *Scheerer*, Pogg., lix. 327, 1843.

Orthorhombic. *I* ∧ *I*=90° nearly, *O* ∧ 1-ī=144° 37′; *a* : *b* : *c*=0·7162 : 1 : 1±

O ∧ ½-ī=160° 27′
O ∧ ¾-ī=133 11
O ∧ 1¼-ī=117 07
O ∧ 1-2̆=141 30
i-ī ∧ *i*-2̆=116 34
i-ī ∧ *I*=135 ±
i-2̆ ∧ *i*-2̆, ov. *i*-ĭ,=126 52
i-3̆ ∧ *i*-3̆, ov. *i*-ĭ,=143 8
½-ī ∧ ½-ī, ov. *O*,=140 54

238



In tabular crystals and prisms. Cleavage: *i*-ī distinct and easy. Also granular.

H.=5·5. G.=3·41. Lustre vitreous, inclining to resinous. Color light-yellow, wine-, honey-, resin-yellow, brownish, grayish. Streak-powder yellowish-white. Transparent—subtranslucent. Fracture more or less conchoidal—splintery.

Comp.—O. ratio for $(\dot{Ca}, \dot{Mg}, \dot{Na})$, $\ddot{Zr}$, $\ddot{Si}$, $(\dot{Fe}, \dot{Mn})$, $\ddot{\ddot{Cb}}$=9·78 : 5·08 : 15·89 : 0·77 : 3·57; from Scheerer's analysis (with which Hermann's agrees nearly), whence Scheerer deduces a formula making it a columbate of zirconia + 5 parts of a silicate of soda and lime. It corresponds well to the formula $(\frac{2}{3}(\dot{Ca}, \dot{Mg}, \dot{Na})^2+\frac{1}{3}\ddot{Zr})\ddot{Si}[+\frac{1}{10}(\dot{Fe}, \dot{Mn})\ddot{\ddot{Cb}}]$, the last member *columbite*.

Analyses: 1, Scheerer (l. c.); 2, Hermann (Bull. Soc. Nat. Moscow, xxxviii. 467):

	$\ddot{\mathrm{S}}\mathrm{i}$	$\ddot{\mathrm{C}}\mathrm{b}$	$\ddot{\mathrm{Z}}\mathrm{r}$	$\dddot{\bar{\mathrm{F}}}\mathrm{e}$	$\dot{\mathrm{M}}\mathrm{n}$	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\mathrm{N}}\mathrm{a}$	$\dot{\bar{\mathrm{H}}}$
1. Brevig	30·62	14·47	15·17	2·12	1·55	26·19	7·78	0·24, $\dot{\mathrm{M}}\mathrm{g}$ 0·4=98·14 Scheerer.
2. "	29·16	11·58	22·72	$\dot{\mathrm{F}}\mathrm{e}$ 1·28	1·52	24·98	7·63	1·33=99·61 Herm.

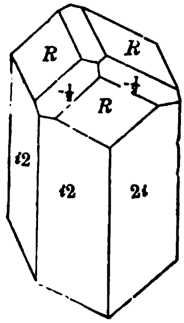
Pyr., etc.—B.B. in a strong heat fuses to a yellowish glass. With the fluxes gives the reaction of manganese, iron, and silica. Dissolves easily when heated in strong muriatic acid, with a separation of the silica and columbic acid.

Obs.—Occurs with elæolite in zircon-syenite, on several islands of the Langesund fiord, near Brevig in Norway. Some crystals are nearly an inch long. On cryst., Descl., in Ann. Ch. Phys., III. xl., and Ann. d M., V. xvi. 229; Dauber, Pogg., xcii. 242. Descloizeaux, in his later paper, makes *i-ī* and *i-ĭ* the vertical faces of the prism *I*, with *I* ∧ *I*=90° 16′, and he describes the crystals as hemihedral in many planes.

266. WILLEMITE. Siliceous Oxyd of Zinc, Silicate of Zinc (fr. N. Jersey), *Vanuxem & Keating*, J. Ac. Philad., iv. 8, 1824. Willemite (fr. Moresnet) *Levy*, Jahrb. Min. 1830, 71; Ann. d. M., IV. iv. 513, 1843. Williamsite, Wilhelmite, Villemite, *all. orthogr.* Anhydrous Silicate of Zinc. Hebetin (fr. Moresnet) *Breith.*, Char., 130, 1832. Troostite (fr. N. J.) *Shep.*, Min., 1st part, 154, 1832.

Rhombohedral. *R* ∧ *R*=116° 1′, *O* ∧ *R*=142° 17′; *a*=0·67378. Observed planes: in crystals fr. N. Jersey, *i*-2, *R*, $-\frac{1}{2}$, 1^3; fr. Moresnet *O*, *I*, $\frac{3}{4}$. *R* ∧ $\frac{1}{2}$=148° 1′. *R* ∧ 1^3=150° 5′, 1^3 ∧ *i*-2=151° 55′, *R* ∧ *i*-2=121° 59′; $\frac{3}{4}$ ∧ $\frac{3}{4}$=128° 30′; Levy. Cleavage: *i*-2 easy in N. Jersey crystals; *O* easy in those of Moresnet. Also massive and in disseminated grains. Sometimes fibrous.

239



H.=5·5. G=3·89—4·18. Lustre vitreo-resinous, rather weak. Color whitish or greenish-yellow, when purest; apple-green, flesh-red, grayish-white, yellowish-brown; often dark-brown when impure. Streak uncolored. Transparent to opaque. Brittle. Fracture conchoidal. Double refraction strong; axis positive.

Var.—The crystals of Morésnet and New Jersey differ in occurring forms as above described. The latter are often quite large, and pass under the name of *troostite;* they are commonly impure from the presence of manganese and iron. G. of crystals from New Jersey, 3·89—4, Vanuxem and Keating; 4·02, Herm.; 4·154, Delesse; from Moresnet, 3·935, Thomson; 4·16—4·18, Levy; from Stolberg, 4·18, Monheim.

Comp.—$\dot{\mathrm{Z}}\mathrm{n}^2\,\ddot{\mathrm{S}}\mathrm{i}$=Silica 27·1, oxyd of zinc 72·9=100. Analyses: 1, 2, Vanuxem and Keating (l. c.); 3, Hermann (J. pr. Ch., xlvii. 11); 4, Delesse (Ann. d. M., IV. x. 213); 5, H. Wurtz (Rep. Am. Assoc., iv. 147); 6, Thomson (Min., i. 545); 7, Levy (Ann. d. M., IV. iv. 513); 8, Monheim (Verh. nat. Ver. Bonn., 1848, 157); 9, Damour (Descl. Min., 554):

	$\ddot{\mathrm{S}}\mathrm{i}$	$\dddot{\bar{\mathrm{F}}}\mathrm{e}$	$\dddot{\bar{\mathrm{M}}}\mathrm{n}$	$\dot{\mathrm{F}}\mathrm{e}$	$\dot{\mathrm{M}}\mathrm{n}$	$\dot{\mathrm{Z}}\mathrm{n}$	$\dot{\mathrm{M}}\mathrm{g}$	$\dot{\bar{\mathrm{H}}}$
1. Stirling	25·44	6·50		——	——	68·06	——	——=100 Van. & K.
2. "	25·00	0·67	2·66	——	——	71·33	——	——=99·66 Van. & K.
3. "	26·80	——	——	*tr.*	9·22	60·07	2·91	1·00=100 Herm.
4. "	27·40	——	——	0·87	2·90	68·83	——	——=100 Delesse.
5. "	27·91	——	——	5·35	3·73	59·93	1·66	——, $\dot{\mathrm{C}}\mathrm{a}$ 1·60=100·18 Wurtz
6. Moresnet	26·97	1·48	——	0·78	——	68·77	——	1·25, $\ddot{\bar{\mathrm{A}}}\mathrm{l}$ 1·44[a]=99·91 Thom.
7. "	27·05	0·75	——	——	——	68·40	——	0·30=96·50 Levy.
8. Stolberg	26·90	——	——	0·35	——	72·91	——	——=100·16 Monheim.
9. Greenland	27·86	——	——	0·37		71·51	——	——=99·74 Damour.

[a] With a trace of zinc and iron.

First analyzed and described by Vanuxem and Keating.

Pyr., etc.—B.B. in the forceps glows and fuses with difficulty to a white enamel; the varieties from New Jersey fuse from 3·5 to 4. The powdered mineral on charcoal in R.F. gives a coating, yellow while hot and white on cooling, which, moistened with solution of cobalt, and treated in O.F., is colored bright green. With soda the coating is more readily obtained. Decomposed by muriatic acid with separation of gelatinous silica.

Obs.—From Vieille-Montagne near Moresnet, between Liége and Aix-la-Chapelle, in crystals and massive, the crystals but a few millimeters in length; also at Stolberg near Aix-la-Chapelle; at Raibel in Carinthia; at Kucsaina in Servia and in Greenland in compact quartz. In New Jersey at both Franklin and Stirling in such quantity as to constitute an important ore of zinc. It occurs intimately mixed with zincite and franklinite, and is found massive of a great variety of colors, from pale honey-yellow and light green to dark ash-gray and flesh-red; sometimes in crystals (*troostite*) six inches long and an inch or more thick, imbedded in franklinite and also in calcite.

Named by Levy after William I., King of the Netherlands.

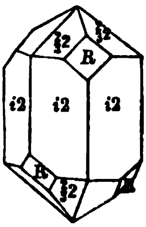
267. PHENACITE. Phenakit *N. v. Nordenskiöld*, Ak. H. Stockh., 160, 1823, Pogg., xxxi. 57

Rhombohedral; often hemihedral. $R \wedge R = 116° \ 36'$, $O \wedge R = 142° \ 38'$, Kokscharof; $a = 0{\cdot}661065$. Observed planes: rhombohedrons, R, -2, -1, $-\frac{1}{2}$; scalenohedrons, 1^2, 1^3, -2^2, $\frac{2}{3}^2$ (bevelling terminal edge of R); pyramids, $\frac{2}{3}\text{-}2$, $\frac{4}{3}\text{-}2$; prisms, I, $i\text{-}2$, $i\text{-}\frac{3}{2}$; hemihedral, $\frac{r}{l}\ \frac{2}{3}\text{-}\frac{3}{2}$, $\frac{l}{r}\ \frac{3}{2}\text{-}\frac{3}{2}$, $\frac{r}{l}\ 3\text{-}\frac{3}{2}$, Koksch. Min. Russl., ii. 308, iii. 81.

$R \wedge I = 127° \ 21'$
$R \wedge i\text{-}2 = 121 \ 42$
$\frac{2}{3}\text{-}2 \wedge \frac{2}{3}\text{-}2 = 156 \ 44$
$\frac{2}{3}\text{-}2 \wedge R = 159 \ 56$

$R \wedge -2 = 160° \ 35'$
$R \wedge -\frac{1}{2} = 148 \ 18$
$\frac{1}{2} \wedge \frac{1}{2} = 144 \ 4$
$2 \wedge 2 = 87 \ 12$

240



Crystals sometimes oblong, as in fig. 240: but often the prism nearly or quite wanting, and the form that of a low obtuse rhombohedron, with replaced edges and lateral angles. Cleavage: $i\text{-}2$ distinct, R imperfectly so. Twins: composition-face $i\text{-}2$.

H.$=7{\cdot}5-8$. G.$=2{\cdot}96-3$. Lustre vitreous. Colorless; also, bright wine-yellow, inclining to red; brown. Transparent—subtranslucent. Fracture like that of quartz. Double refraction positive.

Comp.—$\text{Be}^3\ddot{\text{S}}\text{i}$=Silica 54·2, glucina 45·8=100. Analyses: 1, Hartwall (Pogg., xxxi. 57), 2, Bischof (Pogg., xxxiv. 525):

1. Ural	$\ddot{\text{S}}\text{i}$ 55·14	Be 44·47	$\ddot{\text{Al}}$ and $\dot{\text{M}}\text{g}$ *tr.*=99·61	Hartwall.
2. Framont	54·40	45·57	$\dot{\text{C}}\text{a}$ and $\dot{\text{M}}\text{g}$ 0·09=100·06	Bischof.

Pyr., etc.—Alone remains unaltered; with borax fuses with extreme slowness, unless pulverized, to a transparent glass. With soda affords a white enamel; with more, intumesces and becomes infusible. Dull blue with cobalt solution.

Obs.—Occurs in mica schist at the emerald and chrysoberyl mine of Takovaja, 85 versts E. of Katherinenburg, where the crystals are sometimes nearly 4 inches across, and one found weighs 1¼ lbs.; also in small crystals on the east side of the Ilmen Mts., 5 versts N. of Miask, along with topaz and green feldspar; also in highly modified crystals with quartz, in limonite, near Framont in Alsace; at Mt. Mercado, near Durango, Mexico, in limonite and magnetite, the crystals numerous, but not fresh, being below the true hardness; and in a valley on the summit of La Cruz, on the side of the rancho of Tinaja, it forms, according to G. Weidner, a rock, containing hornblende and actinolite.

Named from φέναξ, *a deceiver*, in allusion to its having been mistaken for quartz.

268. MELIPHANITE. Melinophan *Scheerer*, J. pr. Ch., lv. 449, 1852. Meliphane *Dana*, Am. J. Sci., II. xliv. 405, 1867.

Tetragonal or hexagonal. Massive, and consisting sometimes of plates or lamellæ, but not as a result of cleavage structure. Cleavage hexagonal (?), in traces.

H.=5. G.=3·0, Richter; 3·018, Rammelsberg. Lustre vitreous. Color sulphur, citron, or honey-yellow. Transparent to translucent. Brittle. Double refraction strong, uniaxial; axis negative; Descl.

Comp.—Formula perhaps as on p. 250. Analyses: 1, imperfect, by R. Richter (l. c.); 2, Rammelsberg (Pogg., xcviii. 297):

$\ddot{\mathrm{Si}}$	$\ddot{\bar{\mathrm{Al}}}$	$\ddot{\bar{\mathrm{Mn}}}$	$\ddot{\bar{\mathrm{Fe}}}$	$\ddot{\bar{\mathrm{Be}}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Na}}$	F	
44·8	12·4	1·4	1·1	2·2	31·5	0·2	2·6	2·3	$\ddot{\mathrm{C}}$b, $\ddot{\mathrm{Z}}$r, $\ddot{\bar{\mathrm{C}}}$e, $\dot{\mathrm{Y}}$ 0·3=98·8 Richter.
43·66	1·57			11·74	26·74	0·11	8·55	5·73, $\dot{\mathrm{K}}$ 1·40, $\dot{\bar{\mathrm{H}}}$ 0·30=99·80 Ramm.	

Rammelsberg's analysis, if the fluorine is taken as replacing part of the oxygen in the bases and acid, gives for the oxygen (including the fluorine) ratio for $\dot{\mathrm{R}}$, $\ddot{\bar{\mathrm{R}}}$, $\ddot{\mathrm{Si}}$ 3·7 : 3 : 8·3. The exact nature of the compound is still doubtful. Rammelsberg deduces the same formula as that for leucophane, taking as the common oxygen ratio 4 : 3 : 9. But Descloizeaux's optical examinations make the two distinct species.

Pyr., etc.—B.B. in the forceps does not phosphoresce, fuses with intumescence to a white enamel; in other respects resembles leucophane.

Obs.—From the zircon-syenite of Norway, near Fredericksvärn, with elæolite, mica, fluorite, and magnetic iron. An imperfect crystal in the cabinet of R. P. Greg, Esq., gave him for the angle between two prismatic faces 133°; the edge between these two faces was replaced by a rough plane, apparently not equally inclined.

Named from μέλι, *honey*, and φαίνω, *I appear*, from the honey-yellow color. [Scheerer misswrote the word *melinophane*, which would come from μήλινος, *ashen*, or μελίνη, *millet*.] The dropping of the *t* of the genitive, as done above, has classical authority.

269. HELVITE. Ein Fossil w. Aehnlichk. m. d. Granat hat, aber nicht Granat zu seyn scheint, *Mohs*, Null Kab., i. 92, 1804. Helvin *Wern.*, 1816, Breith. in Hoffm. Min., iv. b. 112, 1817. Wern. Letztes Min. Syst., 2, 29, 1817; Tetrahedral Garnet *Mohs*, Char. Syst. Min., 71, 1820, Edinb. Tetraëdrischer Granat *id.*, Grundr., 412, 1824.

Isometric: tetrahedral. Figs. 31, 32. Cleavage: octahedral, in traces. H.=6–6·5. G.=3·1–3·3; 3·216, Breithaupt. Lustre vitreous, inclining to resinous. Color honey-yellow, inclining to yellowish-brown, and siskin-green; streak uncolored. Subtranslucent. Fracture uneven.

Comp.—O. ratio for $\dot{\mathrm{R}}$, $\ddot{\mathrm{Si}}=1:2$; for $\dot{\mathrm{Mn}}+\dot{\mathrm{Fe}}$, $\ddot{\bar{\mathrm{Be}}}=1:1$; formula $(\frac{1}{3}(\dot{\mathrm{Mn}}, \dot{\mathrm{Fe}})+\frac{1}{3}\ddot{\bar{\mathrm{Be}}})^2\ddot{\mathrm{Si}}+\frac{1}{3}\mathrm{Mn\,S}$, Ramm.

Analyses: 1, 2, Gmelin (Pogg., iii. 53); 3, Rammelsberg's correction of Gmelin's anal. 1 (Min. Ch., 701); 4, Rammelsberg (ib.):

	$\ddot{\mathrm{Si}}$	$\ddot{\bar{\mathrm{Be}}}$	$\dot{\mathrm{Mn}}$	$\dot{\mathrm{Fe}}$	Mn	S	ign.
1. Schwarzenborg	33·26	12·03[a]	41·76	5·56	——	5·05	1·15=98·81 Gmelin.
2. "	35·27	8·03	42·12	8·00	——	——	——, $\ddot{\bar{\mathrm{Al}}}$ 1 44 Gmelin.
3. "	33·26	12·03	30·57	8·00	8·67	5·05	1·15=98·73 Gmelin.
4. Norway	33·13	11·46	36·50	4·00	9·77	5·71	——=100·57 Ramm.

[a] With some alumina.

Pyr., etc.—Fuses at 3 in R.F. with intumescence to a yellowish-brown opaque bead, becoming darker in R.F. With the fluxes gives the manganese reaction. Decomposed by muriatic acid, with evolution of sulphuretted hydrogen, and separation of gelatinous silica.

Obs.—Occurs in gneiss at Schwarzenberg in Saxony, associated with garnet, quartz, fluorite, and calcite; at Breitenbrunn, Saxony; at Hortekulle near Modum, and also at Brevig, in Norway in zircon-syenite.

Named by Werner, in allusion to its yellow color, from ἥλιος, *the sun*.

270. DANALITE. *J. P. Cooke*, Am. J. Sci., II. xlii 73.

Isometric. In octahedrons, with planes of the dodecahedron; the dodecahedral faces striated parallel to the longer diagonal.

H.=5·5—6. G.=3·427. Lustre vitreo-resinous. Color flesh-red to gray. Streak similar, but lighter. Translucent. Fracture subconchoidal, uneven. Brittle.

Comp.—$(\frac{1}{3}\dot{\mathrm{R}}+\frac{1}{3}\mathrm{\bar{B}e})^2\ddot{\mathrm{Si}}+\frac{1}{3}\mathrm{Zn\,S}$; in which $\dot{\mathrm{R}}=\dot{\mathrm{F}}\mathrm{e}, \dot{\mathrm{M}}\mathrm{n}, \dot{\mathrm{Z}}\mathrm{n}$. Analyses: J. P. Cooke (l. c.):

	$\ddot{\mathrm{Si}}$	$\dot{\mathrm{F}}\mathrm{e}$	$\dot{\mathrm{M}}\mathrm{n}$	$\dot{\mathrm{Z}}\mathrm{n}$	$\mathrm{\bar{B}e}$	S
1. Rockport	($\frac{2}{3}$) 31·73	27·40	6·28	17·51	13·83	5·48=102·23.
2. Gloucester	29·88	28·13	5·71	18·15	14·72[a]	4·82, $\dot{\mathrm{C}}$a 0·83, $\dot{\mathrm{M}}$g *tr.*=102·24.

[a] With alumina.

By subtracting from anal. 1 oxygen 2·74, equivalent to the sulphur, the sum is 99·49; and from anal. 2, 2·41 p. c. oxygen, the sum is 99·83.

Pyr., etc.—B.B. fuses readily on the edges to a black enamel. With soda on charcoal gives a slight coating of oxyd of zinc. Perfectly decomposed by muriatic acid, with evolution of sulphuretted hydrogen and separation of gelatinous silica.

Obs.—Occurs in the Rockport granite, Cape Ann, Mass., small grains being disseminated through this rock; also near Gloucester, Mass.; in both localities associated with a lithia mica, in the latter, with green feldspar and fluorite.

Named after J. D. Dana.

271. GARNET. ʼΑνθραξ pt. [rest Ruby Spinel and Sapphire] *Theophr.* Carbunculus pt. [rest id] *Plin.*, xxxvii. 25; Carchedonius, Garamanticus [=Carthaginian or Garamantic Carbuncle], Alabandicus [cut at Alabanda], Anthracitis, *Plin.*, ib., 25–27. Granatus *Albertus Magnus*, 232, 1270. Carbunculus Carchedonius=*Germ.* Granat, C. Alabandicus and Troezenius=*Germ.* Almandin, *Agric.*, Foss., 272, Interpr., 463, 1546. Granat *Wall.*, Min., 120, 1747. Garnet. Grenat *Fr.*

Isometric. Observed planes: *O* (very rare), *I*, 1; trapezohedral, 2-2, $\frac{4}{3}$-$\frac{4}{3}$; tetrahexahedral, *i*-2, *i*-$\frac{3}{2}$, *i*-$\frac{20}{19}$; trisoctahedral, $\frac{3}{2}$; hexoctahedral, 3-$\frac{3}{2}$, 4-$\frac{4}{3}$. Dodecahedron, fig. 3, and the trapezohedron 2-2, fig. 10, most common; also figs. 11, 13, 14, 21, 28; octahedral form very rare; figs. 241–243 distorted dodecahedrons; f. 244, distorted trapezohedron; f. 246, combination of the dodecahedron and trapezohedron, but distorted, and having only four planes of the former.

Cleavage: dodecahedral, sometimes quite distinct. Twins: composition-face octahedral. Also massive; granular, coarse, or fine, and sometimes friable; lamellar, lamellæ thick and bent. Also very compact, cryptocrystalline like saussurite.

H.=6·5—7·5. G.=3·15—4·3. Lustre vitreous—resinous. Color red, brown, yellow, white, apple-green, black; some red and green colors often bright. Streak white. Transparent—subtranslucent. Fracture subconchoidal, uneven. Brittle, and sometimes friable when granular massive; very tough when compact cryptocrystalline.

Comp., Var.—Garnet is a unisilicate, of sesquioxyd and protoxyd bases, having the general formula $(\frac{1}{2}\dot{\mathrm{R}}^3+\frac{1}{2}\mathrm{\bar{R}})^2\ddot{\mathrm{Si}}^3$, or $(\dot{\mathrm{R}}^3)^2\ddot{\mathrm{Si}}^3+\mathrm{\bar{R}}^2\ddot{\mathrm{Si}}^3$.

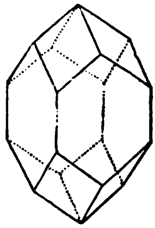
The name is from the Latin *granatus*, meaning *like a grain*, and directly from *pomegranate*, the seeds of which fruit are small, numerous, and red, in allusion to the aspect of the crystals.

There are three prominent groups, based on the nature of the predominating sesquioxyd.

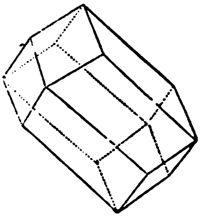
I. ALUMINAGARNET, in which the sesquioxyd is mainly *alumina* ($\mathrm{\bar{A}l}$).

II. IRONGARNET, in which it is largely *sesquioxyd of iron* ($\mathrm{\bar{F}e}$), usually with some alumina.

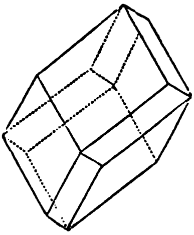
241



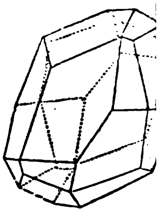
242



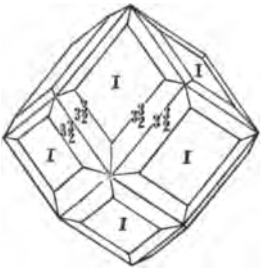
243



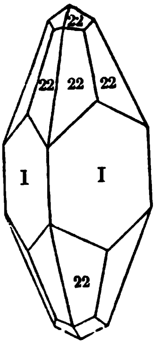
244



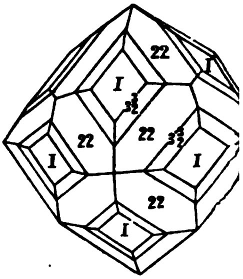
245



246



247



III. CHROMEGARNET, in which it is largely *sesquioxyd of chromium* ($\ddot{C}r$).

The protoxyd bases present, either singly or two or more together, are *lime* ($\dot{C}a$), *magnesia* (*protoxyd of iron* ($\dot{F}e$), *protoxyd of manganese* ($\dot{M}n$), with rarely a few p. c. of *protoxyd* (?) *of ch* *protoxyd of nickel*, or *yttria*, or a trace of an *alkali*. Subdivisions of the above groups have b based on the predominance of one or another of these protoxyds; and on this ground there the following varieties or subspecies:

A. GROSSULARITE, or *Lime-Aluminagarnet.*

B. PYROPE, or *Magnesia-Aluminagarnet.*

C. ALMANDITE, or *Iron-Aluminagarnet.*

D. SPESSARTITE, or *Manganese-Aluminagarnet.*

E. ANDRADITE, or *Lime-Irongarnet*, including 1, ordinary; 2, manganesian, or *Rothoffite;* yttriferous, or *Yttergarnet.*

F. BREDBERGITE, or *Lime-Magnesia-Irongarnet.*

G. OUVAROVITE, or *Lime-Chromegarnet.*

Excepting the last, these subdivisions blend with one another more or less completely throu varieties containing combinations of the protoxyd bases, and also of the sesquioxyd bases. T following are their characters. Most of the various names enumerated below under each divis making the synonymy, have stood for a time as names of supposed distinct species.

A. *Lime-Aluminagarnet;* GROSSULARITE. (Kanelstein [=Cinnamon Stone] fr. Ceylon [s placed near Zircon] *Wern.*, 1803, Ludwig's Wern., ii. 209, 1804; Essonite [ερ.] *H.*, Tr. Pier préc., 1817; Hessonite *Leonh.*, Handb., 433, 1821: Essonite [var. of Garnet] *Beud.*. 170, 18 Romanzovit [fr. Kimito] *Nordenskiöld*, Schw. J., xxxi. 380. Grossularite [fr. Wilui R., Sib.] *We* 1808–9, Hofm. Min., i. 479, 1811; Granat *Pallas*, N. Nord. Beyt. St. Pet., 1793; Wiluit pt. [V uit] *Severgin.* Grenat du chaux, ou Grossulaire, *Beud.*, 337, 1824.) A silicate mainly of alumi and lime; formula mostly $(\frac{1}{2}\dot{C}a^3+\frac{1}{2}\ddot{A}l)^2\dddot{S}i^3$=Silica 40·1, alumina 22·7, lime 37·2=100. But so lime often replaced by protoxyd of iron, and thus graduating toward the Almandite group. Co (*a*) white: (*b*) pale green; (*c*) amber- and honey-yellow; (*d*) wine-yellow, brownish-yellow, cin mon-brown; rarely (*e*) emerald-green from the presence of chromium. G.=3·4—3·75.

The original *grossularite* (*wiluite*) included the pale green from Siberia, and was so named fr the botanical name for the gooseberry; G =3·42—3·72. *Cinnamon-stone*, or *essonite*, included cinnamon-colored variety from Ceylon, there called *hyacinth;* but under this name the yell kinds are usually included. *Succinite* is an amber-colored kind from Ala, Piedmont. *Romanzo* s brown.

Pale green, yellowish, and yellow-brown garnets are not invariably grossularite; some (including topazolite) belong to the group of Irongarnet, or Andradite (p. 268).

Analyses: 1, Croft (G. Rose, Reis. Ural, ii. 132); 2, T. Wachtmeister (Ak. H. Stockh., 1823); 3, T S. Hunt (Rep. G. Can., 1847, 447, and also 1863, 496); 4, N. v. Ivanoff (Kokscb. Min. Russl., ii. 79); 5, Wachtmeister (l. c.); 6, Karsten (Karst. Arch. Min., iv. 388); 7, Klaproth (Beitr., iv. 319, v. 138); 8, Arfvedson (Ak. H. Stockh., 1822, 87); 9, C. Gmelin (Jahresb., v. 224); 10, Klaproth (l. c.); 11, Karsten (l. c.); 12, Nordenskiöld (Schw. J., xxxi. 380); 13, Richter (Ber. Ges. Leipsic, 1858, 99); 14, Pisani (C. R., lv. 216):

	S̈i	Ä̶l	F̶e	Ḟe	Ṁn	Ṁg	Ċa
1. Urals, *white*	36·86	24·19	——	——	——	——	37·15=98·10 Croft.
2. Tellemark, *wh.*	39·60	21·20	——	2·00	3·15	——	32·30=98·25 Wacht.
3. Orford, Can., *white*	38·60	22·71	——	1·60		0·49	34·83, Ṅa 0·47, K̇ *tr.*, ign. 1·10=99·80 Hunt.
4. Slüdianka R., *Gross*	40·99	14·90	10·94	——	——	0·98	32·94=100·75 Ivanof.
5. Wilui "	40·55	20·10	5·00	——	0·48	——	34·86=100·99 Wacht.
6. " "	38·25	19·35	7·33	——	0·50	2·40	31·75=99·58 Karsten.
7. " "	44·0	8·5	12·0	——	*tr.*	——	33·5=98 Klaproth.
8. Malsjö, *Cin.*	41·87	20·57	3·93	——	0·39		33·94=100·70 Arfved.
9. Ceylon, "	40·01	23·00	3·67	——	——	——	30·57, K̇ 0·59, ign. 0·33=98·17 Gmelin.
10. " "	38·80	21·20	6·50	——	——	——	31·25=97·75 Klaproth.
11. St. Gothard, "	37·82	19·70	5·95	——	0·15	4·15	31·35=99·12 Karsten.
12. *Romanzovite*	41·21	24·08	7·02	——	0·92		24·76, ign. & loss 1·98=100 N.
13 Traversella, *dark red*	39·99	17·98	6·45	——	——	2·76	32·70=99·88 Richter.
14. Elba, *octahed.*	39·38	16·11	8·65	——	*tr.*	1·00	36·04, ign. 0·31=101·49 P.

In anal. 3, G.=3·522–3·536; anal 4, G.=3·427.

B. *Magnesia-Aluminagarnet*; PYROPE. (Carbunculi Carchedonii in Boëmorum agris *Agric.*, Foss., 272, 1546. Bohemian Garnet. Böhmischer Granat (as a distinct sp.) *Wern.*, Bergm. J., 124, 1789; Klapr., i. 16, ii. 21. Pyrop *Wern.*, 1800, Ludw. Wern., i. 48, 1803. Karfunkel *Germ.*, Escarboucle pt. *Fr.*) A silicate of alumina, with various protoxyd bases, among which magnesia predominates much in atomic proportions, while in small proportion in other garnet, or absent. Formula $(\frac{1}{2}(\dot{Mg}, \dot{Ca}, \dot{Fe}, \dot{Mn})^3+\frac{1}{2}\ddot{Al})^2\ddot{Si}^3$. The original pyrope is the kind containing chrome. In he analysis of the Arendal magnesia-garnet, Ṁg : Ċa : Ḟe + Ṁn = 3 : 1 : 2; and the ratio of the nagnesia to the other protoxyd bases is 1 : 1. In Moberg's analysis of the chromiferous pyrope, which is considered the best, Ṁg : Ċa : Ḟe + Ṁn : Cr = 3 : 0·75 : 1·33 : 0·57; and Ṁg : Ċa + Ḟe + Ṁn + Ċr = 1 : 0·87. G.=3·7–3·72, Breith.; 3·78, Mohs; 3·738 (anal. 18), Genth.

Analyses: 15, Wachtmeister (l. c.); 16, Kobell (Kastn. Arch. Nat., v. 165, viii. 447, ix. 344); 17, Moberg (J. pr. Ch., xliii. 122); 18, F. A. Genth (Am. J. Sci., II. xxxiii. 196); 19, Zilliacus Ramm. Min. Ch., 695):

	S̈i	Ä̶l	F̶e	Ḟe	Ṁn	Ṁg	Ċa
15. Arendal, *black*	42·45	22·47	——	9·29	6·27	13·43	6·53=100·44 Wacht. G.=3·157.
6. *Pyrope*	42·08	20·00	1·51	9·09	M̶n 0·32	10·20	1·99, C̶̈r 3·01=98·20 Kobell.
7. "	41·35	22·35	——	9·94	2·59	15·00	5·29, Ċr 4·17=100·69 Moberg.
8. Santa Fé, N. Mex.	42·11	19·35	——	14·87	0·36	14·01	5·23, C̶̈r 2·62, ign. 0·45=99 Genth.
9. Miesmaki, Finl.	41·56	19·84	5·33	4·37	——	22·00	4·25, C̶̈r 0·35, ign. 1·58=99·28 Z.

The name *pyrope* is from πυρωπός, *fire-like.*

C. *Iron-Aluminagarnet*; ALMANDITE. (Precious or Oriental Garnet. Orientalischer Granat, Sirianischer (fr. Siriam in Pegu) Granat *Klapr.*, Beitr., ii. 22, 1798. Alamandin (Alabandicus Plin.) *Karst*, Tab., 20, 69, 1800. Common Garnet pt. Fahlungranat *Berz.*, Lohthr.) A silicate mainly of alumina and protoxyd of iron; formula $(\frac{1}{2}\dot{Fe}^3+\frac{1}{2}\ddot{Al})^2\ddot{Si}^3$=Silica 36·1, alumina 20·6, protoxyd of iron 43·3=100; or Ṁn may replace some of the Ḟe, and F̶e part of the Ä̶l. Color e deep-red and transparent, and then called *precious garnet*; also brownish-red, and translucent r subtranslucent, *common garnet*; black, and then referred to var. *melanite.* Part of *common garnet* belongs to the *Andradite* group, or is irongarnet. The Alabandic carbuncles of Pliny were o called because cut and polished at Alabanda. Hence the name almandine, now in use. Pliny escribes vessels of the capacity of a pint, formed from carbuncles, "non claros ac plerumque ordidos ac semper fulgoris horridi," devoid of lustre and beauty of color, which probably were rge common garnets of the latter kind.

Analyses: 20, Hisinger (Schw. J., xxi. 258); 21, 22, Kobell (ib., lxiv. 283); 23–25, Karsten (l c.); 26–28, Wachtmeister (l. c.); 29, Klaproth (Beitr., ii. 22, v. 131); 30, W. Wachtmei (Jahresb., xxv. 364); 31, Bahr (ib.); 32, Besnard (Jahresb., 1849, 745): 33, 34, Mallet (J. G. Dubl., Ramm. 5th Suppl., 125); 35, W. J. Taylor (Am. J. Sci., II. xix. 20); 36, C. A. Kurib (ib.); 37, Kjerulf (J. pr. Ch., lxv. 192); 38, 39, T. Wachtmeister (l. c.); 40, Moberg (J. pr. xliii. 122); 41, Pützer (Ramm. Min. Ch., 695):

	$\dddot{\mathrm{Si}}$	$\overline{\dddot{\mathrm{Al}}}$	$\overline{\dddot{\mathrm{Fe}}}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Mn}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$
20. Fahlun, *Almand.*	39·66	19·66	——	39·68	1·80	——	——=100·80 Hising.
21. Zillerthal, *bn.*	39·12	21·08	6·00	27·28	0·80	——	5·76=100·04 Kobell.
22. Hungary, *prec.*	40·56	20·61	5·00	32·70	1·47	——	——=100·34 Kobell.
23. Zillerthal, "	39·62	19·30	——	34·05	0·85	2·00	3·28=99·10 Karsten.
24. Ohlapian	37·15	18·08	——	31·30	0·30	10·15	0·36=97·34 Karsten.
25. Greenland	39·85	20·60	——	24·85	0·46	9·93	3·51=99·20 Karsten.
26. Engsö, *dull red*	40·60	19·95	——	33·93	6·69	——	——=101·17 Wacht.
27. N. York	42·51	19·15	——	33·57	5·49	——	1·07=101·79 Wacht.
28. Norway	52·11	18·04	——	23·54	1·74	——	5·78=101·20 Wacht.
29. Oriental	35·75	27·25	——	32·33	0·25	——	——=95·58 Klapr.
30. Garpenberg	39·42	20·27	——	24·82	7·51	3·69	2·63=98·34 Wacht.
31. Brena, Westm.	37·16	19·30	——	37·65	3·19	2·03	0·90=100·23 Bahr.
32. Albernreit, *bnh.-r.*	38·76	21·00	——	32·05	6·43	3·95	——=102·19 Besn.
33. Wicklow, *black*	35·77	19·85	——	38·07	5·04	——	——=98·73 Mallet.
34. Killiney, *brown*	37·80	21·13	——	34·83	——	4·46	1·53=99·75 Mallet.
35. Yonkers, N. Y., *trp.*	38·32	21·49	——	30·23	2·46	6·29	1·38=100·17 Taylor.
36. Delaware Co., Pa., *trp.*	40·15	20·77	——	26·66	1·85	8·08	1·83=99·34 Kurlbau
37. Oravitza	37·52	20·01	——	36·02	1·29	2·51	0·89=98·23 Kjerulf.
38. Hallandsaos, *dull red*	41·00	20·10	——	28·81	2·88	6·04	1·50=100·33 Wachtm
39. " "	42·00	21·00	——	25·18	2·37	4·32	4·98=99·85 Wachtm
40. Abo, *rdh.-bn.*	40·19	20·17	——	35·27	0·99	4·98	0·50=102·10 Moberg.
41. Brazil, *massive*	37·23	15·22	6·73	26·76	3·40	3·14	4·31=96·79 Pützer.

In anal. 26, G.=4·236; anal. 27, 3·90; anal. 33, 4·196; anal. 38, 4·188; anal. 39, 4·043; a 40, 3·86.

D. *Manganese-Aluminagarnet*; SPESSARTITE. (Granatförmiges Braunsteinerz (fr. Spessart) *Kla* Beitr., ii. 239, 1797=Braunsteinkiesel (near Garnet) *Karst*, Tab., 20, 69, 1800. Manganes Garnet (fr. Haddam) *Seybert*, Am. J. Sci., vi. 155, 1823. Mangangranat *Germ.* Broddbogra *Berz.* Spessartine *Beud.*, 52, 1832.) Color dark hyacinth-red (fr. Spessart), sometimes wit shade of violet, to brownish-red. G.=3·7–4·4; fr. Spessart 3·6, Klapr.; fr. Haddam 4·128, S bert; fr. Broddbo 4·575, d'Ohsson; fr. Miask 4·38, Lissenko.

Analyses: 42, H. Seybert (Am. J. Sci., vi. 155, 1823); 43, Rammelsberg (J. pr. Ch., lv. 48 44, d'Ohsson (Schw. J., xxx. 346); 45, Lissenko (Koksch. Min. Russl, iii. 230); 46, Klapr (Beitr., ii. 244):

	$\dddot{\mathrm{Si}}$	$\overline{\dddot{\mathrm{Al}}}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Mn}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$
42. Haddam, Ct.	35·83	18·06	14·93	30·96	——	——=99·78 Seybert.
43. "	36·16	19·76	11·10	32·18	0·22	0·58=100 Ramm.
44. Broddbo	39·00	14·30	15·44	27·90	——	—— $\ddot{\mathrm{Sn}}$ 1·00=97·64 D'Ohss
45. Miask	36·30	17·48	14·32	30·60	——	0·51=99·21 Lissenko.
46. Spessart	35·00	14·25	14·00	35·00	——	——=98·25 Klaproth.

In anal. 42, G.=4·128; anal. 43, 4·275; anal. 45, 4·38.

E. *Lime-Irongarnet*; ANDRADITE. (Common Garnet, pt. Allochroite (from Drammen and Fei gen, Norway) *d'Andrada*, J. de Phys., li. 243, 1800, Scherer's J., iv. 32. Black Garnet; Mela (fr. Frascati) *Wern.*, 1800, Ludw. Wern., i. 48, 64, 1803. Aplome *H.*, Tr., iv. 239, 1801. Kolop nit *d'Andrada*; *Simon.* Gehl. J., iv. 405, 1807. Grénat résinite=Colophonite *H.*, Cours 18 *Lucas.* Tabl., 265. 1806; Pech-Granat *Karst.*, Tab., 32, 89, 1808. Topazolite (fr. Ala) *Bonvoisin* de Phys., lxii. 1806. Pyreneit (fr. Pyrenees) *Wern.*, 1811–12, Hoffm. Min., ii. 373, 1815. Ka granat *Berz.*, Löthr. Granat v Longban *Rothoff*, Afh., iii. 329, 1810; Rothoffite *Berz.*, N. Syst. M 218, 1819. Polyadelphite (fr. Franklin, N. J.) *Thom.*, Min. i, 154, 1836. Jelletite (fr. Mt. Rosa) *john*, J. G. Soc., Dublin, v. 119, 1853. Yttergranat (fr. Norway) *Bergemann*, Sitz. Ges. Bonn., Ju 1854.) Colors various, including wine-, topaz-, and greenish-yellow (topazolite), apple-green; brow ish-red, brownish-yellow; grayish-green, dark green; brown; grayish-black, black. G.=3·64–

Named *Andradite* by the author after the Portuguese mineralogist, d'Andrada, who describ and named the first of the included subvarieties, Allochroite. The included kinds vary so wid in color and other respects that no one of the names in use will serve for the group.

Chemically there are the following subvarieties: 1. Simple *Lime Irongarnet*, in which the protoxyds are wholly or almost wholly lime. Includes: (*a*) *Topazolite*, having the color and transparency of topaz, and also sometimes green; although resembling essonite, Damour has shown that it belongs here. (*b*) *Colophonite*, a coarse granular kind, brownish-yellow to dark reddish-brown in color, resinous in lustre, and usually with iridescent hues; named after the resin *colophony*. (*c*) *Melanite* (named from μέλας, *black*), black, either dull or lustrous; but all black garnet is not here included. *Pyreneite* is grayish-black melanite; the original afforded Vauquelin 4 p. c. of water, and was iridescent, indicating incipient alteration. (*d*) Dark green garnet, not distinguishable from some allochroite, except by chemical trials. *Jelletite* is green garnet, light or dark, and yellowish-green, from the moraine of the Findel glacier near Zermatt, Mt. Rosa; named after Jellet, one of the describers of it.

Calderite, a mineral from Nepaul, India, is said to be nothing but massive garnet; but whether belonging to this group or not is not stated.

2. *Manganesian Lime-Irongarnet.* (*a*) *Rothoffite.* The original *allochroite* was a manganesian irongarnet of brown or reddish-brown color, and of fine-grained massive structure. The *Rothoffite*, from Longban, first analyzed by Rothoff, is similar, with the color yellowish-brown to liver-brown. Other common kinds of manganesian irongarnet are light and dark, dusky green and black, and often in crystals. Thomson's *Polyadelphite* was a massive brownish-yellow kind, from Franklin, N. J (anal. 66, 67). The same locality affords another in dark green crystals, containing still more manganese.

(*b*) *Aplome* has its dodecahedral faces striated parallel to the shorter diagonal, whence Haüy inferred that the fundamental form was the cube; and as this form is simpler than the dodecahedron, he gave it a name derived from ἁπλόος simple. Color of the original aplome (of unknown locality) dark brown; also found yellowish-green and brownish-green at Schwarzenberg in Saxony, and on the Lena in Siberia.

3. *Yttriferous Lime-Irongarnet; Yttergarnet.* Contains several p. c. of yttria (anal. 75); G.=3·88, Bergemann; B.B. infusible.

Analyses: 47, Hisinger (Jahresb., ii. 101); 48, Seybert (Am. J. Sci, v. 118); 49, Karsten (l. c.); 50, Bredberg (Ak. H. Stockh., 1822, i. 63); 51, Bucholz (Scherer's N. J., iv. 172); 52–57, Wachtmeister (l. c.): 58, Thomson (Ann. Lyc. N. Y., iii. 9, 1829); 59, Vauquelin (J. de Phys, l. 94); 60, Klaproth (Beitr., v. 168); 61, Karsten (l. c.); 62, Damour (L'Institut, No. 1198, Dec. 1856); 63, Ebelmen (Ann. d. M, IV. vii. 19); 64, W Fisher (Am. J. Sci., II ix. 84); 65, Bahr (J. pr. Ch., liii. 312); 66, Weber (Ramm 5th Suppl., 193); 67, Baumann (ib); 68, D. Forbes (Edinb. N. Ph. J., II. iii.); 69, 70, N. v. Ivanof (Koksch Min. Russl., iii. 79); 71, Tschermak (Jahresb., 1860, 766); 72, E. K. Granqvist (Koksch Min. Russl., iii. 32); 73, A. Stromeyer (Jahresb. Hanover, xiii. 23, 1864); 74, Rose (Karst. Tab., 33); 75, Bergemann (Sitz. Ges. Bonn, July, 1854); 76, Wright (J. G. Soc., Dublin, v. 119, Ann. d. M, V. iii. 707); 77, Damour (l. c.); 78, v. Merz (Nat. Ges Zurich, vi.); 79, Karavaief (Koksch. Min. Russl., iii. 34):

	$\ddot{Si}$	$\bar{Al}$	$\bar{Fe}$	$\dot{Fe}$	$\dot{Mn}$	$\dot{Mg}$	$\dot{Ca}$
47. Westmanland	37·55	—	31·35	—	4·70	—	26·74=100·34 Hisinger.
48. Willsboro', *Coloph.*	38·00	6·00	28·06[a]	—	—	—	29·00, $\dot{H}$ 0·33=101·39 Seyb.
49. Schwarzenberg, *gn.*	36·85	4·05	25·35	—	0·95	—	32·32=99·52 Karsten.
50. Sala	36·62	7·53	22·18	—	—	1·95	31·80=100·08 Bredberg.
51. Thuringia, *brown*	34·00	2·00	27·84	—	3·15	—	30·75, $\dot{H}$, $\dot{Cu}$ 4·25 Bucholz.
52. Longban, *yw.*	35·10	—	29·10	—	7·08	—	26·91, $\dot{K}$ 0·98=99·17 Wacht.
53. Altenau, *Aplome*	35·64	—	30·00	—	3·02	—	29·21, $\dot{K}$ 2·35 Wacht.
54. Hesselkulla, *bn.*	37·99	2·71	28·53	—	1·62	—	30·74=100·59 Wacht.
55. “ *gn.*	38·13	7·32	19·42	—	3·30	—	31·65=99·82 Wacht.
56. Arendal, *bnh.-bk.*	40·20	6·95	20·50	—	4·00	—	29·48=101·13 Wacht.
57. Vesuvius, *bn.*	39·93	13·45	10·95	3·35	1·40	—	31·66=100·94 Wacht.
58. Franklin, N. J., *bn.*	33·72	7·97	17·64[a]	—	16·70	—	25·88, $\dot{H}$ 0·08=101·99 T.
59. Frascati, *black, Mel.*	34·0	6·4	25·5	—	—	—	33·0=98·9 Vauquelin.
60. “ “	35·5	6·0	26·0[a]	—	—	—	32·5, $\ddot{Mn}$ 0·4=100·4 Klapr.
61. “ “	34·60	4·55	28·15	—	—	0·65	31·80=99·75 Karsten.
62. “ “	35·84	6·24	23·12	—	—	1·04	32·72, $\ddot{Ti}$ 1·04=100 Damour.
63. Beaujeu “	36·45	2·06	29·48	—	0·28	0·06	30·76, ign. 0·96 Ebelmen.
64. Franconia, N. H., *bk.*	38·35	—	28·15	—	—	—	32·00=99 Fisher.
65. Gustafsberg, G.=3·6	37·80	11·18	15·66	4·97	0·13	*tr.*	30·28=100·02 Bahr.
66. *Polyadelphite*	34·83	1·12	28·73	—	8·82	1·42	24·05=98·97 Weber.
67. “	35·47	3·10	28·55	—	5·41	2·18	26·74=101·40 Baumann.
68. Stokōe, *green* (⅔)	24·40	9·46	20·43	—	2·40	*tr.*	31·38, $\dot{Na}$ & loss 1·93=100 F

[a] Determined as protoxyd.

	$\ddot{\mathrm{Si}}$	$\bar{\mathrm{Al}}$	$\bar{\mathrm{Fe}}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Mn}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$
69. Schischimsk Mts.	35·21	*tr.*	34·11	—	*tr.*	—	30·96=100·28 Ivanof.
70. Achmatovsk	37·22	6·04	24·81	—	*tr.*	0·49	31·07=99·63 Ivanof.
71. Dobschau, *green*	38	3	28	—	—	2	30·=101 Tschermak.
72. Pitkäranta, *bnh.-gn.*	37·79	12·39	21·45	—	0·83	—	30·78=103·24 Granqvist.
73. Arkansas	31·25	—	31·80	—	—	0·46	33·30, $\ddot{\mathrm{Ti}}$ 3·19=100 Stron
74. Drammen, *Allochr.*	37·00	5·00	18·50	—	6·25	—	30·00=96·75 Rose.
75 Norway, *bk.*, *yttrif.*	34·94	*tr.*	30·01	—	1·09	0·50	26·04, $\dot{\mathrm{Y}}$ 6·66=99·24 Ber
76. Mt. Rosa, *Jelletite, gn.*	38·09	—	33·41	—	—	—	28·61=100·11 Wright.
77. Zermatt, " *bottle-gn.*	36·03	1·24	30·05	—	—	0·54	32·14=100 Damour.
78. " " *light gn.*	36·24	0·56	30·53	—	—	0·35	32·38=100·06 Merz.
79. Bosgolovsk, *ywh.-bn.*	35·37	0·53	31·49	—	0·29	0·54	32·50=100·72 Karavaief.

In anal. 52, G.=3·965; anal. 53, G.=3·871; anal. 56, G.=3·665; anal. 68, G.=3·64, from Brevigfiord with brevicite; anal. 69, G.=3·798; anal. 71, G.=3·72, in serpentine; anal, 73 made on a mineral erroneously called schorlamite; anal. 75, G.=3·88, H.=5; anal. 77, G.=3

F. *Lime-Magnesia Irongarnet;* BREDBERGITE. A variety from Sala, Sweden, is here inclu Formula ($\frac{1}{2}\dot{\mathrm{Ca}}^3+\frac{1}{2}\dot{\mathrm{Mg}}^3)^2\ddot{\mathrm{Si}}^3+\bar{\mathrm{Fe}}^2\ddot{\mathrm{Si}}^3$=Silica 37·2, peroxyd of iron 33·1, magnesia 12·4, lime =100. It corresponds under Irongarnet nearly to aplome under Aluminagarnet. Analysis Bredberg (Ak. H. Stockh., i. 63, 1822):

	$\ddot{\mathrm{Si}}$	$\bar{\mathrm{Al}}$	$\bar{\mathrm{Fe}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$
80. Sala	36·73	2·78	25·83	12·44	21·79=99·57

G. *Lime Chromegarnet;* OUVAROVITE. (Uwarowit *Hess.*, Pogg., xxiv. 388, 1832.) A sili of lime and sesquioxyd of chromium. Formula ($\frac{1}{2}\dot{\mathrm{Ca}}^3+\frac{1}{2}\bar{\mathrm{Cr}})^2\ddot{\mathrm{Si}}^3=(\dot{\mathrm{Ca}}^3)^2\ddot{\mathrm{Si}}^3+\bar{\mathrm{Cr}}^2\ddot{\mathrm{Si}}^3$.

In the Ural variety, a fourth of the oxyd of chromium is replaced by alumina; that is, $\bar{\mathrm{Al}}$: =1 : 3 nearly. Color emerald-green. H.=7·5. G.=3·41—3·52. B.B. infusible; with bora clear chrome-green glass. Named after the Russian minister, Uvarof. Analyses: 81, Komo (Verh. min. Ges. St. Pet., 1841, 55); 82, Erdmann (Jahresb., xxiii. 291, Ramm. Min. Ch., 6 83, Damour (L'Institut, 1856, No. 1198); 84, T. S. Hunt (Rep. G. Can., 1863, 497):

	$\ddot{\mathrm{Si}}$	$\bar{\mathrm{Al}}$	$\bar{\mathrm{Fe}}$	$\bar{\mathrm{Cr}}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$
81. Bissersk	37·11	5·88	—	22·54	2·44	1·10	30·34, $\dot{\mathrm{H}}$ 1·01=100·4
82. "	36·93	5·68	1·96	21·84	—	1·54	31·63, $\dot{\mathrm{Cu}}$ *tr.*=99·58
83. "	35·57	6·26	—	23·45*	—	—	33·32=98·50 Damour.
84. Orford, Can.	36·65	17·50	—	6·20	4·97	0·81	33·20, $\dot{\mathrm{H}}$ 0·30=99·63

* Includes some $\mathrm{Fe}^2\mathrm{O}^3$.

Garnet usually contains no water, or only a trace of it, and thus differs from the rel docrase. The grossularite from Wilui afforded G. Magnus only 0·12 p. c.; the cinnamon-st of Ala, 0·25—0·34; the almandine of Slatoust, none (Pogg., xcvi. 347).

In jewelry, the lighter clear garnets are often called hyacinth. The yellowish is the *Jacint bella;* a yellowish crimson, the *Guarnaccino;* and another very similar, *Vermeille*, or *Hyac Garnet;* the red, with a violet tinge, *Rubino-di-rocca*, and also *Grenat Syrian* (from Syriam Pegu), and probably the *Amethystizontes* of Pliny. The deep and clear red, like Burgundy w in shade, is the true *precious garnet*, which is either pyrope or almandite. The ancient na ανθραξ, meaning *a burning coal*, alludes to the internal fire-like color and reflection, and applied also to some ruby. The Latin name *carbunculus*, from *carbo*, *coal*, has the same signif tion.

Pyr., etc.—Most varieties fuse easily to a light-brown or black glass; F.=3 in almand spessartite, grossularite, and allochroite; 3·5 in pyrope; but ouvarovite, the chrome-garnet f Canada (No. 84 included), is almost infusible, F.=6. Allochroite and almandite fuse to a m netic globule. Reactions with the fluxes vary with the bases. Almost all kinds react for ir strong manganese reaction in spessartite, and less marked in other varieties; a chromium re tion in ouvarovite, and in most pyrope. Some varieties are partially decomposed by acids; except ouvarovite are after ignition decomposed by muriatic acid, and generally with separat of gelatinous silica. Decomposed on fusion with alkaline carbonates.

A brownish-red Arendal garnet, having G.=4·058, was reduced by heating to G.=4·046, by fusion to 3·596—3·204, Church; and a Ceylon essonite, having G.=3·666, had G.=3 after heating to incipient fusion, Church.

Obs.—Garnet crystals are very common in mica schist, gneiss, syenitic gneiss and hornblen and chlorite schist; they occur often, also, in granite, syenite, crystalline limestone, sometimes in serpentine, and occasionally in trap and volcanic tufa and lava.

Garnet is sometimes found in the massive form as a prominent constituent of a rock. A white variety (lime-aluminagarnet) occurs, forming, with a little serpentine, a whitish garnet rock at Orford in Canada, having G.=3·52—3·53. A similar *garnet-felsite* exists in Bayreuth in Bavaria. At St. François in Canada there is a yellowish-white and greenish-white garnet rock, consisting of the same garnet along with pyroxene, in the proportion, according to T. S Hunt, of 57·72 of the former to 40·71 of the latter, having G.=3·33, and affording on analysis, $\ddot{\mathrm{S}}\mathrm{i}$ 44·85, $\ddot{\mathrm{A}}\mathrm{l}$ 10·76, $\bar{\mathrm{F}}\mathrm{e}$ 3·20, $\dot{\mathrm{M}}\mathrm{g}$ 5·24, $\dot{\mathrm{C}}\mathrm{a}$ 34·38, ign. 1·10=99·53 (Rep. G. Can., 1863, 496). *Eclogyte* is a *garnet-euphotide*, consisting of a massive reddish garnet and grass-green smaragdite or omphacite. These garnet rocks are all very tough as well as heavy rocks.

Many foreign localities of garnet have been mentioned in the preceding pages, under the head of *composition* and *varieties*. The best *cinnamon-stone* comes from Ceylon, in gneiss; Malsjö in Wermland, in crystalline limestone; on the Mussa-Alp in Piedmont, with clinochlore and diopside, where the crystals present the planes *I*, 2-2, *i*-2, $\frac{3}{2}$, 3-$\frac{3}{2}$, *O*; 1; at Mittaghorn, in Switzerland, with the same minerals, reddish-brown in color, and having sometimes the planes *i*-2 and $\frac{3}{2}$ with *I* and 2-2; pale isabella-yellow at Auerbach, with the planes 2-2, *I*, 3-$\frac{3}{2}$, *i*-2, *i*-$\frac{3}{2}$; a brownish variety (*romanzovite*) at Kimito in Finland. A honey-yellow garnet in *octahedrons* occurs in Elba. Grossularite of pale greenish color, comes from the banks of the Wilui in Siberia, in serpentine with idocrase, and from Cziklowa, in the Bannat; in white or colorless crystals in Tellemark, in Norway, and the Schischimskaja Gora, in the Ural; also whitish in a resinopal pseudomorph after coral in Van Diemen's Land. Emerald-green crystals are found at Dobschau in Hungary. *Almandite* or precious garnet comes in fine crystals from Ceylon, Pegu, Brazil, and Greenland. Common garnet is found in dodecahedrons 3 to 4 inches through at Fahlun in Sweden, Arendal and Kongsberg in Norway, and the Zillerthal. *Allochroite*, an apple-green and yellowish variety, of different shades, occurs at Zermatt in Valais, in geodes of crystals in chlorite schist; brilliant black crystals (*melanite*) and also brown, at Vesuvius on Somma; and in a volcanic tufa at Frascati near Rome; peak Espada and that of Ereslids near Barèges in the Hautes-Pyrenees (*Pyreneite*). Aplome occurs in yellowish and brownish-green crystals at Schwarzenberg in Saxony, and on the borders of the Lena in Siberia. *Spessartite* at Spessart near Aschaffenburg in Bavaria; in the white feldspar of the granite of Elba, at St. Marcel, Piedmont, in pegmatite at Vilate near Chanteloube, Haute-Vienne; at Broddbo, near Fahlun, in Sweden; in a porphyritic trap, near Ilefeld in the Harz. Pyrope occurs in trap, tufa, and in the sands of the region, near Meronitz, Trziblitz, and Podsedlitz, in Bohemia, where alone the variety used as a gem is obtained; also at Zöblitz in Saxony, and the valley of Krems in Bohemia, in a serpentine rock. *Ouvarovite* is found at Saranovskaja near Bissersk, in the vicinity of Kyschtimsk, Urals, lining cavities or fissures in chromic iron; at Haule, in Rupshu, on chromite.

Near Cauterets, the Hautes-Pyrénées, large crystals of brown garnet have a nucleus, easily separable, of dull green crystallized idocrase; the containing rock is a compact gray limestone.

In N. America, in *Maine*, beautiful yellow crystals or cinnamon-stone (with idocrase) at Parsonsfield, Phippsburg, and Rumford; manganesian garnet at Phippsburg, as well as the finest yellow garnet in Maine; in mica slate near the bridge at Windham, with staurotide; in granite veins at Streaked Mountain, along with beryl; in large reddish-brown crystals at Buckfield, on the estates of Mr. Waterman and Mr. Lowe; handsome red garnets at Brunswick. In *N. Hamp.*, at Hanover, small clear crystals in syenitic gneiss; blood-red dodecahedrons at Franconia, in geodes in massive garnet, with calcite and magnetic iron; at Haverhill, in chlorite, some 1½ in.; at Warren, beautiful cinnamon garnets with green pyroxene; at Unity, on the estate of J. Neal, with actinolite and magnetite, and at Lisbon, near Mink Pond, in mica slate with staurolite; at Grafton, ½ to 1 in. in diameter. In *Vermont*, at New Fane, large crystals in chlorite slate; also at Cabot and Cavendish. In *Mass.*, at Carlisle, geodes of transparent cinnamon-brown crystals similar to figure 14, with scapolite in limestone; at Boxborough, similar but less remarkable specimens; also in gneiss at Brookfield and Brimfield; massive with epidote at Newbury, and in crystals at Bedford, Chesterfield, with the Cummington kyanite, and at the beryl locality of Barre. In *Conn.*, trapezohedrons, ½–1 in., in mica slate, at Reading and Monroe; at Haddam, ib. of manganesian garnet, often 2 in. through, with chrysoberyl; at Middletown feldspar quarry, with octahedral faces (Shepard); at Lyme, large blackish-brown crystals in limestone. In *N. York*, in mica slate, in Dover, Duchess Co., small; at Roger's Rock, crystallized and massive, and colophonite of yellow, brown, and red colors, abundant; brown crystals at Crown Point, Essex Co.; colophonite as a large vein in gneiss at Willsboro, Essex Co., with wollastonite and green coccolite, and also at Lewis, 10 m. south of Keeseville; in Middletown, Delaware Co., large brown cryst.; a cinnamon variety, crystallized and massive, at Amity; on the Croton aqueduct, near Yonkers, in small rounded crystals, and a beautiful massive variety—the latter, when polished, forms a beautiful gem. In *N. Jersey*, at Franklin, black, brown, yellow, red, and green dodecahedral garnets; also near the Franklin furnace. In *Penn.*, in Chester Co., at Pennsbury, fine dark brown crystals with polished faces, in granite; near Knauertown, at Keims' mine, in handsome lustrous crystals; at Chester, brown;

in Concord, on Green's Creek, resembling pyrope; in Leiperville, red; at Mineral Hill, fine-bro at Warren, black. In *Delaware*, cinnamon-stone in trapezohedrons, at Dickson's quarry, 7 from Wilmington. Also at Knife rapids on the Mississippi In *California*, green with co ore, Hope Valley, El Dorado Co., on Rogers' claim; also with copper ore in Los Angeles Co. Mt. Meadows; ouvarovite, in crystals on chromite, at New Idria; in *Alaska*, in large trapezo drons, near Stickeen river; pyrope, near Santa Fé, New Mexico.

In *Canada*, at Marmora, dark-red; at Grenville, a cinnamon-stone; an emerald-green chro garnet, containing 6 to 7 p. c. of oxyd of chrome, in Orford, Canada, in granular masses and dru of minute transparent dodecahedral crystals, with millerite and calcite (anal. 82); and in same vicinity large cinnamon-red and yellowish crystals of garnet along with pyroxene.

The cinnamon-stone from Ceylon (called hyacinth) and the precious garnet are used as g when large, finely colored, and transparent. The stone is cut quite thin, on account of the de of color, with a pavilion cut below, and a broad table above bordered with small facets. octagonal garnet measuring 8½ lines by 6½ has sold for near $700. Pulverized garnet is so times employed as a substitute for emery.

Alt.—Garnets containing protoxyd of iron often become rusty and disintegrated through oxydation of the iron, and sometimes are altered, more or less completely, to *limonite*, *magn* or *hematite*. The action of waters containing traces of carbonic acid and carbonates and silic in solution, results in the same changes nearly as with pyroxene, producing at different tim loss, or alteration, of bases, or by a further change and the addition of water, *steatite*, *serpent chlorite*. The lime in the lime garnets may be taken up by the carbonic acid of the waters; if magnesia is combined with the carbonic acid (forming a bicarbonate), it may take the plac the lime, and thus give rise to a *serpentine* or *steatite* pseudomorph, or to a *chlorite*, if the iron pa remains. Alkaline carbonates seldom produce the changes, for alkaline pseudomorphs are r An excess of silica is to be expected in analyses, according to Bischof, since part of the bases often lost through incipient change. Quartz also occurs with the form of garnet.

Trollé Wachtmeister found in a crystallized, reddish-brown garnet, having G.=3·851, fr Klemetsaune in Norway, which was partly penetrated by a whitish mineral, $\ddot{\mathrm{Si}}$ 52·11, $\dddot{\bar{\mathrm{Al}}}$ 18 $\dot{\mathrm{Fe}}$ 23·54, $\dot{\mathrm{Mn}}$ 1·74, $\dot{\mathrm{Ca}}$ 5·77=101·19, in which there is a deficiency of bases, or what is equival an excess of silica, the oxygen ratio of bases and silica being 1 : 1·7, instead of 1 : 1. Schill fo in a melanite from Kaiserstuhl, $\ddot{\mathrm{Si}}$ 45·80, $\dddot{\bar{\mathrm{Al}}}$ 11·00, $\dddot{\bar{\mathrm{Fe}}}$ 12·33, $\dot{\mathrm{Ca}}$ 22·10, $\dot{\mathrm{Mg}}$ 2·00, $\dot{\mathrm{Fe}}$ 7·16, $\dot{\mathrm{Mn}}$ =101·09, giving for the oxygen ratio of bases and silica 1 : 1·34. Sthamer obtained for a mas garnet, of a dark grayish-green color, from Miask, having a serpentine-like nucleus, $\ddot{\mathrm{Si}}$ 46·11, 12·09, $\dddot{\bar{\mathrm{Fe}}}$ 13·19, $\dot{\mathrm{Ca}}$ 20·33, $\dot{\mathrm{Mg}}$ 7·36=99·08, giving for the oxygen ratio of bases and silica 1 :

Pyrope occurs altered to talc at its several localities. A serpentine pseudomorph after gar from Schwarzenberg in Saxony, afforded Kersten $\ddot{\mathrm{Si}}$ 34·24, $\dot{\mathrm{Mg}}$ 33·28, $\dot{\mathrm{Fe}}$ 3·38, $\dot{\mathrm{Mn}}$ 0·41, $\dot{\mathrm{Na}}$ 0 $\dot{\bar{\mathrm{H}}}$ with some bitumen 10·62, magnetic iron 17·50=99·78=82·28 serpentine and 17·50 magn iron.

Some garnets effervesce with acids, from the presence of carbonate of lime, which they hav ceived probably through the action of waters holding carbonic acid or bicarbonates in solution. for example, a black garnet from Arendal, Norway, which contains both calcite and epidote; crystals from Tvedestrand, which are, wholly calcite within, there being but a thin crust garnet.

Artif.—Melanite garnets have been obtained in a porous glass proceeding from the fusion idocrase (Klaproth), and also of a melanite from Frascati (v. Kobell). Miller mentions the oc rence of garnet in crystals as a furnace product. Daubrée and Studer state that crystals of gar may be made by fusing together the constituents. Mitscherlich has also obtained garnets a ficially (Ann. Ch. Phys., lxii. 219).

TRITOMITE of Weibye, a hydrous species, is probably related in composition, as it is in form, garnet and helvin; it appears to give, although a sesquioxyd silicate, the garnet oxygen ratio 1 See description under HYDROUS SILICATES.

---

272. ZIRCON. Λυγκύριον (=Lyncurium)? *Theophr.* [Pliny knew of no stone of the name L curium, xxxvi. 13.] Chrysolithos? pt., *Plin.*, xxxvii. 42; Melichrysos? ib., 45; Crateritis? 56. Not Chrysolithos (Gemmarii hodie etiam Hyacinthum vocant) *Germ.* Jacinth, *Agric.*, Fo 295, Interpr., 464, 1546. Not Hyacinthus *Wall.*, 121, 1747. Jargon (in note acknowledg ignorance of it) *Cronst.*, 42, 1758. Jargon, Topazius pt. (clarus hyalinus, var. *f*). *Wall.*, 1772. Grenat à prisme quadrilatère, etc., Hyacinte (fr. Expailly) *Faujas*, Viv., 187, and Erra 1772. Hyacinte pt. (var. 1; angles and figs. given) [rest Idocrase, Meionite, Harmotome]

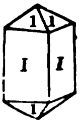
Lisle, Crist., 1772, ii. 1783; Diamant brut, ou Jargon de Ceylan, ib., ii. 229, 1783. Zircon (fr Ceylon) *Wern.*, 1783; *Karsten*, Lempe Mag., iv. 99, 1787. Zircon (a Silicate of ZIRCONIA) *Klapr.*, Schrift. Nat. Fr. Berl., ix. 1789, Beitr., i. 203. Zirconite. Ostranit *Breith.*, Uib., 1830, Char., 1832. Calyptolite *Shep.*, Am. J. Sci., II. xii. 210, 1851. Engelhardit *E. v. Hofmann*, Koksch. Min Russl., iii. 150, 1858.

Tetragonal. $O\wedge 1\text{-}i=147^\circ\ 22'$; $a=0{\cdot}640373$. Observed planes: *O* very rare; prisms *I*, *i-i*; octahedral 1, 2, 3, 1-*i*; zirconoid, 3-3, 4-4, 5-5.

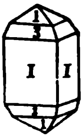
$I\wedge 1=132^\circ\ 10'$ — $i\text{-}i\wedge 1=118^\circ\ 20'$ — $1\wedge 1$, pyr., $=123^\circ\ 19\tfrac{1}{2}'$
$I\wedge 2=151\ \ 5\tfrac{3}{4}$ — $i\text{-}i\wedge 1\text{-}i=122\ \ 38$ — $1\wedge 1$, bas., $=84\ \ 19\tfrac{3}{4}$
$I\wedge 3=159\ \ 48\tfrac{1}{2}$ — $i\text{-}i\wedge 3\text{-}3=148\ \ 16\tfrac{3}{4}$ — $1\text{-}i\wedge 1\text{-}i$, pyr., $=135\ \ 10$
$I\wedge 1\text{-}i=112\ \ 25$ — $i\text{-}i\wedge 4\text{-}4=155\ \ 8$ — $1\wedge 1\text{-}i=151\ \ 39\tfrac{1}{4}$

Faces of pyramids sometimes convex. Cleavage: *I* imperfect, 1 less distinct. Also in irregular forms and grains.

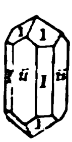
248



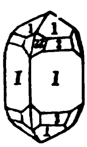
249



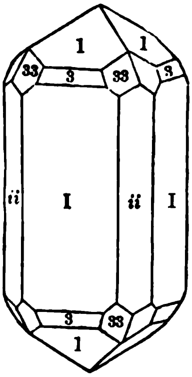
250



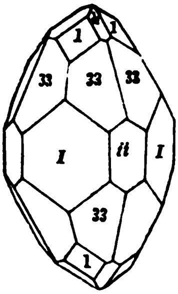
251



252

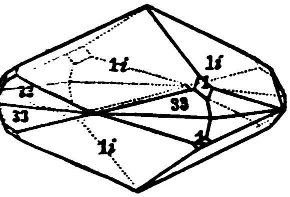


253



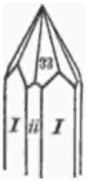
McDowell Co., N. C.

254



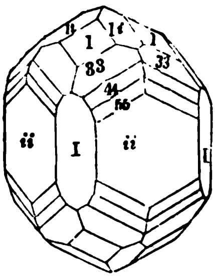
Gov. of Tomsk.

255



Ural.

256



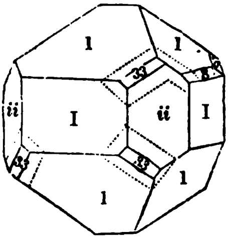
Saualpe.

H.=7·5. G.=4·05–4·75. Lustre adamantine. Colorless, pale yellowh, grayish, yellowish-green, brownish-yellow, reddish-brown. Streak unolored. Transparent to subtranslucent and opaque. Fracture conchoidal, rilliant. Double refraction strong, positive.

Var.—The colorless and yellowish or smoky zircons of Ceylon have there been long called *jargons* in jewelry, in allusion to the fact that while resembling the diamond in lustre, they were com tively worthless; and thence came the name *zircon*. The brownish, orange, and reddish were called distinctively *hyacinths*—a name applied also in jev to some topaz and light colored garnet. Crystals like fig. 25 the *engelhardite* of Russia. The crystals from Fredericks analyzed by Berlin (anal. 5), were by mistake called *Erdma* Minute dark brown and greenish-brown crystals from the ch beryl locality at Haddam, Ct., are the *calyptolite* of Shepard, pro an altered variety, like ostranite, malacone, etc. (see beyond). 257 represents, of actual form, a crystal from Warren Co., N which is chesnut-brown about some of the angles (as marked by ted lines), and the rest grayish-white; others from the region stripes of color parallel to the edges of 3-3; the planes 3-3 and 3 part wanting.

For crystals from Stockholm G.=4·072—4·222, Svanberg Ilmen Mts., 4·599, 4·610, id.; fr. Ceylon, 4·681, id.; 4·721, Co fr. Fredericksvärn, 4·2, Berlin; from Duncombe Co., N. C., 4 Chandler; fr. Litchfield, Me., 4·7, Gibbs; fr.—? 4·615—4·71, He berg; fr. Grenville, Canada, 4·625—4·602, T. S. Hunt; fr. Reading, Pa., 4·595. Wetherill.

257



Johnsburg, N. Y.

The crystals have but slight variations in angle. Kokscharof deduced (Min. Russl., iii. 193) for the Ural crystals 1 ∧ 1=123° 19′ 34″ and 84° 19′ 46″; which agree very closely his measurements (123° 20′ 21″) and those for the mineral by Kupffer (Preisschrift, etc.), obtained 123° 20′ 8″. For the engelhardite Kokscharof obtained 84° 21′ 45″. H. Dauber f for crystals from Miask 123° 20′ 18″ (Pogg., cvii. 275, 1859); from five from Pfitschthal, 20′ 46″; from three crystals fr. Fredericksvärn, 123° 20′ 33″; from a Ceylon crystal, 123° 19′

Comp.—$\ddot{\mathrm{Zr}}\,\ddot{\mathrm{Si}}$=Silica 33, zirconia 67=100. Analyses: 1, Klaproth (Beitr., v. 126); 2, quelin (Haüy's Min., 1801); 3, Berzelius (Ak. H. Stockh., 1824); 4, Wackernagel (Ramm. Ch., 890); 5, Berlin (Pogg., lxxxviii. 162); 6, Henneberg (J. pr. Ch., xxxviii. 508); 7, Vanu (J. Ac. Philad., iii. 59); 8, C. F. Chandler (Am. J. Sci., II. xxiv. 131); 9, W. Gibbs (Pogg., 559); 10, Wetherill (Trans. Am. Phil. Soc. Philad., x. 346, Am. J. Sci., xv. 443); 11, T. S. (Am. J. Sci., II. xii. 214):

	$\ddot{\mathrm{Si}}$	$\ddot{\mathrm{Zr}}$	$\ddot{\not{\mathrm{F}}}\mathrm{e}$	$\dot{\mathrm{Ca}}$	$\dot{\not{\mathrm{H}}}$
1. Ceylon	32·5	64·5	1·5	——	——=98·5 Klaproth.
2. " *Hyacinth*	32·0	64·5	2·0	——	——=98·5 Vauquelin.
3. Expailly	33·48	67·16	—	——	——=100·64 Berzelius.
4. Fredericksvärn	34·56	66·76	*tr.*	——	——=101·32 Wackernagel.
5. "	33·43	65·97	0·70	——	——=100·10 Berlin.
6. ?	33·85	64·81	1·55	0·88	——=101·09 Henneberg.
7. Buncombe Co., N. C.	32·08	67·07	——	——	——=99·15 Vanuxem.
8. " " "	33·70	65·30	0·67	——	0·41=100·08 Chandler.
9. Litchfield, Me.	35·26	63·33	0·79	——	——, undec. 0·36=99·74 Gib
10. Reading, Pa.	34·07	63·50	2·02	——	0·50=100·09 Wetherill.
11. Grenville, *brown*	33·7	67·3		——	——=101·0 Hunt.

Klaproth discovered the earth zirconia in this species in 1789 (Beitr., i. 203).

Pyr., etc.—Infusible; the colorless varieties are unaltered, the red become colorless, dark-colored varieties are made white; some varieties glow and increase in density by ig Not perceptibly acted upon by salt of phosphorus. In powder is decomposed when fused soda on the platinum wire, and if the product is dissolved in dilute muriatic acid it gives orange color characteristic of zirconia when tested with turmeric paper. Not acted upo acids except in fine powder with concentrated sulphuric acid. Decomposed by fusion alkaline carbonates and bisulphates.

G. before heating of a Ceylon zircon, 4·183, after heating to redness, 4·534, Damour; bu some zircons no change, according to Church; trials, before and after, of the Henderson 4·575, 4·540; another, ib., 4·665, 4·665; the Expailly, 4·863, 4·861; the Fredericksvärn, 4 4·633. A phosphoric glow after heating, and the greatest density after this glow, Church.

Obs.—Occurs in crystalline rocks, especially granular limestone, chloritic and other sch gneiss, syenite; also in granite; sometimes in iron-ore beds.

Zircon-syenite is a coarse syenitic rock, containing crystals of zircon, with oligoclase, ægi elæolite, epidote. Crystals are common in most auriferous sands (p. 6). Sometimes found in canic rocks.

Found in alluvial sands in Ceylon; in the gold regions of the Ural, near Miask, Bereso Newjansk, etc.; at Laurvig and Hakedal in Norway; at Arendal in Norway, in the iron-mi at Fredericksvärn, in zircon-syenite; at Ohlapian in Transylvania; at Bilin in Bohemia; Sel in Saxony; Pfitschthal in the Tyrol, at Expailly. near Le Puy in France; in Auvergne, in volcanic tufa; at Vesuvius, with ryacolite; in Scotland, at Scalpay, Isle of Harris; at Strontian in Argyleshire; in the auriferous sands of the Croghan Kinshela Mtn., Ireland; in Greenland; at Santa Rosa in Antioquia, N. Grenada; in the gold regions of Australia.

In N. America, in *Maine*, at Litchfield; at Mt. Mica in Paris; Greenwood; Hebron. In *Vermont*, at Middlebury. In *Conn.*, at Norwich, with sillimanite, rare; at Haddam (calyptolite) in minute crystals. In *N. York*, at Hall's mine in Moriah, Essex Co., cinnamon-red, in a vein of quartz; near the outlet of Two Ponds, Orange Co., with scapolite, pyroxene, and sphene, in crystals sometimes 1 in. in length; on Deer Hill, 1 m. S.E. of Canterbury, in the same Co., crystals abundant of a deep brownish-red or black color, and occasionally 1½ in. in length; in Warwick, at the southern base of Mount Eve, chocolate-brown crystals in limestone and scapolite; near Amity, and also in Monroe and Cornwall, at several localities, of white, reddish-brown, clove-brown, and black colors; at Diana in Lewis Co., in large brown crystals sometimes 2 in. long, with sphene and scapolite, but rare; in St. Lawrence Co., with apatite, at Robinson's in the town of Hammond, near de Long's Mills, some of the crystals 1½ in. long and ½ in. wide, and occasionally containing a nucleus of carbonate of lime; also at Rossie (form *I*, 1, 3); at Johnsburg, in Warren Co. In *N. Jersey*, at Franklin; at Trenton in gneiss. In *Penn.*, near Reading, in large crystals in magnetic iron ore; at Easton, in talcose slate. In *N. Car.*, in Buncombe Co., on the road from the Saluda Gap to Asheville, upon the first elevation after passing Green river, crystals found loose in the soil, and imbedded in feldspar; in the sands of the gold washings of McDowell Co. (f. 253). In *California*, in the auriferous gravel of the north fork of the American river, and elsewhere. In *Canada*, at Grenville; St. Jerome; Mille Isles.

The name *Hyacinth* was applied by the ancients to a bluish-violet stone, regarded as our sapphire, nd was derived from a flower (lily) so-called of this color. [In modern mineralogy a *hyacinth-o'or* is reddish-orange with a tinge of brown.] Intagli of zircon are common among ancient gems, nd the fact that the *lyncurium* of Theophrastus was, as he says, used for engraved signets, while t the same time electric on friction, and often amber-colored, are the principal evidence that it ras our zircon.

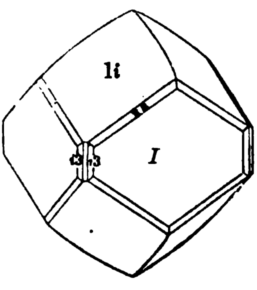
Alt.—Zircon is one of the least alterable of minerals, as it contains no protoxyds, and only the ost insoluble of peroxyds. It however passes to a hydrous state, and is attended ultimately ith a loss of silica and the addition of oxyd of iron and other impurities derived from infiltrating aters. *Auerbachite, malacon, œrstedite, tachyaphaltite, calyptolite, cyrtolite*, are probably altered ircon.

The following tetragonal zircon-like minerals are probably altered zircon. They afford B.B. ore or less water:

272A. **Malacon.** (Malakon *Scheerer*, Pogg., lxii. 436, 1845.) 1 ∧ 1=124° 40′ to 124° 57′, nd ∧3 · 30′. H.=6·5. G.=3·9—4·047. Lustre vitreous to subvitreous. Color brown, powder ddish-brown or uncolored. From Hitteröe in Norway; and Chauteloube, Haute Vienne, occurng in thin plates, over 3 to 4 mm. thick, and occasionally with crystals on their surface. Named om μαλακος, *soft*.

272B. **Cyrtolite.** (Malacone, Altered Zircon, *J. P. Cooke*, Am. J. Sci., xliii. 228; Cyrtolite *. J. Knowlton*, ib., xliv. 224.) Form as in f 258, with the pyraidal planes convex. H.=5—5·5; after ignition 7—7·5, Cooke. .=·98—4 04, Cooke; 3·85, 3·97, Knowlton. Lustre somewhat lamantine. Color brownish-red; powder the same. From Rockort, Mass., in granite, with danalite and cryophyllite. Named om κυρτος, *bent*. Fig. 258 from Cooke.

258



A mineral found with columbite at Rosendal, near Björkboda, nland, has been referred to adelpholite of Nordenskiöld (p. 525), it an analysis by A. E. Nordenskiöld (anal. 7) shows that it is altered zircon. near malacon or cyrtolite (Œfv. Ak. Stockh., 63, 452, Pogg., cxxii. 615, 1864).

272C. **Tachyaphaltite.** (Tachyaphaltit *Weibye*, Pogg., lxxxviii. 0, 1853.) Crystals like those of zircon, with planes *I*, *i-i*, and o octahedrons, one of 110° and the other of 50°. H.=5·5. G. 3·6. **Lustre** submetallic to vitreous. Color dark reddish-brown. reak dirty yellow. Subtranslucent. From granite veins in gneiss near Krageröe in Norway, th sphene. Named from ταχυς, *quick*, and ασφαλτος, the mineral flying readily from the gangue hen struck. Berlin puts a ? after *thoria* in his analysis (No. 8).

272D. **Œrstedite.** (Œrstedit *Forchhammer*, Pogg., xxxv. 630, 1835.) 1 ∧ 1=123° 16½′. H.= . G.=3·629. Lustre splendent adamantine. Color reddish-brown. From Arendal in Norway, and commonly on crystals of pyroxene. Named after Œrsted.

272E. **Auerbachite.** (Auerbachit *Hermann*, J. pr. Ch., lxxiii. 209, 1858.) $1 \wedge 1 = 122'$ 4 85° 21′, Kokscharof; 86° 30′, Herm.; 87°, Auerbach. H.=6·5. G.=4·06. Lustre grea vitreous, weak. Color brownish-gray. From a siliceous schist in the Circle of Mariupol trict of Alexandrovsk, Russia. Named after Dr. Auerbach, by whom the crystals were first st

272F. **Bragite** (*Forbes & Dahll*, Nyt. Mag. Nat., xiii 1855). Occurs in imperfect crystals, ably tetragonal, in orthoclase, near Helle, Narestö, Alve, and Askerö, Norway. H.=6- G.=5·13—5·35; lustre submetallic; color brown; streak yellowish-brown; thin splinters lucent. Heated in glass tube decrepitates strongly and loses water. B.B. in the platinum ceps infusible, but becomes yellow; with borax, a glass which is brownish-yellow while ho green and finally greenish-yellow on cooling. In salt of phosphorus a skeleton of silica analysis has yet been made, and the true relations of the species are doubtful.

Analyses: 1, Scheerer (l. c.); 2, Damour (Ann. Ch. Phys., III. xxiv.); 3, Hermann (Chem., liii. 32); 4, J. P. Cooke (l. c.); 5, 6, Knowlton (l. c.); 7, A. E. Nordenskiöld (l. c Berlin (Pogg., lxxxviii. 160); 9, Forchhammer (l. c.); 10, Hermann (l. c.):

		S̈i	Z̈r	F̶̈e	Ü̶	Ḟe	Ẏ	Ṁg	Ḣ
1. *Malacon*,	Hitteröe	31·31	63·40	0·41	——	——	0·34	0·11	3·03=98·99 Scheer
2. "	Chanteloube	30·87	61·17	3·67	——	——	——	——	3·09, Ṁn 0·14=99
3. "	Ilmen Mts.	31·87	59·82	——	——	3·11	——	——	4·00, Ṁn 1·20=10
4. *Cyrtolite*,	Rockport	27·90	66·93	2·57^c	——	——	——	——	2·19=99·59 Cooke
5. "	" (⅔)	26·38	60·78	——	1·59	3·63	Ċe 2·07	*tr.*	4·56, S̈n 0·47=99 4
6. "	"	26·18	64·60^a	——	1·40	——	Ċe 1·40	*tr.*	——, S̈n 0·41=9
7. *Adelpholite?*	Finland	24·33	57·42	3·47	——	——	Ċa 3·93	——	9·53, S̈n 0·61=99
8. *Tachyaphalt.*,	Norway	34·58	38·96	3·72	——	——	T̈h 12·32	——	8·49, Ä̶l 1·85=99
9. *Œrstedite*,	Arendal	19·71	68·96^b	——	——	1·14	——	2·05	5·53, Ċa 2·61=10
10. *Auerbachite*,	Russia	42·91	55·18	——	——	0·93	——	——	0·95=99·97 Herm.

a With some Fe O. b With some Ti O^2. c With trace of manganese.

In Auerbachite, the only anhydrous kind among the above, the oxygen ratio for the silic zirconia is 1 : 1½, instead of 1 : 1.

Artif.—Formed in crystals by action of chlorid of silicon on zirconia (Daubrée); by act fluorid of silicon on zirconia, or of fluorid of zirconium on quartz, beautiful transparent octahe resulting (Deville and Caron).

273. VESUVIANITE. Hyacinthus dictus octodecahedricus *Cappeler*, Prodr. Crist., 8 (fig. 261 below), 1723. Hyacinte pt., Hyacinte du Vesuve, *de Lisle*, Crist., 234, 1772, pl. 291, pl. iv. 1783. Hyacinte volcanique *Demeste*, Lettr., i. 413. Hyacinth-Krystalle (fr. Wil *Pallas*, N. Nord., Beytr., St. Pet., v. 282, 1793; Wiluite pt. Vulkanischer Schorl *Widen* Handb., 290, 1794. Hyacinthine *Delameth.*, Sciagr., i, 268, 1792, T. T., ii. 323, 1796. Ves *Wern.*; in Klapr. Beitr., i. 34, 1795, ib. (fr. Vesuv. and Siberia), ii. 27, 33, 1797. Idocra J. d. M., v. 260, 1799; Tr., ii. 1801.

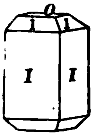
Gahnit (fr. Gökum) *v. Lobo*, Afh., iii. 276, 1810, anal. by Murray, Afh., ii. 173, 1807; *Berz.* Frugardit *N. Nordenskiöld*, Bidrag, i. 80, 1820; Frugardite. Egeran (fr. Eger, Bo *Wern.*, Min. Syst., 3, 34, 1817. Cyprine (fr. Tellemark) *Berz.*, Löthr., 1821. Xanthite *Th* Ann. Lyc. N. Hist. N. Y., iii, 44, 1828. Gökumite (fr. Gökum) *Thoms.*, ib., 61, 1828. H merit (fr. Slatoust) *Herm.*, Verh. Min. Ges. St. Pet., 1845–46, 205. Jewreinowit *N. Nor* Verz. Finl. Min., 1852; Kokscharof Min. Russl., i. 116, 1853.

Tetragonal. $O \wedge 1\text{-}i = 151^\circ\ 45'$; $a = 0·537199$. Observed planes: vertical, I, $i\text{-}i$, $i\text{-}2$, $i\text{-}3$, $i\text{-}\frac{5}{3}$, $i\text{-}\frac{7}{4}$; pyramids, $\frac{1}{20}$, $\frac{1}{10}$, $\frac{1}{9}$, $\frac{1}{8}$, $\frac{1}{7}$, $\frac{1}{6}$, $\frac{1}{5}$, $\frac{1}{4}$, $\frac{1}{3}$, $\frac{4}{5}$, 1, $\frac{8}{5}$, 2, 3; $\frac{1}{2}\text{-}i$, $1\text{-}i$, $\frac{3}{2}\text{-}i$, $2\text{-}i$, $3\text{-}i$; zirconoids in the zone $i\text{-}i$: 1, 2-2, $\frac{8}{3}\text{-}\frac{8}{3}$, $\frac{61}{20}\text{-}\frac{61}{20}$, 4-4, 5-5, 7-7; in other zones, 1-2, $\frac{4}{3}\text{-}2$, 4-2; $\frac{1}{3}\text{-}3$, $\frac{3}{5}\text{-}3$, $\frac{2}{3}\text{-}3$, 1-3, $1\text{-}\frac{7}{4}$, $1\text{-}\frac{7}{3}$.

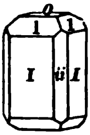
$O \wedge 1 = 142^\circ\ 46\frac{1}{2}'$ $O \wedge I = 90^\circ$ $i\text{-}i \wedge i\text{-}2 = 153^\circ\ 26'$
$O \wedge 2 = 123\ 21$ $I \wedge 1\text{-}i = 118\ 15'$ $i\text{-}i \wedge i\text{-}3 = 161\ 34$
$O \wedge 2\text{-}2 = 129\ 46\frac{1}{2}$ $i\text{-}i \wedge 2\text{-}2 = 133\ 25\frac{1}{2}$ $1 \wedge 1$, ov. $1\text{-}i$, $= 129\ 2$
$O \wedge 4\text{-}4 = 114\ 18$ $i\text{-}i \wedge 3\text{-}3 = 144\ 51\frac{1}{2}$ $1 \wedge 1$, ov. I, $= 74\ 27$
$O \wedge \frac{8}{3}\text{-}3 = 139\ 39\frac{1}{2}$ $i\text{-}i \wedge 4\text{-}4 = 152\ 9$ $1\text{-}i \wedge 1\text{-}i$, pyr., $= 140\ 54$

Cleavage: *I* not very distinct, *O* still less so. Columnar structure rare, straight and divergent, or irregular. Sometimes granular massive. Prisms usually terminating in the basal plane *O*; rarely in a pyramid or zirconoid; sometimes the prism nearly wanting, and the form short pyramidal with truncated summit and edges.

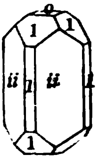
259



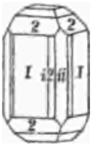
260



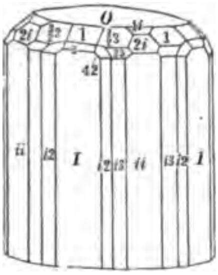
261



262

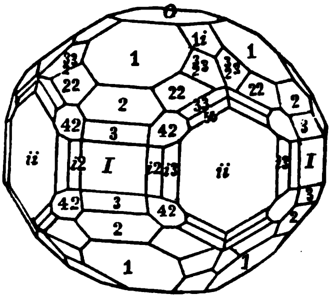


263



Sandford, Me.

264



Vesuvius.

H.=6·5. G.=3·349—3·45. Lustre vitreous: often inclining to resinous. Color brown to green, and the latter frequently bright and clear; occasionally sulphur-yellow, and also pale blue; sometimes green along the axis, and pistachio-green transversely. Streak white. Subtransparent—faintly subtranslucent. Fracture subconchoidal—uneven. Double refraction feeble, axis negative.

Comp., Var.—$(\frac{3}{5}\dot{R}^3+\frac{2}{5}\not{R})^2\ddot{Si}^3$, the oxygen ratio for the protoxyds, sesquioxyds, and silica being 3 : 2 : 5, according to Rammelsberg, after a determination of the state of oxydation of the iron. The variations from the ratio 3 : 2 : 5 appear to be variations about this as the normal ratio. In all cases the oxygen ratio for $\dot{R}+\not{R}$, $\ddot{Si}$ is 1 : 1. The bases are mainly alumina for the sesquioxyd, and lime for the protoxyd portion, as in the formula $(\frac{3}{5}\dot{C}a^3+\frac{2}{5}\ddot{\ddot{A}}l)^2\ddot{Si}^3$. But more or less sesquioxyd of iron replaces part of the alumina, and magnesia part of the lime, while $\dot{M}n$, $\dot{K}$, $\dot{N}a$ may be present in traces.

The species is sometimes divided into (1) *non-magnesian*, containing little or no magnesia; and (2) *magnesian*, the magnesia 4 to 13 p. c. of the mineral. But, as the analyses show, there is no corresponding line of division. Even the crystals from Vesuvius vary in the proportion of magnesia from 0 to 7·11 p. c.

Var. 1. *Ordinary.* The mineral from Gökum in Finland, called *Gahnite*, *Loboite*, *Gökumite*, and that from Frugard, *Frugardite*, have been denominated *magnesian.* The last is in brown and green crystals, with G.=3·349, v. Nord. *Jevreinoffite*, which also is from Frugard, in the parish of Mäntzälä, is but little magnesian or not at all so; it occurs in pale-brown to colorless crystals; G.=3·39. *Heteromerite* occurs in small oil-green prisms, having the planes *I*, *i-i*, 1, 3, 3-3, in the district of Slatoust, Ural. Egeran is a subcolumnar brown variety, from Eger in Bohemia, and found also at Eger in Norway.

Xanthite is a yellowish-brown vesuvianite, from near Amity, N. Y., the crystals not differing from those of the common variety; it contains 2·80 p. c. of protoxyd of manganese. A manganesian variety, from St. Marcel, Piedmont (where ores of manganese occur), has a sulphur to honey-yellow color.

2. *Cyprine.* Pale sky-blue or greenish-blue; owing its color to a trace of copper, whence the name; from Tellemark, Norway.

Analyses: 1, Magnus (Pogg., xxi. 50); 2, Karsten (Karst. Arch. Min., iv. 391); 3, Scheerer (Pogg., xcv. 520); 4, Karsten (l. c); 5, v. Kobell (Kastn. Arch. Nat., vii. 399); 6, Scheerer (l. c.); 7, 8, Karsten (l. c.); 9, v. Merz (Nat. Ges. Zurich, vi. Heft 4); 10, v. Kobell (l. c.); 11, Magnus (l. c.); 12, Scheerer (l. c.); 13, Magnus (l. c.); 14, Richardson (Thomson Min., i. 262); 15, Norden sklöld (Schw. J., xxxi. 436); 16, Heikel (Arppe's Finl. Min, Act. Soc. Fenn., IV.); 17, Iv (Koksch. Min. Russl., i. 116); 18, Malmgren (Arppe, l. c.); 19, Magnus (l. c.); 20, Varrent (Pogg., xlvi. 348); 21, Ivanof (Pogg., xlvi. 341); 22, 23, Hermann (J. pr. Ch., xliv. 193); 2 Hauer (Jahrb. G. Reichs., 1853, 155); 25, Hermann (l. c.); 26, Thomson (Min., i. 143); 27 Rammelsberg (Pogg., ..v. 92):

		S̈i	A̶l	F̶e	Ḟe	Ṁn	Ṁg	Ċa	Ḣ
1.	Vesuvius, *brown*	37·36	23·53	——	3·99	5·21		29·68	——=99·77 Magn
2.	"	37·60	18·50	——	6·25	0·10	3·10	33·71	——=99·16 Karst
3.	"	37·80	12·11	9·36	——	*tr.*	7·11	32·11	1·67=100·16 Sche
4.	Piedmont, *gn.*	39·25	18·10	——	4·30	0·75	2·70	33·95	——=99·05 Karst
5.	Ala "	34·85	20·71	——	5·40	——	——	35·61	——=96·57 Kobel
6.	" "	37·35	11·85	9·23	——	*tr.*	6·03	32·70	2·73, H Cl 0·015= 99·90 Sche
7.	Eger, Bohem., *Egeran*	39·70	18·95	——	2·90	0·96	——	34·88	——, Ṅa 2·1=99·4
8.	Saas Valley, *brown*	38·40	18·05	——	3·10	0·65	1·50	36·72	——, Ṅa 0·9=99·3
9.	Zermatt, "	37·04	17·67	——	4·97	0·42	2·48	35·79	1·79, Ṅa 0·76=10 M
10.	Monzoni	37·65	15·42	——	6·42	——	——	38·24	——=97·72 Kobel
11.	Cziklowa, *green*	38·52	20·06	——	3·42	0·02	2·99	32·41	——=97·42 Magn
12.	Eger, Norway, *bnh.-gn.*	37·73	13·49	5·95	0·95	0·47	1·98	37·49	1·89=99·95 Schee
13.	Christiansand	37·66	17·69	——	6·49	0·50	4·54	31·90	——=98·77 Magn
14.	Tellemark, *cyprine*	38·80	20·40	——	8·35	——	——	32·00	——=99·55 Rich'd
15.	Frugard, Finl., *Frug.*	38·53	17·40	——	8·90	0·33	10·60	27·70	——=98·46 Nord.
16.	Lupikko, "	36·43	16·84	7·23	——	——	4·32	35·00	0·86, S̈n 1·06=101 Hei
17.	*Jevreinoffite*	37·41	20·00	4·60	——	——	——	34·20	——, K̇ 1·16, Ṅa =99·07 Iva
18.	"	35·22	26·10	2·73	——	——	2·02	34·18	——, K̇ 1·01, Ṅa 0 Ṗb 0·01=101·74 Malmgr
19.	Slatoust, Ural	37·18	18·11	——	4·67	1·49	0·77	35·79	——=98·01 Magn
20.	" "	37·55	17·88	——	6·34	——	2·62	35·56	——=99·95 Varre
21.	" "	37·08	14·16	——	16·02	——	1·86	30·88	——=100 Ivanof.
22.	" " *green*	38·19	14·34	5·26	0·61	2·10	6·20	32·69	——=99·39 Herm.
23.	" " *green*	39·20	16·56	1·20	0·30	——	4·00	34·73	——, K̇, Ṅa 2·0, C̈ =99·49 He
24.	" *Heteromerite*	36·59	22·25	5·07	——	——	*tr.*	34·81	0·55=99·27 v. Ha
25.	Achmatovsk	37·62	13·25	7·12	0·60	0·50	3·79	36·43	——, C̈ 0·7=100·01
26.	Amity, N.Y., *Xanthite*	35·09	17·43	6·37	——	2·80	2·00	33·08	1·68=98·43 Thom.
27.	Vesuvius, *ywh.-bn.*	37·75	17·23	4·43	——	——	3·79	37·35	——=101·55 Ram
28.	" *dull bn.*	$\frac{3}{3}$ 37·83	10·98	9·03	——	——	4·37	35·69	——=97·90 Ramm
29.	Monzoni, *ywh.*	$\frac{4}{2}$ 38·25	15·49	2·16	——	——	4·31	36·70	——, K̇ 0·47=97·3 Ra
30.	" *brown*	37·56	11·61	7·29	——	——	5·33	36·45	——=98·24 Ramm
31.	Dognazka	37·15	15·52	4·85	——	——	5·42	36·77	—— K̇ 0·35=10 Ra
32.	Haslau (Eger, Boh.)	$\frac{3}{2}$ 39·52	13·31	8·04	——	——	1·54	35·02	——, K̇ 1·32=98·7 Ra
33.	Egg	$\frac{3}{2}$ 37·20	13·30	8·42	——	——	4·22	34·48	—— K̇ 0·31, T̈i 1·5 99·44 Ra
34.	Eger, Norway	$\frac{3}{3}$ 37·88	14·48	7·45	0·45	——	4·30	34·28	——=98·89 Ramm
35.	Sanford, Me.	$\frac{4}{3}$ 37·64	15·64	6·07	——	——	2·06	35·86	——, T̈i 2·40=99· Ra
36.	Wilui	38·40	10·51	7·15	——	——	7·70	35·96	——=99·72 Ramm
37.	Ala	$\frac{4}{4}$ 37·15	13·44	6·47	——	——	2·87	37·41	——, K̇ 0·93=98·2 Ra

In analysis 2, G.=3·42; anal. 4, G.=3·399; anal. 14, G.=3·228; anal. 16, G.=3·374; 22. G.=3·42; anal. 23, G.=3·35; anal. 25, G.=3·4; anal. 26, G.=3·221; anal. 27, G.=3·3 anal. 28, G.=3·428—3·429; anal. 29, G.=3·344; anal. 30, G.=3·385; anal. 31, G.=3·378; a 32, G.=3·411; anal. 33, G.=3·436; anal. 34, G.=3·384; anal. 35, G.=3·434; anal. 36, G.=3·4 anal. 37, G.=3·407.

Analyses 27–37 were made by Rammelsberg, with special reference to the state of oxydatio the iron. The oxygen ratios thus deduced by him are as follows: (27) 1·3 : 1 : 2·1; (28) 1·5 : 1 :

(29) 1·5 : 1 : 2·5 ; (30) 1·6 : 1 : 2·5 ; (31) 1·5 : 1 : 2·2 , (32) 1·3 : 1 : 2·4 ; (33) 1·4 : 1 : 2·4 ; (34) 1·3 : 1 : 2·2 ; (35) 1·3 : 1 : 2·3 ; (36) 1·9 : 1 : 2·8 ; (37) 1·5 : 1 : 2·3.

Idocrase often contains some water, amounting occasionally to 3 p. c., the presence of which is probably due to alteration, and hence it is not to be included as part of the protoxyd bases. G. Magnus found (Pogg., xcvi. 347) in crystals from Slatoust, 2·44 $\dot{H}$; from Ala, 2·98 $\dot{H}$; green, from Vesuvius, 0·29 ; in another, 2·03 ; brown, id., 1·79. Magnus also obtained a little carbonic acid : 0·15 p. c. from the Slatoust idocrase, and 0·06 from the brown of Vesuvius.

Pyr., etc.—B.B. fuses at 3 with intumescence to a greenish or brownish glass. Magnus states that the density after fusion is 2·93—2·945. With the fluxes gives reactions for iron, and a variety from St. Marcel gives a strong manganese reaction. Cyprine gives a reaction for copper with salt of phosphorus. Partially decomposed by muriatic acid, and completely when the mineral has been previously ignited.

Obs.—Idocrase was first found among the ancient ejections of Vesuvius and the dolomitic blocks of Somma. It has since been met with most abundantly in granular limestone; also in serpentine, chlorite schist, gneiss, and related rocks. It is often associated with lime-garnet and pyroxene. It has been observed imbedded in opal.

At Vesuvius it is hair-brown to olive-green, and occurs with garnet, mica, nephelite, glassy feldspar, etc.; at Ala, in Piedmont, it is in transparent green or brown brilliant crystals, in chlorite schist, with diopside, ripidolite, etc. Found also at Monzoni in the Fassa Valley; at Egg, near Christiansand, Norway; on the Wilui river, near L. Baikal (sometimes called *wiluite*, like the garnet of the same region); Cziklowa in Hungary; in the Urals and elsewhere at localities above mentioned.

In N. America, in *Maine* at Phippsburg and Rumford, just below the falls, in crystals and massive with yellow garnet, pyroxene, etc., in limestone; at Parsonsfield, with the same materials, abundant; at Poland and Sandford (fig. 263). In *Mass.*, near Worcester, in a quartz rock, with garnet, but exhausted. In *N. York*, ½ m. S. of Amity, grayish and yellowish-brown crystals, sometimes an inch in diameter, in granular limestone; also at the village, and a mile east of the village, of yellow, greenish-yellow, and yellowish-brown colors. In *N. Jersey*, yellowish-brown in crystals at Newton, with corundum and spinel. In *Canada*, at Calumet Falls, in large brownish-yellow crystals in limestone with brown tourmaline; at Grenville in calcite, in wax-yellow crystals.

For recent articles on *cryst.*, see v. Kokscharof's Min. Russl., i. 92, ii. 192; v. Zepharovich, Ber. Ak. Wien, xlix. 6, 1864, both with new measurements and figures, and the latter a complete monograph. Mohs found $O \wedge 1 = 142° 53'$; v. Kokscharof, for crystals from the Urals and Piedmont, 142° 46′ 10″, and from Vesuvius, 142° 46′ 32″ ; v. Zepharovich, for crystals from Findel Glacier at Zermatt, Pfitsch, and Vesuvius, 142° 47′ 26″ ; for brown var. from Mussa, and cryst. from Rymfischweng at Zermatt, 142° 46′ 18″ ; for green var. from Mussa, 142° 45′ 29″, and this last he takes as the normal angle of the species. It gives $a = 0·537541$.

Named *Vesuvian* by Werner, from the first known locality. Werner supposed the mineral to be exclusively volcanic; but as this idea is not expressed, the name is no more objectionable than all others derived from the names of localities. The earlier name, *Hyacinthine*, is bad, as the mineral is not the hyacinth of either ancient or modern time. Haüy's later name, *Idocrase* (subjective, like many others of his) is from εἴδω, *I see*, and κρᾶσις, *mixture*, in allusion to a resemblance between the crystalline forms and those of other species. Nothing in its signification, or in anything else, makes it right to substitute this for Werner's name. In English, the word *vesuvian* has the objection of being an adjective in form and use; but this is avoided by giving it the mineralogical termination above employed.

Alt.—Alterations nearly as in garnet, with a far greater tendency to becoming hydrated. Crystals from Maine often have the exterior, though still brilliant and glassy, cleavable easily from the part below, and equally so, parallel to all the smaller as well as larger faces, so that a pealed crystal has as brilliant and even planes as before. Pseudomorphs include steatite, mica, clinochlore, diopside, and garnet.

An egeran, analyzed by Ficinus (Schrift. Dresd. Min. Ges., i. 235), gave Silica 43·00, alumina 14·70, sesquioxyd of iron 2·40, ib. of manganese 4·00, lime 30·00, soda 5·33=99·43. It is probably in an altered state, as Rammelsberg infers from the description of Ficinus.

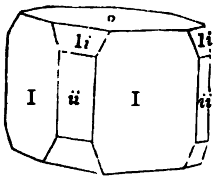
The carbonic acid detected by Hermann in idocrase from Slatoust (anal. 23) is evidence of alteration, and this acid and alkaline or earthy carbonates or bicarbonates in solution, are agents by which change is often produced.

Artif.—Mitscherlich has obtained idocrase by artificial methods (Ann. Ch. Phys., lvii. 219); Studer, from a fusion together of the constituents; also Daubrée, by the action of chlorid of silicon in vapor on the required bases (C. R., 1854, July, p. 135).

274. MELILITE. Mélilite *Delameth.*, T. T., ii. 273, 1796; *Fl. Bellevue* (its discov. in 1 J. de Phys., li. 456, 1800, Humboldtilite *Mont. & Cov.*, Prodr., 375, 1822. Somervillite *B* Ed. J. Sci., i. 185, 1824. Zurlite *Ramondini*, Breislak Inst. Geol., iii. 210, 1818. Mellilite.

Tetragonal; *O* ∧ 1-*i*=147° 15′; *a*=0·6432. Observed planes, *O*, *I*, 1-*i*, *i*-2. 1-*i* ∧ 1-*i*, over *i*-*i*,=65° 30′, 1-*i* ∧ 1-*i*, o terminal edge,=134° 48′. Fig. 265; also others w planes *i*-2 in place of *i*-*i*. Cleavage: *O* distinct, *I* distinct.

265



H.=5. G.=2·9—3·104. Lustre vitreous, inclin to resinous on a surface of fracture. Color white or p yellow, honey-yellow, greenish-yellow, reddish-bro brown. Translucent, and in thin laminæ transpare also opaque. Fracture conchoidal—uneven. Dou refraction weak, axis negative.

Comp.—$(\frac{2}{3}\dot{R}^3+\frac{1}{3}\ddot{\bar{R}})^2\ddot{Si}^3$. Analyses: 1, v. Kobell (Schw. J., lxiv. 293); 2–4, Damour (Ann. Phys., III. x. 59); 5, v. Kobell (Kastn. Arch., iv. 313):

	S̈i	Äl	F̈e	Ṁg	Ċa	Ṅa	K̇
1. *Humb.*, Somma	43·96	11·20	——	6·10	31·96	4·28	0·38, Ḟe 2·32=100·20 Kob
2. " "	40·60	10·88	4·43	4·54	31·81	4·43	0·36=98·35 Damour; G. 2·
3. *Mel.*, C. di Bove	39·27	6·42	10·17	6·44	32·47	1·95	1·46—98·18 Damour; G. 2·
4. " "	38·34	8·61	10·02	6·71	32·05	2·12	1·51=99·36 Damour.
5. *Massive Gehlenite*	39·80	12·80	2·57	4·64	37·64	——	0·30, Ḣ 2·00=99·75 Kobell.

No. 3, yellow crystals; No. 4, brown do. The massive gehlenite of v. Kobell comes under formula of melilite. Melilite was first analyzed (but incorrectly) by Carpi in 1820 (Tasch. M xiv. 219).

Pyr., etc.—B.B. fuses at 3 to a yellowish or greenish glass. With the fluxes the reaction iron. Decomposed by muriatic acid with gelatinization.

Obs.—*Humboldtilite* occurs in cavernous blocks of Somma with greenish mica, the crys often rather large, and covered with a calcareous coating; less common in transparent lust crystals with nephelite, sarcolite, and pyroxene, lining cavities in the rock.

Melilite (fr. μέλι, *honey*), of yellow and brownish colors, is found at Capo di Bove, near Rom leucitophyre with nephelite, phillipsite. gismondite, magnetite, and small black crystals of au and hornblende; *O* ∧ 1-*i*=147° 9′, v. Rath (ZS. G., xviii. 544). *Somervillite*, which Descloize has shown to have the angles of this species, is found at Vesuvius in dull yellow crystals.

Zurlite occurs in opaque square or octagonal prisms in calcareous blocks of Somma with h boldtilite; color whitish or asparagus-green; H. about 6; G.=3·27; B.B. infusible; solubl nitric acid. It is impure humboldtilite (Scacchi, Jahrb. Min., 1853, 261). Named after Sign. Zu

Named from μέλι, *honey*, in allusion to the color.

Artif.—Common as a furnace slag, having been observed in square prisms at Russel's H Tipton, Dowles, Wicks, etc., in England and Wales, near St. Etienne in France, near Charlev Belgium, Königshütte in Upper Silesia, Mägdesprung in the Harz, and Easton, Pa. The follo are analyses: 1, 2, Percy (Rep. Brit. Assoc., 1846, Am. J. Sci., II. v. 127); 3, Karsten (Eisenh iii. 679):

	S̈i	Äl	Ḟe	Ṁn	Ṁg	Ċa	K̇	Ca S
1. Dudley	38·76	14·48	1·18	0·23	6·84	35·68	1·11	0·98=99·26 Percy.
2. Charlevoi	37·91	13·01	0·93	2·79	7·24	31·43	2·60	3·65=99·56 Percy.
3. Königsberg	39·60	12·60	*tr.*	4·30	——	42·85	——	S 0·65=100 Karsten.

275. SPHENOCLASE. Sphenoklas *v. Kob.*, J. pr. Ch., xci. 348, 1864.

Massive, with faint indications of a foliated structure.

H.=5·5—6. G.=3·2. Lustre feeble. Color pale grayish-yellow. Subtranslucent. Frac splintery.

Comp.—According to an analysis by v. Kobell (l. c.):

S̈i 46·08 Äl 13·04 Ḟe 4·77 Ṁn 3·23 Ṁg 6·25 Ċa 26·50=99·87.

Giving the O. ratio for Ṙ, R̈, S̈i, 11·81 : 6·10 : 24·57, or 2 : 1 : 4, v. Kobell.

Pyr., etc.—In the closed tube yields no water. B.B fuses easily (at 3) and quietly to a shining greenish glass. Slightly attacked by muriatic and sulphuric acids; but after heating easily decomposed with gelatinization by muriatic acid.

Obs.—From Gjellebäck in Norway, with wollastonite and the so-called edelforsite, forming thin layers of varying thickness in a bluish granular limestone.

Named from σφήν, *a wedge*, and κλάω, *I break*, it breaking into wedge-shaped pieces.

EPIDOTE GROUP.

The species of the Epidote Group, enumerated with the formulas on p. 251, are characterized by specific gravity above 3, and therefore high; hardness above 5; fusibility B.B. below 4; anisometric crystallization, and therefore biaxial polarization; the dominant prismatic angle 112° to 117°; fibrous forms, when they occur, always brittle; colors white, gray, brown, yellowish-green, and deep green to black, and sometimes reddish.

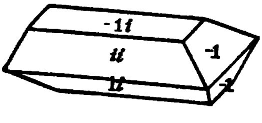
The prismatic angle in zoisite and other orthorhombic species is *I* ∧ *I*; but in epidote it is the angle over a horizontal edge between the planes *O* and *i-i*, the orthodiagonal of epidote corresponding to the vertical axis of zoisite, as explained under the latter species.

T. S. Hunt has observed (C. R., 1863, Am. J. Sci., II. xxxvi. 426, xliii. 205) that the high specific gravity and hardness of the Epidote group, as compared with the Scapolite, is to be ascribed to a more elevated or higher multiple equivalent, or, in other words, to a more condensed molecule. But the numerical value of the multiple, or of the relation between the species, has not yet been ascertained.

276. EPIDOTE. Schorl vert du Dauphiné *de Lisle*, Crist., ii. 401, 1783. Strahlstein pt. *Wern.*, 1788–1800. Thallite (fr. Dauphiny) *Delameth.*, Sciagr., ii. 401, 1792, T. T., ii. 819, 1796; *H.*, J. d. M., v. 270, 1799. Delphinite (ib.) *Saussure*, Voy. Alpes, §1918, 1796 (=Oisanite pt.). Akanticone (fr. Arendal) *d'Andrada*, J. d. Phys., li 240, 1800, Scherer's J, iv. 1800;=Arendalite *Karst.* (and Lectures of Blumenbach, earlier), Tab., 34, 74, 1800. Skorza *Wallachian Min.*, Karst., Tab., 28, 72, 1800, Klapr., Beitr., iii. 282, 1802. Epidote *H.*, Tr., iii. 1801. Pistazit *Wern.*, 1803, Ludw. Min., Wern., ii. 209, 1804. Withamite (fr. Glenco) *Brewst.*, Ed. J. Sci., ii. 218, 1825. Puschkinit *Wagner*, Bull. Soc. Imp. Nat., Moscow, 1841. Achmatit *Herm.*, Verh. Min. St. Pet., 1845–46, 202. Escherit (fr. St. Gothard) *Scheerer*, Pogg., xcv. 507, 1855. Beustit *Breith.*, B. H. Ztg., xxiv. 364, 1865.

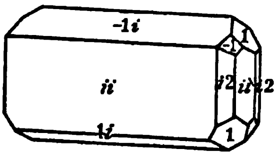
Monoclinic. *C*=89° 27′; *i*-2 ∧ *i*-2=63° 8′, *O* ∧ 1-*ì*=122° 23′; *a* : *b* : *c* =0·48436 : 1 : 0·30719. Observed planes: *O*; vertical, *i-i*, *i-ì*, *i*-2, *i*-4, *i*-6; clinodomes, $\frac{1}{3}$-*ì*, $\frac{1}{2}$-*ì*, 1-*ì*; hemidomes, $\frac{1}{3}$-*i*, 1-*i*, $\frac{5}{3}$-*i*, 2-*i*, 3-*i*, 5-*i*, 11-*i*; $-\frac{1}{4}$-*i*, $-\frac{1}{3}$-*i*, $-\frac{1}{2}$-*i*, $-\frac{5}{7}$-*i*, −1-*i*, −2-*i*, −3-*i*, −5-*i*, −7-*i*; hemipyramids, $\frac{1}{5}$, $\frac{1}{3}$, $\frac{2}{5}$, 1, −1, $-\frac{1}{2}$; 2-$\frac{4}{3}$, −2-$\frac{4}{3}$; $\frac{3}{5}$-$\frac{3}{2}$, 1-$\frac{3}{2}$, 3-$\frac{3}{2}$, −3-$\frac{3}{2}$; 1-2, −1-2; 9-$\frac{9}{4}$; 5-$\frac{5}{2}$, −5-$\frac{5}{2}$; 3-3, −3-3; 2-4; 5-5, −5-5; 7-7, −7-7; 4-8; 2-2̀, −2-2̀; −4-4̀; 5-5̀, −5-5̀; −6-6̀.

266



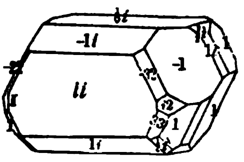
O ∧ *i-i*=90° 33′
O ∧ 1-*i*=154 3
O ∧ −1-*i*=154 15
O ∧ $\frac{1}{2}$-*ì*=141 41
1-*ì* ∧ 1-*ì*, ov. *O*,=64 38

267



i-i ∧ 3-*i*=145° 18′
i-i ∧ 5-*i*=157 29
i-i ∧ −1=104 48
i-i ∧ 1=104 15
i-i ∧ −3-3=128 5

268



1-*i* ∧ 3-*i*=150° 6′
i-ì ∧ 1=145
1-*i* ∧ −2-*i*,ov. *O*=110 13
1 ∧ 1, front,=70 $\frac{1}{2}$
1 ∧ 1,ov. *i-ì*,=109 59$\frac{1}{2}$

i-i ∧ −1-*i*=116 18 *i-i* ∧ 3-3=127 40 −1 ∧ −1, front,=70 2
i-i ∧ 1-*i*=115 24 *i-i* ∧ *i*-2=121 31 −1 ∧ −1,ov.*i-i*,=109 3
i-i ∧ 2-*i*=133 49 −1-*i* ∧ 1-*i*,ov.*O*,=128 18 3-3 ∧ 3-3, front,=96 12
i-i ∧ −2-*i*=134 23 −1-*i* ∧ 1-*i*, ov. *i-i*,=51 42 −3-3 ∧ −3-3,front,=96 41
i-i ∧ −3-*i*=145 39 −1-*i* ∧ −1=125 13 *i*-2 ∧ 1-*i*=102 57
1-*i* ∧ 3-*i*=150 6

Crystals usually lengthened in the direction of the orthodiagonal, or parallel to *i-i*; sometimes long acicular. Cleavage: *i-i* perfect; 1-*i* less so. Twins: composition-plane 1-*i*; also *i-i*. Also fibrous, divergent, or parallel; also granular, particles of various sizes, sometimes fine granular, and forming rock-masses.

H.=6−7. G.=3·25−3·5. Lustre vitreous, on *i-i* inclining to pearly or resinous. Color pistachio-green or yellowish-green to brownish-green, greenish-black, and black; sometimes clear red and yellow; also gray and grayish-white. Pleochroism often distinct, the crystals being usually least yellow in a direction through 1-*i*. Streak uncolored, grayish. Subtransparent—opaque: generally subtranslucent. Fracture uneven. Brittle. Double refraction strong: optic-axial plane *i-i*.

Var.—Epidote has ordinarily a peculiar yellowish-green (pistachio) color, seldom found in other minerals. But this color passes into dark and light shades—black on one side, and brown on the other. Most of the brown and nearly all the gray epidote belongs to the species *Zoisite;* and the reddish-brown or reddish-black, containing much oxyd of manganese, to the species *Piedmontite*, or Manganepidote; while the black is mainly of the species *Allanite*, or Cerium-epidote.

Var. 1. *Ordinary.* Color green of some shade, as described. (*a*) In crystals. (*b*) Fibrous. (*c*) Granular massive. (*d*) *Scorza* is epidote sand, of the usual green color, from the banks of the Arangos, near Muska in Transylvania. The Arendal epidote (*Arendalite*) is mostly in dark green crystals; that of Dauphiny (*Thallite*, *Delphinite*, *Oisanite*) in yellowish-green crystals, sometimes transparent, and found near Bourg d'Oisans, in the Piedmontese Alps. *Puschkinite* includes pleochroic crystals from the auriferous sands of Katharinenburg, Urals; G.=3·066; color emerald-green, when viewed by transmitted light through 1-*i*, yellow transverse to this; named after Puschkin, a Russian senator. *Achmatite* is ordinary epidote, in crystals, from Achmatovsk, Ural. *Escherite* is a brownish-yellow, somewhat greenish epidote, from St. Gothard (anal. 28).

2. The so-called *Bucklandite* from Achmatovsk, described by Hermann (anal. 41, 42), is black with a tinge of green, and differs from ordinary epidote in having the crystals nearly symmetrical, and not, like other epidote, lengthened in the direction of the orthodiagonal. G.=3·51. Hermann's *Bagrationite*, from Achmatovsk, appears to be essentially the same mineral, it agreeing with it in angles, according to Hermann (Bull. Soc. Nat. Moscow, **xxxv.** 248, 1862), and having G.=3·46, while the original bagrationite of Kokscharof is a variety of allanite (q. v.). It differs from the bucklandite in containing a little cerium (anal. 43).

3. *Withamite.* Carmine-red to straw-yellow: strongly pleochroic; the color as seen through in one direction, deep crimson, in another transverse, straw-yellow; H.=6−6·5; G.=3·137; in small radiated groups, *i-i* ∧ −1-*i*=116°, −1-*i* ∧ 1-*i*=128° 20′. From trap, at Glencoe, in Argyleshire, Scotland. Named after Dr. Witham.

4. *Beustite.* Grayish-white to ash-gray; G.=2·859−2·877, Breith. Breithaupt gives the angle *T* ∧ *P*=154° 20′, *M* ∧ *P*=110° 30′, which are very near *O* ∧ 1-*i*, and −2-*i* ∧ 1-*i*. From near Predazzo in the Tyrol.

Comp.—O. ratio for $\dot{R}$, $\overline{\overline{R}}$, $\ddot{S}i$=1 : 2 : 3; $(\frac{1}{3}\dot{C}a^3+\frac{2}{3}(\overline{\overline{F}}e, \ddot{A}l))^2\ddot{S}i^3$; being *lime-iron-epidote*, the mineral having for its protoxyd portion almost solely lime ($\dot{C}a$), but containing sesquioxyd of iron ($\overline{\overline{F}}e$) in place of part of the alumina ($\ddot{A}l$). The results of the larger part of the analyses conform nearly to the above ratio, showing apparently that it is the *normal* ratio. Several appear to afford, according to Hermann, less $\overline{\overline{R}}$ and $\ddot{S}i$ in proportion to the $\dot{R}$, giving different ratios between 1 : 2 : 3 and 1 : 1½ : 2½; but with the sum of the oxygen of the protoxyds and sesquioxyds always equal to that of the silica. The exact condition of the iron, whether part is protoxyd or not, has not in all cases been ascertained, and, therefore, some of the results obtained are not free from doubt. Rammelsberg observes that when this point is cleared up the ratio 1 : 2 : 3 will probably be found to be common to all.

The Achmatovsk "bucklandite" (anal. 41, 42) gives nearly the ratio 2 : 3 : 5; but if the iron be all sesquioxyd, 1 : 2·1 : 2·9. Rammelsberg says the crystals may contain some magnetite.

The ratio of $\bar{\mathrm{Fe}}$ to $\bar{\mathrm{Al}}$ in most epidote is approximately 1 : 2, as in analyses 1 to 18, 20, 22–31, 33, 39; but other ratios occur between 1 : 2 and 1 : 6; and rarely the amount of $\bar{\mathrm{Fe}}$ is so large as to give nearly the ratio 3 : 5. Ratio 1 : 2½ is afforded by analysis 19; 1 : 3 by 32; 1 : 4 by 24–26, 28–30; 1 : 5 by 27; 1 : 6 by 23. In analysis 40, the silica is much below the usual proportion, and the O. ratio for $\dot{\mathrm{R}}$, $\bar{\mathrm{R}}$, $\ddot{\mathrm{Si}}$ is nearly 3 : 4 : 6.

Analyses: 1, Geffken (Pogg., xvi. 483); 2, Kühn (Ann. Ch. Pharm., lix. 373); 3, Rammelsberg (2d Suppl., 48); 4, id. (Min. Ch., 752); 5, 6, Hermann (J. pr. Ch., lxxviii. 295); 7, Scheerer (Pogg., xci. 378, xcv. 501); 8, Richter (ib.); 9, v. Rath (Pogg., xc. 307); 10, Kühn (l. c.); 11, Hermann (J. pr. Ch., xliii. 35, 81); 12, Rammelsberg (Pogg., lxxxiv. 453); 13, Baer (J. pr. Ch., xlvii. 461); 14, Stockar-Escher (see Scheerer); 15, Scheerer (l. c.); 16, Hermann (J. pr. Ch., lxxviii. 295); 17, Scheerer (l. c.); 18, 19, Rammelsberg (l. c.); 20, 21, Kühn (l. c.); 22, Hermann (l. c.); 23, v. Rath (ZS. G. xiv 428); 24, 26–30, Stockar-Escher (Pogg., xcv. 501); 25, Scheerer (l. c.): 31, 32, Hermann (l. c.); 33, Rammelsberg (Min. Ch., 754); 34–37, 39, Hermann (l. c.); 38, Osersky (Verh. Min. St. Pet., 1842, 66); 40, Igelström (Œfv. Ak. Stockh., 1867, 11); 41, Hermann (l. c.); 42, Rammelsberg (l. c.); 43, Hermann (Bull. Soc. Nat. Moscow, xxxv. 248):

		$\ddot{\mathrm{Si}}$	$\bar{\mathrm{Al}}$	$\bar{\mathrm{Fe}}$		$\dot{\mathrm{Mn}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{H}}$
1.	Arendal	36·14	22·24	14·29		2·12	2·38	22·86	——=100·03 Geffken.
2.	"	36·68	21·72	16·72		——	0·53	23·07	——=98·72 Kühn.
3.	"	37·98ᵃ	20·78	17·24		——	1·11	23·74	——=100·85 Ramm.
4.	"	38·76	20·36	16·35		——	0·44	23·71	2·00=101·62 Ramm.
5.	" *gn.*	37·32	22·85	11·56	$\dot{\mathrm{Fe}}$	1·86	0·77	22·03	2·93=99·32 Hermann.
6.	" *gnh.-bk.*	36·79	21·24	12·96	"	5·20	——	21·27	2·86=100·32 Hermann.
7.	" *strp.*	37·59	20·73	16·57		——	0·41	22·64	2·11=100·05 Scheerer.
8.	" *pseud.*	38·84	25·45	10·88		——	——	22·62	2·41=100·20 Richter.
9.	" *pseud.*	37·92	19·21	15·55		——	0·25	22·68	2·51, $\dot{\mathrm{Na}}$ 0·39, $\dot{\mathrm{K}}$ 0·23 =98·74 v. Rath.
10.	B. d'Oisans, *gn.*	39·85	21·61	16·61		——	0·30	22·15	——=102·52 Kühn.
11.	" *olive-gn.*	37·60	18·57	13·37	$\dot{\mathrm{Fe}}$	5·55	1·40	21·19	1·68=99·36 Hermann.
12.	"	38·37	21·13	16·85		——	0·17	23·58	——=100·22 Ramm.
13.	" (?)	37·78	21·25	15·97		——	0·60	23·46	——=, $\dot{\mathrm{Na}}$ 0·41=99·47 Br.
14.	" (?)	37·35	22·02	15·67		——	——	22·54	2·35=99·93 S.-Escher.
15.	"	37·56	20·78	16·49		——	0·29	22·70	2·09=99·91 Scheerer.
16.	"	38·00	20·87	15·06	$\dot{\mathrm{Fe}}$	1·90	——	21·93	2·08 $\dot{\mathrm{Mn}}$ *tr.*=99·64 Herm'n.
17.	Traversella, *dark*	57·65	20·64	16·50	$\dot{\mathrm{Mn}}$	0·49	0·46	22·32	2·06, HCl 0·01=100·13 Schr.
18.	" "	37·51	21·76	12·52	$\dot{\mathrm{Fe}}$	3·59	0·60	21·26	2·68=99·92 Ramm.
19.	" *yellow*	38·34	20·61	9·23	"	2·21	0·43	25·01	2·82=98·65 Ramm.
20.	Penig, Saxony	38·64	21 98	17·42		——	0·27	21·98	——=100·26 Kühn.
21.	Geier, Erzgeb.	40·57	14·47	13·44		——	2·96	30·00	——=101·24 Kühn.
22.	Traversella	40·08	16·91	15·93	"	1·44	4·97	19·11	1·20=99·64 Hermann.
23.	Val. Maigels, *gy.*	39·07	28·90	7·43		——	0·10	24·30	0·63=100·43 Räth.
24.	Gutanen, *bnh.-gn.* (?)	38·05	26·39	9·73		——	——	23·54	2·02=99·73 S.-Escher.
25.	"	38·99	25·76	9·99		——	0·61	22·76	2·05=100·16 Scheerer.
26.	Sustenhorn, *gnh.-bn.*	38·43	26·40	8·75		——	——	23·90	2·46=99·94 S.-Escher.
27.	Lole, *gnh.-bn.*	38·39	28·48	7·56		——	——	22·64	2·30=99·37 S.-Escher.
28.	St. Gothard, *Escherite*	38·08	27·74	8·26		——	——	23·53	2·04=99·65 S.-Escher.
29.	" *bnh.-gn.*	38·28	27·53	8·66		——	——	22·87	2·41=99·75 S.-Eschor
30.	Kaverdiras, *bnh.-gn.*	37·66	27·30	8·90		——	——	23·90	2·33=100·15 S.-Escher.
31.	Ural, Schumnaja, *gn.*	37·47	24·09	10·60	$\dot{\mathrm{Fe}}$	2·81	——	22·19	1·24=99·40 Hermann.
32.	Achmatovsk, *gn.*	35·45	24·92	9·54	"	3·25	——	22·45	3·50=100·11 Hermann
33.	" *gn.*	37·75	21·05	11·41	"	3·59	1·15	22·38	2 67=100 Ramm.
34.	"	37·62	18·45	12·32	"	2·20	0·39	24·76	2·20, $\dot{\mathrm{Na}}$ 0·91=98·85 Herm.
35.	"	40·27	20·08	14·22	"	2·39	0·53	21·61	0·16, $\dot{\mathrm{Mn}}$ *tr.*=99·26 Herm.
36.	Burowa	36·87	18·13	14·20	"	4·60	0·40	21·45	1·56=97·29 Hermann.
37.	*Puschkinite*	37·47	18·64	14·15	"	2·56	——	22·06	1·44, $\dot{\mathrm{Na}}$, $\dot{\mathrm{Li}}$ 2·78=98·60 H.
38.	"	38·88	18·85	16·34		——	6·1	16·00	——, $\bar{\mathrm{Mn}}$ 9·26, $\dot{\mathrm{Na}}$ 1·67, $\dot{\mathrm{Li}}$ 0·46=98·56 Osersky.
39.	Sillböhle	39·67	18·55	14·31		3·25	1·62	20·53	1·23, $\dot{\mathrm{Na}}$ 0·52, $\dot{\mathrm{Mn}}$ *tr.* =99·68 Hermann.
40.	Jakobsberg, Swed. (?)	33·81	18·58	12·57		4·85	3·04	26·46	0·94=100·25 Igelström.
41.	Achmatovsk, "*Buckl.*"	36·97	21·84	10·19	$\dot{\mathrm{Fe}}$	9·19	——	21·14	0·68, $\ddot{\mathrm{C}}$ 0·32=100·53 Herm.
42.	"	38·27	21·25	9·09	"	5·57ᵃ	1·07	22·75	2·00=100 Ramm.
43.	" "*Bagrat.*"	38·88	20·19	9·82	"	3·82	1·98	17 37	1·60 $\dot{\mathrm{La}}$, $\dot{\mathrm{Ce}}$, $\dot{\mathrm{Di}}$ 3·60 =97·26 Hermann.

ᵃ Anal. on material after its ignition; some $\mathrm{Ti\,O^2}$ with the $\mathrm{Si\,O^2}$

In anal. 5, G.=3·37; anal. 6, G.=3·49; anal. 8 has the form of pyroxene; anal. 9, G.=3·223, has the form of scapolite; anal. 11, G.=3·38; anal. 12, G=3·463, material analyzed after its ignition; anal. 16, G.=3·42; anal. 23, G.=3·361—3·316, in the Grisons; 24, 3·373; 26, G.=3·326; 27, 3·359, Borderrheinthal: 3·384, from Maggiathal; 29, 3·378, from Formazzathal; 30, 3·369, Vorderrheinthal; 31, 3·43; 32, 3·33—3·34; 33, 3·485; 34, 3·39; 35, 3·41; 36, 3·35; 37, G.=3·43, fr. Werchneivinsk; 39, 3·45, near Helsingfors; 40, 3·51; 42, 3·46.

Pyr., etc.—In the closed tube gives in most cases water. B.B. fuses with intumescence at 3–3·5 to a dark brown or black mass which is generally magnetic. Reacts for iron and sometimes for manganese with the fluxes. Partially decomposed by muriatic acid, but when previously ignited gelatinizes with acid. Decomposed on fusion with alkaline carbonates. G. of Arendal epidote changes on ignition, from 3·409 to 2·984

Obs.—Epidote is common in many crystalline rocks, as syenite, gneiss, mica schist, hornblendic schist, serpentine, and especially those that contain the ferriferous mineral hornblende. It often accompanies beds of magnetite or hematite in such rocks. It is sometimes found in geodes in trap; and also in sandstone adjoining trap dikes, where it has been formed by metamorphism through the heat of the trap at the time of its ejection. It also occurs at times in nodules in different quartz-rocks or altered sandstones. It is associated often with quartz, pyroxene, feldspar, axinite, chlorite, etc., in the Piedmontese Alps.

It sometimes forms with quartz an epidote rock, called *epidosyte.* Such a rock, from Grand Matanne River, Canada, having a hardness of 7·0, and G.=3·04, gave T. S. Hunt, on analysis (Logan's Rep., 1863, 497), $\ddot{Si}$ 62·60, $\dddot{\bar{Al}}$ 12·30, $\dddot{\bar{Fe}}$ 9·40, $\dot{Mg}$ 0·72, $\dot{Ca}$ 14·10, $\dot{Na}$ 0·43, ign 0·16=99·71, which corresponds to 61·33 epidote and 38·22 quartz. A similar rock exists at Melbourne in Canada.

Beautiful crystallizations come from Bourg d'Oisans, Ala, and Traversella, in Piedmont: Zermatt in the Valais; near Gutanen in the Haslithal; at Kaverdiras and Baduz in the valley of Tavetsch (the latter sometimes referred to zoisite, but optically epidote according to Descloizeaux); Monzoni in the Fassa valley; Zillerthal in the Tyrol, sometimes in rose-red and greenish crystals of small size, resembling *thulite;* the Sau-Alpe in Carinthia; and the other localities mentioned above.

In N. America, occurs in *N. Hamp.* at Franconia, crystallized and granular, with magnetite; Warren, with quartz and pyrite. In *Mass.*, at Hadlyme and Chester, in crystals in gneiss: at Athol, in syenitic gneiss, in fine crystals, 2 m. S.W. of the centre of the town; Newbury, in limestone; at Rome, in hornblende schist; at Nahant, poor, in trap. In *Rhode Island*, at Cumberland, in a kind of trap. In *Conn.*, at Haddam, in large splendid crystals. In *N. York*, 2. m. S.E. of Amity, in quartz; 2 m. S. of Carmel, Putnam Co., with hornblende and garnet; 2 m. S. of Coffee's Monroe, Orange Co.; 6 m W. of Warwick, pale yellowish-green, with sphene and pyroxene; at Harlem, in gneiss, on the banks of East river, near 38th St. In *N. Jersey*, at Franklin, massive; at Roseville in Byram township, Sussex Co., in good crystals. In *Penn.*, at E. Bradford. In *Michigan*, in the Lake Superior region, at many of the mines; at the Norwich mine, beautifully radiated with quartz and native copper. In *Canada*, at St. Joseph, in a concretionary argillaceous rock of the Quebec group.

For recent papers on cryst. see Kokscharof Min. Russl., iii. 268, iv. 106; v. Zepharovich. Ber. Ak. Wien, xxxiv. 480, xlv. 381; Descl. Min, i. 1862; Hessenberg, Min. Not., III.; v. Rath. Pogg., cxv. 472.

Epidote is one of Haüy's crystallographic names, derived from the Greek ἐπίδοσις, *increase*, and translated by him, "qui à reçu un accroissement," the base of the prism (rhomboidal prism) having one side longer than the other. In its introduction Haüy set aside three older names. Thallite (from θαλλός, color of young twigs, alluding to the green color) was rejected because it was based on a varying character, color; *Delphinite* and *Arendalite*, because derived from localities. But the name *Epidote* is now so involved in geological as well as mineralogical literature that the law of priority cannot well do the justice demanded of it. Werner's name *Pistacite* from πιστάκιον, *the pistachio-nut* (referring to the color) was not proposed as early as thallite or epidote.

Alt.—Epidote is less liable to alteration than most of the silicates, partly because the iron it contains is mostly, when not wholly, in the state of sesquioxyd. The analyses afford generally one or two per cent. of water, which is probably foreign to the species; and in a green mineral from Isle Royale, having the composition of epidote, J. D. Whitney found 5 per cent. of water (Rep. Geol. L. Sup., 1851, 97).

Artif.—Epidote has not been found among the crystallizations of furnace slags, or formed in the laboratory of the chemist. It has been a frequent result of the action of heat and steam on ferruginous sandstones accompanying the ejection of doleryte and other eruptive rocks; and this fact suggests the method by which it may be artificially formed.

276A. **KŒLBINGITE.** (Kölbingit *Breith.*, B.H. Ztg., xxiv. 398. Ainigmatit *Breith.*, ib.) Monoclinic. *I* ∧ *I*=66° 31′, *O* ∧ *i-i*=59°. Cleavage: *I* perfect; *i-i* imperfect; *i-i* in traces.

H.=5·5–6. G.=3·599, 3·609, 3·613 Lustre vitreous. Color greenish to velvet-black Streak pistachio-green. Subtranslucent. Fracture conchoidal to uneven.

Comp.—Consists, according to R. Müller (l. c.), largely of the silicates of protoxyd of iron and lime.

Obs.—Occurs at Kangerdluarsuk, Greenland, with ægirite, eudialyte, etc., and resembles much a black hornblende. Unlike hornblende and the related species, the crystal is oblique from an acute edge (as in epidote), and the angles of the prism are very different. Arfvedsonite differs in having a celandine-green streak; and ægerite a mountain-green. It may be epidote.

Ænigmatite has the form and angles of kœlbingite; but H.=5—5·5; G.=3·833—3·863; the iron in the compound is sesquioxyd; and the streak is reddish-brown. Probably altered kœlbingite.

277. PIEDMONTITE. Röd Magnesia (fr. Piedmont) *Cronst.*, Min., 106, 1758. Manganèse rouge (id.) *Napione*, Mem. Ac. Turin, iv., 1790. Manganèse oxydé violet silicifère (id.) *H.*, Tr., iv., 1801. Epidote manganésifère (id.) *L. Cordier*, J. d. M., xiii. 135, 1803; *H.*, Tabl., 1809. Piemontischer Braunstein *Wern.*, Hoffm. Min., iv. a, 152, 1817. Manganepidot *Germ.* Piemontit *Kenng.*, Min., 75, 1853.

Monoclinic; like epidote in form, and nearly so in angles. *i-i* ∧ –1-*i*=115° 20′, –1-*i* ∧ $\frac{1}{2}$-*i*=98° 50′, *i-i* ∧ $\frac{1}{2}$-*i*=145° 37′. Cleavage *i-i* perfect, –1-*i* less so. Also massive.

H.=6·5. G.=3·404, Breithaupt. Lustre vitreous, especially bright on *i-i*; slightly pearly on other faces. Color reddish-brown and reddish-black; in very thin splinters columbine-red. Streak reddish. Opaque to subtranslucent. Fragile.

Comp.—O. ratio for $\dot{\mathrm{R}}$, $\overline{\mathrm{R}}$, $\ddot{\mathrm{Si}}$=1 : 2 : 3; $(\frac{1}{3}\dot{\mathrm{C}}\mathrm{a}^3+\frac{2}{3}(\overline{\mathrm{Mn}}, \overline{\mathrm{Fe}}, \overline{\mathrm{Al}}))^2\ddot{\mathrm{Si}}^3$; or epidote in which a large part of the alumina is replaced by sesquioxyd of manganese. The protoxyds may also include some protoxyd of manganese as well as magnesia.

Analyses: 1, Sobrero (Arsb., 1840, 218); 2, Hartwall (Ak. H. Stockh., 1828, 171); 3, Geffken (Pogg., xvi. 483); 4, H. St. C. Deville (Ann. Ch. Phys., xliii. 13):

		$\ddot{\mathrm{Si}}$	$\overline{\mathrm{Al}}$	$\overline{\mathrm{Fe}}$	$\overline{\mathrm{Mn}}$	$\dot{\mathrm{M}}\mathrm{g}$	$\dot{\mathrm{C}}\mathrm{a}$
1.	St. Marcel	37·86	16·30	8·23	18·96	——	13·42, $\dot{\mathrm{M}}\mathrm{n}$ 4·82, $\ddot{\mathrm{S}}\mathrm{n}$, $\dot{\mathrm{C}}\mathrm{u}$ 0·4=100·66 S.
2	"	38 47	17·65	6·60	14·08	1·82	21·65=100·27 Hartwall.
3.	"	36·87	11·76	10·34	18·25	——	22·78=100 Geffken.
4.	"	37·3	15·9	4·8	19 0	0·2	22·8 =100 Deville.

The last three analyses correspond nearly with the epidote O. ratio, 1 : 2 : 3. The mineral was first analyzed by Napione (l. c.), and next by Cordier (l. c.).

Pyr., etc.—B.B. fuses with intumescence at 3 to a black lustrous glass. Gives strong reactions for manganese with the fluxes, and also for iron. Not decomposed by acids, but when previously ignited gelatinizes with muriatic acid. Decomposed on fusion with alkaline carbonates.

Obs.—Occurs at St. Marcel, in the valley of Aosta, in Piedmont, in braunite with quartz, greenovite, violan, and tremolite. Crystals rather long subrhomboidal prisms, very fragile, and having most of the surfaces dull.

278. ALLANITE. Crystallized Gadolinite? (fr Greenland) *T. Allan*, Tr. R. Soc. Edinb., vi. 345 (read Nov. 1808)=Allanite *Thomson*, ib., 371 (read Nov. 1810); Phil. Mag., xxxvi. 278, 1811. Cerin (fr. Riddarhyttan) *Hisinger*, Afh., iv. 327, 1815. Orthit (fr. Finbo) *Berz.*, Afh., v. 32, 1818. Pyrorthit (fr. Kararfvet) *Berz.*, Afh., v. 52, 1818. Bucklandit (fr. Arendal), *Levy*, Ann. Phil., II. vii. 134, 1824. Tautolit (fr. L. Laach) *Breith.*, Schw. J., l. 321, 1826. Uralorthite *Herm.*, J. pr. Ch., xxiii. 273, 1841. Bagrationit (fr. Achmatovsk) *Koksch.*, Russiches Berg. J., i. 434, 1847; Pogg., lxxiii. 182, 1848 [not Bagrationite *Herm.*,=Epidote]. Xanthorthit (fr. Erikberg) *Herm.*, J. pr. Ch., xliii. 112, 1848. Erdmannit (fr. Stökö) *Berlin*, Pogg., lxxxviii. 162, 1853.

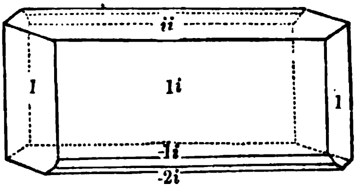
Monoclinic, isomorphous with epidote. *C*=89° 1′; *O* ∧ 1-*ì*=122° 50½′, *i*-2 ∧ *i*-2=63° 58′; *a* : *b* : *c*=0·483755 : 1 : 0·312187. Observed planes: *O*; vertical, *i-i*, *i*-2, *i*-4; clinodome, 1-*ì*; hemidomes, 1-*i*, 5-*i*, –1-*i*, –2-*i*, –3-*i*, –5-*i*; hemipyramids, 1, –1, 1-2, 3-3, –3-3, 2-4, 5-5.

O ∧ *i-i*=90° 59′
O ∧ 1-*i*=154 0
O ∧ –1-*i*=154 23
i-i ∧ 1-*i*=115 1
i-i ∧ –1-*i*=116 36
i-i ∧ –1=105 12

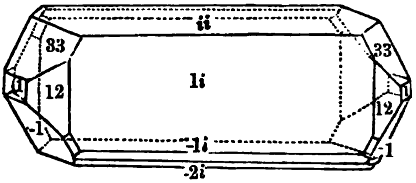
i-i ∧ 1=104° 11½′
i-i ∧ 3-3=127 52
i-i ∧ –3-3=128 32
i-i ∧ *i*-2=121 59
–1-*i* ∧ 1-*i*=128 23

1-*i* ∧ 1-2=144° 54′
1-*i* ∧ 1=125 26
–1-*i* ∧ –1=125 50
1 ∧ 1=70 52
–1 ∧ –1, front,=71 38
3-3 ∧ 3-3 " =96 54

269



270



Crystals either short, flat tabular, or long and slender, sometimes acicular. Twins like those of epidote. Cleavage: *i-i* in traces. Also massive, and in angular or rounded grains.

H.=5·5—6. G.=3·0—4·2. Lustre submetallic, pitchy, or resinous—occasionally vitreous. Color pitch-brown to black, either brownish, greenish, grayish, or yellowish. Streak gray, sometimes slightly greenish or brownish. Subtranslucent—opaque. Fracture uneven or subconchoidal. Brittle. Double refraction either distinct, or wanting.

Comp., Var.—This species, while closely like epidote in crystallization. varies much in the results of analyses, and also in external appearance. The more prominent ways of variation are the following: (1) The crystals are sometimes broad tabular, and sometimes very long acicular. (2) The crystals, when well-formed, often manifest no double refraction, as Descloizeaux has observed. (3) The amount of water present varies from none to 17 p. c., and the hardness and specific gravity correspondingly, the kinds containing the most water being lowest; and, in some, G. not exceeding 2·53. (4) There is also much diversity in pyrognostic and other chemical characters, as explained beyond.

The varieties that have been distinguished are as follows:

1. *Allanite.* In tabular crystals or plates, the crystals sometimes 8 to 10 in. long, 5 to 6 wide, and an inch or so thick. Color black or brownish-black. G.=3·50—3·95; 3·53—3·54, from Jotun-Fjeld; 3·79, from Snarum, Norway; 3·53, from E. Bradford, Pa., and 3·935, from Bethlehem, Pa., Brush; 3·84, from Franklin, N. J., Hunt. Named after T. Allan, the discoverer of the mineral, and found among specimens from East Greenland, brought to Scotland by C. Giesecké. *Cerine* is the same thing, named by Hisinger, having H.=6; G.=3·77—3·8; lustre weak, greasy; and being subtranslucent in thin splinters.

Bucklandite is anhydrous allanite in small black crystals from a mine of magnetite near Arendal, Norway. Although not yet analyzed, it is referred here by v. Rath on the ground of the angles and physical characters (Pogg., cxiii. 281). That of L. Laach is also shown to have the angles of allanite by v. Rath (l. c.); the angles are those cited above as the angles of the species. *Tautolite Breith.*, is also from the trachyte of L. Laach, and is probably the same species. Angles: *i*-2 ∧ *i*-2 =70° 48′ and 109° 12′, *i-i* ∧ 1-*i*=114° 30′, 1-*i* ∧ 1=125° 30′, –1-*i* ∧ 1-*i*=128° 37′ and 51° 29′, Descl.; *i*-2 ∧ *i*-2=70° 14′, –1-*i* ∧ 1-*i*=51° 52′, Breith. H.=6·5—7. G.=3·86.

2. *Uralorthite* is allanite in large prismatic crystals from the Ilmen Mts., near Miask. H.=6; G.=3·41—3·60, Herm.; 3·647, Ramm. It is pitch-black, gives a gray powder, and is nearly anhydrous.

2. *Bagrationite.* Occurs, according to Kokscharof, in black crystals, which are nearly symmetrical like the bucklandite of Achmatovsk, and not lengthened, like uralorthite, in the direction of the orthodiagonal. Angles the same with those of uralorthite, after many measurements by Kokscharof. H.=6·5. G.=3·84, Koksch. Streak dark brown. B.B. intumesces and forms a black, shining, magnetic pearl. In powder not attacked by hot muriatic acid or by boiling nitric acid. Not analyzed. Named after the discoverer, P. R. Bagration. From Achmatovsk, Ural

Hermann has described and analyzed what he calls *bagrationite*, from Achmatovsk, which he states has the angles of the bucklandite *of Achmatovsk*, and which, therefore, is true epidote (q. v.). The analyses by Hermann sustain this reference.

3. *Orthite* included, in its original use, the slender or acicular prismatic crystals, often a foot long, containing some water. But these graduate into massive forms, and some orthites are anhydrous, or as nearly so as much of the allanite. The name is from ὀρθός, *straight*. The tendency to alteration and hydration may be due to the slenderness of the crystals, and the consequent great exposure to the action of moisture and the atmosphere. H.=5–6. G.=2·80–3·75; 3·63–3·65 from Fille-fjeld; 3·546, from Hitteröe, Ramm.; 3·373, Scheerer; 3·69–3·71, from Swampscot, Mass., Balch; 2·86–2·93, from Naes mine, 10 m. E. of Arendal, a hydrous variety containing 11 p. c. of water. Lustre vitreous to greasy

4. *Xanthorthite*, of Hermann, is yellowish and contains much water, and is apparently an altered variety; G.=2·78–2·9. Named from ξανθός, *yellow*, and *orthite*.

5. *Pyrorthite* of Berzelius is an impure orthite-like mineral, in long prisms of rather loose texture, containing as its principal impurity some carbonaceous material (over 30 p. c.), and showing this in its burning before the blowpipe. Named from πῦρ, *fire*, and *orthite*. From Kararfvet, near Fahlun.

6. *Erdmannite*, of Berlin, from Stökö, near Brevig, is near orthite in composition. It occurs in imbedded grains and plates, with G.=3·1, lustre vitreous, color dark brown, and is translucent in thin splinters. Named after Prof. Erdmann. Contains 4 to 5 p. c. of water.

Allanite is a *cerium-epidote*. But, besides a large percentage of cerium, it contains generally the related metals, lanthanum and didymium, with also, sometimes, a little yttrium, and rarely traces of glucinum. The condition of oxydation of the iron has not been exactly determined in most of the analyses, and consequently the results are discordant. The best determinations, according to Rammelsberg, afford approximately, the garnet-ratio 1 : 1 : 2, instead of the epidote ratio 1 : 2 : 3, whence the formula $(\frac{1}{3}\dot{\mathrm{R}}^3+\frac{1}{3}\ddot{\bar{\mathrm{R}}})^2\ddot{\mathrm{S}}\mathrm{i}^3$. In this formula $\dot{\mathrm{R}}=\dot{\mathrm{C}}\mathrm{a}$, $\dot{\mathrm{C}}\mathrm{e}$, $\dot{\mathrm{L}}\mathrm{a}$, $\dot{\mathrm{D}}\mathrm{i}$, $\dot{\mathrm{F}}\mathrm{e}$, with sometimes $\dot{\mathrm{M}}\mathrm{g}$, $\dot{\mathrm{Y}}$, $\dot{\mathrm{M}}\mathrm{n}$; and $\ddot{\bar{\mathrm{R}}}=\ddot{\bar{\mathrm{A}}}\mathrm{l}$, $\ddot{\bar{\mathrm{F}}}\mathrm{e}$. Analyses 9–11 gave this oxygen ratio to Genth.

Analyses: I. ALLANITE; 1, Stromeyer (Pogg., xxxii. 288); 2, Credner (Pogg., lxxix. 414); 3, Rammelsberg (Pogg., lxxx. 285); 4, Bergemann (Pogg., lxxxiv. 485): 5, Zschau (Jahrb. Min., 1852, 652); 6, 7, Scheerer (Pogg., li. 407, 465, lvi. 479, lxi. 636); 8, Hermann (J. pr. Ch., xxiii. 273, xliii. 35, 99); 9, 10, 11, P. Keyser (Am. J. Sci., II. xix. 20); 12, T S. Hunt (Proc. N. H. Soc. Boston. viii. 57).

II. *Cerine;* 13, Hisinger (Afh. i. Fys., iv. 327); 14, Scheerer (l. c.); 15, P. T. Cleve (Œfv. Ak. Stockh., xix. 425, 1862, J. pr. Ch., xci. 223); 16, v. Rath (Pogg., cxix. 273); 17, 18, D. M. Balch (Am. J. Sci, II. xxxiii. 348).

III. *Uraorthite;* 19, 20, Hermann (J. pr. Ch., xliii. 102, 105); 21, Rammelsberg (Min. Ch., 746).

IV. *Orthite;* 22, 23, Berzelius (Hisinger's Min. Schwed.); 24, 25, Berlin (Jahresb., xvii. 221); 26, 27, 28, Scheerer (l. c.); 29, C. W. Blomstrand (Œfv. Ak. Stockh., 1854, 296, J. pr. Ch., lxvi. 156); 30, F. Stifft (Jahrb. Min., 1856, 395); 31, D. Forbes (Edinb. N. Ph. J., II. vi. 112); 32, Strecker (Christiania Univ. Programme, 1854, Ed. N. Ph. J., II. vi. 112); 33, Zittel (Ann. Ch. Pharm., cxii. 85).

V. *Xanthorthite;* 34, 35, Bahr and Berlin (Œfv. Ak. Stockh., 1845, 86).

VI. *Erdmannite;* 36, Berlin (Pogg., lxxxviii. 162).

		$\ddot{\mathrm{S}}\mathrm{i}$	$\ddot{\bar{\mathrm{A}}}\mathrm{l}$	$\ddot{\bar{\mathrm{F}}}\mathrm{e}$	$\dot{\mathrm{F}}\mathrm{e}$	$\dot{\mathrm{M}}\mathrm{n}$	$\dot{\mathrm{C}}\mathrm{e}$	$\dot{\mathrm{L}}\mathrm{a}$	$\dot{\mathrm{D}}\mathrm{i}$	$\dot{\mathrm{Y}}$	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\mathrm{M}}\mathrm{g}$	$\dot{\mathrm{H}}$
1.	***Allanite***	33·02	15·23	——	15·10	0·40	21·60	——	——	——	11·08	——	3·0=99·40 S.
2.	"	37·55	15·99	——	16·83	0·23	3·19	9·30		0·56	13·60	0·22	1·80=99·27 C.
3.	"	31·86	16·87	3·58	12·26	——	21·27	2·40		——	10·15	1·67	1·11=101·17 R.
4.	"	33·83	13·61	3·33	12·72	0·82	20·90		——	——	9·36	1·40	2·95=99·02 B.
5.	"	33·41	10·90		20·88		20·73	——	——	0·69	10·52	——	3·12=100·25 Z.
6.	" (⅔)	34·92	15·90	——	14·98	1·27	13·34	5·80		——	11·96	0·93	0·51=99·61 S.
7.	" (⅔)	34·88	15·95	——	15·35	——	13·73	7·80		——	11·50	0·66	——=99·87 S.
8.	"	37·46	18·09	——	13·84	——	6·77	9·76		1·50	13·18	1·02	3·40=99·27 H.
9.	" (⅔)	32·19	12·00	6·34	10·55	0·51	15·37	8·84		——	9·14	0·84	1·19, $\dot{\mathrm{N}}\mathrm{a}$ 1·00, $\dot{\mathrm{K}}$ 0·18=98 15 K.
10.	" (⅔)	32·89	12·49	7·33	9·02	0·25	15·68	10·10		——	7·12	1·77	2·49, $\dot{\mathrm{N}}\mathrm{a}$ 0·09, $\dot{\mathrm{K}}$ 0·14=99·37 K.
11.	" (⅔)	33·31	14·34	10·83	7·20	——	13·42	2·70		——	11·28	1·28	3·01, $\dot{\mathrm{N}}\mathrm{a}$ 0·41, $\dot{\mathrm{K}}$ 1·33=99·06 K.
12.	"	30·20	13·05	18·25	——	*tr.*	16·60	6·90		——	11·76	1·70	1·30 Hunt.
13.	***Cerine***	30·17	11·31	——	20·72	——	28·19	——	——	——	9·12	——	——, $\dot{\mathrm{C}}\mathrm{u}$ 0·87=100·38 H.

	S̈i	A̶l	F̶e	Ḟe	Ṁn	Ċe	L̇a	Ḋi	Ẏ	Ċa	Ṁg	Ḣ
14. *Cerite*	32·06	6·49	25·26	——	——	23·80	2·45	——	——	8·08	1·16	0·60=99·90 S
15. "	30·99	9·10	8·71	12·69	——	11·35	16·08		——	9·08	1·36	0·33=99·69 C
16. "	31·83	13·66	10·28	8·69	0·40	20·89	——	——	——	11·46	2·70	——=99·91 R.
17. "	33·31	14·73	——	15·82	——	21·94	——	——	1·32	7·85	1·25	1·49, Ṅa *undet* =97·71 B
18. *Massive*	32·94	33·60		——	——	20·71	——	——	1·32	7·87	1·47	1·49, Ṅa *undet* =99·40 B
19. *Uraloorth.*	35·49	18·21	——	13·03	M̶n 2·37	10·85	6·54	——	——	9·25	2·06	2·00=99·80 H
20. "	34·47	14·36	8·24	7·67	——	14·79	7·66	——	——	10·20	1·08	1·56=100·03 Hermann
21. "	34·08	16·86	7·35	7·90	——	21·38			——	9·28	0·95	1·32, Ċu 0·13= 99·25 R
22. *Orthite*	36·25	14·00	——	11·42	1·36	17·39	——	——	3·80	4·87	——	8·70=97·79 B
23. "	32·00	14·80	——	12·44	3·40	19·44	——	——	3·44	7·84	——	5·36=98·72 B
24. "	36·24	8·18	——	9·06	——	4·98	——	——	29·81	5·48	0·61	4·59, K, Ṅa 0·61=99·96 B
25. "	33·60	12·58	——	13·48	——	4·56	——	——	20·83	9·59	1·60	3·34, K̇, Ṅa 0·62=100 B.
26. "	34·93	14·26	——	14·90	0·85	21·43			1·91	10·42	0·86,	0·52=100·08 S
27. "	33·81	13·04	——	15·65		20·50	——	——	1·45	9·42	0·38	3·38, K̇ 0·67= 98·30 S.
28. "	32·77	14·32	——	14·76	1·12	17·70	2·31		0·35	11·18	0·50	2·51, K̇ 0·26= 98·28 S.
29. "	33·25	14·74	14·30	——	1·08	14·51		——	0·69	12·04	0·74	8·22 (loss *incl.* Ṅa 0·14, K̇ 0·29=100 B.
30. "	32·79	14·67	——	14·71	——	22·31			2·42	9·68	1·20	2·67, Ṅa 0·34. K̇ 0·41=101·20 S.
31. "	31·03	9·29	——	20·68	0·07	6·74	4·35	——	1·02	6·68	2·06	12·24, Ṅa 0·56, K̇ 0·90, B̶e 8·71=99·13 F.
32. "	31·85	10·28	——	19·27	——	12·76	——	——	——	9·12	1·86	13·37 (C̈ *incl.*) Ċu 0·54=99·05 S.
33. "	32·70	17·44	16·26	——	0·34	3·92	15·41		——	11·24	0·90	2·47, C̈ 0·28. Ṅa 0·24, K̇ 0·51=101·71 Z.
34. *Xanthorth.*	32·93	15·54	——	4·21	0·39	20·01			0·59	6·76	2·15	17·55 (incl. C̈) =100·13 B. & B.
35. "	27·59	16·14	——	16·01	1·55	11·75			2·12	2·28	4·94	11·46. C̈ 6·71= 100·55 B. & B.
36. *Erdmann.*	31·85	11·71	——	8·52	0·86	34·89			1·43	6·46	——	4·28=100 Ber.

Analysis 1, from Iglorsoit; 2, G.=3·79, from Krux, Thuringia; 3, O. ratio 1 : 1 : 2, from Chester Co., Pa.; 4, from West Point, N. Y.; 5, G.=3·4917, near Dresden; 6, near Jotunfjeld; 7, Snarum; 8, G.=3·48—3·66, from Werchoturie, Ural, the so-called bucklandite; 9, G.=3·782, H.=5·5, pitch-black, no cleavage, from Orange Co., N. Y.; 10, G.=3·831, H.=6, pitch-black, from near Eckhardt's furnace, Berks Co., Pa.; 11, G.=3·491, H.=5, bnh.-bk., Bethlehem, Northampton Co., Pa.; 12, G.=3·84, Franklin, N. J., in magnetic iron.

13, G.=3·77—3·80, Bastnaes; 14, Riddarhyttan; 15, G.=4·108—4·103, O. ratio 4 : 3 : 7; 16, G.=3·983, from L. Laach; 17, 18, G.=3·69—3·71, jet-black, massive, from Swampscot, Mass.

19, 20, G.=3·41—3·647, from Miask, in the Ural; 21, G.=3·647, Miask.

22, G.=3·288, Fahlun; 23, Finbo; 24, 25, G.=3·5, Ytterby; 26, G.=3·63—3·65, Fillefjeld; 27, 28, G.=3·373, Hitteröe; 29, Wexio, Sw.; 30, G.=3·44—3·47, pitch-bk. to bnh.-bk., in syenite near Weinheim; 31, 32, G.=2·86—2·93, gnh.-bk., Naes mine, Norway, in a granite containing both orthoclase and oligoclase; 33, Naes mine, near Arendal; 34, G.=2·78, yellow, Eriksberg; 35, G.=2·88, black, Kullberg; 36, Stökö, in the Langesund fiord, near Brevig, G.=3·1.

Rammelsberg found, on examination, that the Hitteröe orthite contained F̶e 8·16 and Ḟe 8·30, and thus deduced for the mineral the O. ratio 1 : 1 : 2. The cerine of Bastnaes contained, according to Damour, 1·74 p. c. of water.

The *pyrorthite* afforded Berzelius (l. c.) S̈i 10·43, A̶l 3·59, Ḟe 6·08, Ṁn 1·39, Ċe 13·92, Ẏ 4·87, Ċa 1·81, Ḣ 26·50, carbon (by loss) 31·41.

Pyr., etc.—Some varieties give water in the closed tube. B.B. fuses easily and swells up (F.=2·5) to a dark, blebby, magnetic glass. With the fluxes reacts for iron. Most varieties gelatinize with muriatic acid, but if previously ignited are not decomposed by acid.

Obs.—Occurs in albitic and common feldspathic granite, syenite, zircon-syenite, porphyry, white limestone, and often in mines of magnetic iron. *Allanite* occurs in Greenland, in granite; at

Criffel, in Scotland, in small crystals: at Jotun Fjeld in Norway, in a kind of porphyry, and at Snarum, in albite, along with rutile and apatite; at Plauensche Gründ, near Dresden; in granite near Suhl in the Thüringerwald. *Cerine* occurs at Bastnäs in Sweden with hornblende and chalcopyrite. *Orthite* occurs in acicular crystals sometimes a foot long at Finbo near Fahlun, and at Ytterby in Sweden; at Skeppsholm near Stockholm, in black vitreous masses disseminated through gneiss; also at Kragerõe, Hitteröe, and Fille Fjeld in Norway; at Miask in the Ural. Uralorthite occurs with small crystals of zircon in flesh-red feldspar at Miask in the Ural.

In *Mass.*, at the Bolton quarry; at St. Royalston, in boulders; in Athol, on the road to Westminster, in gneiss; at Swampscot, near Marblehead. In *Conn.*, at Allen's vein, at the gneiss quarries, Haddam. In *N. York*, near W. Point, in tabular cryst.; Moriah, Essex Co., with magnetite and apatite, some cryst. 8–10 in. long, 6–8 broad, and 1–2 thick; at Monroe, Orange Co. In *N. Jersey*, at Franklin with feldspar and magnetite. In *Penn.*, at S. Mountain, near Bethlehem, in large crystals; at E. Bradford in Chester Co. (called orthite, G.=3·5, anal. 3); at Easton, Northampton Co.; near Eckhardt's furnace, Berk's Co., abundant. In *Canada*, at St. Paul's, C. W.; Bay St. Paul, C. E.; at Hollow lake, head-waters of the S. Muskoka (G.=3·255–3·288, Chapman).

On cryst., see Kokscharof, Min. Russl., iii. 344, iv. 37; v. Rath, Pogg., cxiii. 281, ZS. G., xvi. 256.

Alt.—The hydrous varieties of allanite or orthite are properly altered forms of the species. They often contain carbonic acid. It is probable that the carbonates of lanthanum and of cerium proceed at times from the alteration of allanite.

At Sillböhle, in Finland, there are crystals of allanite having an epidote nucleus, and crystals of epidote having a nucleus of allanite, apparently indicating that a change had taken place from one to the other.

279. MUROMONTITE. *Kerndt*, J. pr. Ch., xliii. 228, 1848.

Amorphous; without any trace of crystallization. In grains. H.=7. G.=4·263. Lustre vitreous or slightly greasy. Color black or greenish-black.

Comp.—Apparently related to allanite, but containing much yttrium, and little aluminum or cerium. Analysis: Kerndt (l. c.):

S̈i	A̶l	B̶e	F̶e	Ṁn	Ċe	L̶a	Ẏ	Ċa	Ṁg	Ṅa	K̇	Ḣ & loss.
31·09	2·24	5·52	11·23	0·91	5·54	3·54	37·14	0·71	0·42	0·65	0·17	0·85

Obs.—From Mauersberg, near Marienberg, in the Saxon Erzgebirge.

Named from a Latin rendering of Mauersberg.

279A. BODENITE *Breith.*, Pogg., lxii. 273, 1844, *Kersten*, ib., lxiii. 135, *Kerndt*, J. pr. Ch., xliii. 229. Related to muromontite in composition, and in containing more yttrium than cerium, but has a larger percentage of alumina and lime, and no glucina, and is hydrous. Composition according to Kerndt (l. c.):

S̈i	A̶l	F̶e	Ṁn	Ċe	L̶a	Ẏ	Ċa	Ṁg	Ṅa	K̇	Ḣ
26·12	10·34	12·05	1·62	10·46	7·57	17·43	6·32	2·34	0·84	1·21	3·82=100.

From Boden, near Marienberg, with muromontite.

279B. MICHAELSONITE *Dana*. An *orthite-like* mineral occurring near Brevig with meliphanite, containing, like muromontite, little alumina and some glucina, afforded Michaelson and Nobel (Öfv. Ak. Stockh., 1862, 505):

	S̈i	A̶l	F̶e	Z̶r	B̶e	Ċe	L̶a, D̶i	Ẏ	Ṁg	Ċa	Ṅa	Ḣ	
1.	29·21	2·81	6·42	5·44	4·27	9·79	15·60	1·63	0·45	14·93	2·45	5·50=98·41	Mich.
2.	28·80	17·51				11·47	14·12	1·49	*tr.*	16·06	——	——	Nobel.

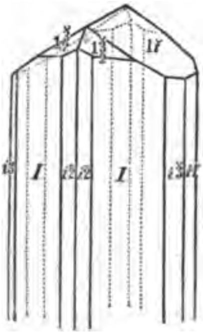
In anal. 2, Nobel obtained also 0·83 p. c. of a precipitate by means of S H. H.=4–5; G.=3·44; in thin splinters transparent to translucent; lustre vitreous; amorphous. It differs from muromontite in containing but little yttria.

280. ZOISITE. Saualpit (fr. the Sau-Alpe in Carinthia) *v. Zois*, and *Carinthian Mineralcg* before 1806, *Klapr.*, Beitr., iv. 179, 1807. Zoisito (fr. Carinthia) *Wern.*, 1805. Var. of Epic *H.*, J. d. M., xix. 365, 1806, *Bernhardi*, Moll's Efem., iii. 24, 1807. Illuderit *Leonh*, Syst. T p. iv. 1806. Lime-Epidote. Zoisite, sp. distinct from Epidote, *Brooke*, Ann. Phil., II. v. 1823. Thulite *Brooke*, Cryst., 494, 1823. Unionite *Silliman*, Am. J. Sci., II. viii. 384.

Jade (fr. near L. Geneva) *H. B. de Saussure*, Voy. Alpes, i. § 112, 1780. Bitterstein, Schw erische Jade, *Höpfner*, Mag. Helvet., i. 291, Bergm. J., 448, 1788. Nephrite pt. *Wern.* I manite *Delameth.*, T. T., ii. 354. Jade tenace, Jade de Saussure, *H.*, Tr., iv. 1801. Saussu *T. de Saussure*, J. d. M., xix. 205 1806. Var. of Zoisite *T. S. Hunt*, Am. J. Sci., II. xxv. 1858, xxvii. 336, 1859.

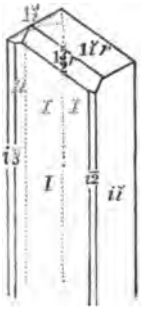
Orthorhombic. $I \wedge I=116^\circ 40'$, $O \wedge 1\text{-}\bar{\imath}=131^\circ 1\frac{1}{2}'$; $a:b:c=1{\cdot}1493:1{\cdot}62125$. Observed planes: vertical, I, $i\text{-}\breve{\imath}$, $i\text{-}\bar{\imath}$, $i\text{-}\breve{3}$, $i\text{-}\breve{2}$, $i\text{-}\breve{\tfrac{3}{2}}$, $i\text{-}\bar{3}$, $1\text{-}\breve{4}$; dom $1\text{-}\breve{\imath}$, $\frac{1}{2}\text{-}\bar{\imath}$; octahedral, $\frac{1}{4}$, $2\text{-}\breve{4}$; $\frac{3}{2}\text{-}\breve{6}$.

271



Tennessee.

272



Tennessee.

$I \wedge i\text{-}\breve{\imath}=121^\circ 40'$, meas.

$I \wedge i\text{-}\breve{2}=165\ 29$

$i\text{-}\breve{\imath} \wedge i\text{-}\breve{3}=151\ 37$

$i\text{-}\bar{\imath} \wedge i\text{-}\breve{2}=162\ 51$

$i\ \breve{2} \wedge i\text{-}\breve{2}=145\ 42$

$i\text{-}\breve{3} \wedge i\text{-}\breve{3}$, front, $=56\ 46$

$i\text{-}\bar{3} \wedge i\text{-}\bar{3}$, side, $=123\ 14$

$1\text{-}\breve{\imath} \wedge 1\text{-}\breve{\imath}$, top, $=109\ 20$

$1\text{-}\bar{\imath} \wedge 1\text{-}\bar{\imath}$, top, $=80\ 3$

$i\text{-}\breve{\imath} \wedge 1\text{-}\breve{\imath}=125\ 20$, meas.

$\frac{1}{2}\text{-}\bar{\imath} \wedge \frac{1}{2}\text{-}\bar{\imath}=120\ 14$

$\frac{1}{4} \wedge \frac{1}{4}=144\ 57$, Descl.

Figure 272, observed form, the right and $i\text{-}2$, and $i\text{-}3$ wanting, and planes left side of summit nearly obsolete; 271, the normal form as deduced fro 272. Crystals, lengthened in the direction of the vertical axis, and ver cally deeply striated or furrowed. Cleavage: $i\text{-}\breve{\imath}$ very perfect. Commonly crystalline masses longitudinally furrowed. Also compact massive.

H.$=6-6{\cdot}5$. G.$=3{\cdot}11-3{\cdot}38$. Lustre pearly on $i\text{-}\breve{\imath}$; vitreous on surfa of fracture. Color grayish-white, gray, yellowish, brown, greenish-gra apple-green; also peach-blossom-red to rose-red. Streak uncolored. Trar parent to subtranslucent. Double refraction feeble; optic-axial plane i- bisectrix positive, normal to $i\text{-}\bar{\imath}$; Descl.

Var.—A. LIME-ZOISITE. 1. *Ordinary*. Colors gray to white and brown. $I \wedge I$ in Z. of Saual 116° 48′, Breith.; of Moravia, 117° 5′, A. Weisbach, the crystal the rhombic prism I with t planes $i\text{-}2$ and $i\text{-}\bar{\imath}$, and basal cleavage at right angles to I distinct. For Z. of Rauris, G.$=3{\cdot}2$ Breith.; of Saualpe, 3·345, id.; of Moravia, 3·336, id.; of Faltigl, 3·381, id.; of Titiribi, N. Gr nada, 3·381, id. *Unionite* is a very pure zoisite.

2. *Rose-red*, or *Thulite*. G.$=3{\cdot}124$; fragile; dichroism strong, especially in the direction of t vertical axis; in this direction reddish, transversely colorless.

B. LIME-SODA ZOISITE; SAUSSURITE (in part). The original saussurite, from the vicinity Lake Geneva, is a fine-grained compact zoisite, as shown by Hunt, both by the specific gravi and the composition. G.$=3{\cdot}261$, fr. the vicinity of Lake Geneva, de Saussure; 3·365—3·3 Hunt; 3·227, Fikenscher; H.$=6{\cdot}5-7$; color pale bluish-green, greenish-gray, to white or near so; very tough. Hütlin and Pfaffins have described a saussurite which occurs with serpenti in the Schwarzwald (anal. 28). It was partly altered, and had the low hardness 3·5, with G.=3·16.

Comp.—A lime-epidote, with little or no iron, and thus differing from epidote. Formula $(\frac{1}{3}\dot{\text{Ca}}^3+\frac{2}{3}\ddot{\text{Al}})^2\ddot{\text{Si}}^3$=Silica 39·9, alumina 22·8, lime 37·3=100. The amount of sesquioxyd of iron varies from 0 to 6·33 p. c.; if much more is present, amounting to a sixth atomically of the protoxyd bases, the compound appears to take the monoclinic form of epidote, instead of the orthorhombic of zoisite.

Saussurite, according to the analyses, has the O. ratio for $\dot{\text{R}}$, $\ddot{\text{R}}$, $\ddot{\text{Si}}$=1 : 2 : 3½, instead of 1 : 2 : 3, and it appears as if this was another case in which an increase of silica accompanies the increase of alkali in the bases. Both Hunt and Fikenscher's analyses give the O. ratio 2 : 3½ for the sesquioxyds and silica. Hunt's. however, has an excess of protoxyds. In a second analysis by Hunt (see below), the specimen contained mixed talc, amounting to 10 or 12 p. c.; and if the magnesia in the first, and in Fikenscher's, is due in part to talc, this would subtract from the silica; and but a small reduction in this way would make the ratio 1 : 2 : 3.

Analyses: 1, 2, Klaproth (Beitr., iv. 179, v. 41); 3, Rammelsberg (Pogg., c. 133); 4, Bucholz (Gehl. J., i. 200); 5, Geffken (Epid. Anal. Dissert. Jenæ, 1824); 6, Rammelsberg (l. c.); 7, Geffken (l. c.); 8, Hermann (J. pr. Ch., xliii. 35); 9, Stromeyer (Unters., 378); 10, Rammelsberg (l. c.); 11, Richter (Haid. Ber., iii. 114); 12, Rengert (Ramm. Min. Ch., 1020); 13, 14, Rammelsberg (l. c., 751); 15, Bernard (J. pr. Ch., v. 212); 16, Kühn (Ann. Ch. Pharm., lix. 373); 17, Rammelsberg (l. c.); 18, Brush (Am. J. Sci., II. xxvi. 69); 19, Thomson (Min., i. 271); 20, Genth (Am. J. Sci., II. xxxiii. 197); 21, Trippel (ib.); 22, C. Gmelin (J. pr. Ch., xliii.); 23, Berlin (Pogg., xlix. 539); 24, Pisani (C. R., lxii. 100); 25, Boulanger (Ann. d. M., III. viii. 159); 26, T. S Hunt (Am. J. Sci., II. xxvii. 345); 27, Fikenscher (J. pr. Ch., lxxxix. 456); 28, Hütlin and A. v. Pfaffius (Kenng., Ueb., 1861, 76):

	$\ddot{\text{Si}}$	$\ddot{\text{Al}}$	$\ddot{\text{Fe}}$	$\dot{\text{Mg}}$	$\dot{\text{Ca}}$	$\dot{\text{H}}$
1. Saualpe, *gnh.-gy.*	45	29	3	——	21	——=98 Klaproth.
2. " *rdh.-white*	44	32	2·5	——	20	——=98·5 Klaproth.
3. "	40·64	28·39	3·89	0·57	24·26	2·09=99·84 Ramm.
4. Fichtelgebirge	40·25	30·25	4·50	——	22·50	2·00=99·50 Bucholz.
5. "	40·03	29·83	4·24	——	18·85	——, $\dot{\text{Mn}}$ 7·55=100·50 Geffk.
6. "	40·32	29·77	2·77	0·24	24·35	2·08=99·53 Ramm.
7. Faltigl, Tyrol	40·74	28·94	5·19	4·75	20·52	——, $\dot{\text{Mn}}$ 1·78=101·92 Geffk.
8. "	40·95	30·34	5·51	——	21·56	1·69=100·05 Hermann.
9. Sterzing, Tyrol, *white*	39·91	31·97	2·44	0·89[a]	23·85	0·95, $\dot{\text{Mn}}$ 0·17=100·18 Str.
10. "	40·00	30·34	2·06	0·23	24·15	2·04=98·82 Ramm.
11. Passeyrthal, Tyrol	40·57	32·67	5·11	——	20·82	1·22=101·39 Richter.
12. " " *gyh.-white*	39·56	27·64	3·00	1·11	25·00	2·87=99·18 Rengert.
13. Thal Fusch, *ywh.-gy.*	41·92	27·09	2·94	1·21	22·73	3·67=99·56 Ramm.
14. Mt. Rosa, *gnh.*	42·35	28·30	3·08	0·56	21·60	3·18, $\dot{\text{K}}$ 0·91=99·98 Ramm.
15. Grossarlthal, Salzburg	40·00	26·46	6·33	3·60	20·16	——, $\dot{\text{K}}$ 1·50=98·55 Besnard.
16. Zwiesel, Bav.	40·62	29·18	6·19	0·73	22·67	0·42=99·81 Kühn.
17. Goshen, Mass.	40·06	30·67	2·45	0·49	23·91	2·25=99·83 Ramm.
18. Unionville, Pa., *Unionite*	40·61	33·44	0·49	*tr.*	24·13	2·22=100·89 Brush.
19. Williamsburg, Mass.	40·21	25·59	8·55	——	23·28	1·71=99·34 Thomson.
20. Polk Co., Tenn., *gy.*, *gnh.*	40·04	30·63	2·28	*tr.*	25·11	0·71, $\dot{\text{Mn}}$ 0·19, Ċu 0·24=99·20 Genth.
21. " "	43·20	29·60	2·88	0·56	22·72	0·26=99·22 Trippel.
22. Tellemark, *Thulite*	42·81	31·14	2·29	——	18·73	0·64, $\dot{\text{Na}}$ 1·89, $\ddot{\text{Mn}}$ 1·63=99·18 Gmelin.
23. Arendal, "	40·28	31·84	1·54	0·66	21·42	1·32, $\ddot{\text{Mn}}$ 1·05[b], $\ddot{\text{V}}$ 0·22=98·53 Berlin.
24. Traversella, "	41·79	31·00	$\dot{\text{Fe}}$ 1·95	2·43	19·68	3·70=100·55 Pisani.
25. Orezza, *Saussurite*	43·6	32·0	——	2·4	21·0	——, $\dot{\text{K}}$ 1·6=100·6 Boulang.
26. L. Geneva, "	43·59	27·72	2·61	2·98	19·71	0·35, $\dot{\text{Na}}$ 3·08=100·04 Hunt.
27. " "	45·34	30·28	$\dot{\text{Fe}}$ 1·37	3·88	13·87	0·71, $\dot{\text{Na}}$ 4·23=99·68 Fik.
28. Schwarzwald, "	42·64	31·00	$\dot{\text{Fe}}$ 2·40	5·73	8·21	3·83, $\dot{\text{Na}}$, $\dot{\text{K}}$ 3·83 Hütlin.

[a] Soda and potash. [b] Made Mn^2O^3 by Berlin.

In anal. 3, G.=3·353; anal. 6, G.=3·361; anal. 10, G.=3·352; anal 13, G.=3·251; 14, G.=3·280; 17, G.=3·341; 18, G.=3·299; 20, G.=3·344, some specimens pinkish; 23, G.=3·34; 24, G.=3·02, H.=6·5; 26, G.=3·3—3·4, H.=7, the mineral from the valley of the Rhone in Switzerland, or the region of L. Geneva; 27, G.=3·227, same loc.; 28, G.=3·16.

Anal. 20 is of the same mineral that was analyzed by Mallet under the name *idocrase* (Am. J Sci., II. xx. 85). In anal 28, 1·13 of the silica was separated as *soluble* silica. Hunt obtained for another specimen of saussurite containing much talc (which was so disseminated through it that separation was impossible) $\ddot{Si}$ 48·10, $\bar{Al}$ 25·34, $\bar{Fe}$ 3·30, $\dot{Ca}$ 12·60, $\dot{Mg}$ 6·76, $\dot{Na}$ 3·55, ign. 0·66=100·31. If all but 3 p. c. of the magnesia (the amount in anal. 26) belonged to the talc, the amount of talc present would be 11 p. c.

Pyr., etc.—B.B. swells up and fuses at 3—3·5 to a white blebby mass. Not decomposed by acid; when previously ignited gelatinizes with muriatic acid.

Obs.—This species was instituted by Werner in 1805, first united to epidote by Haüy and Bernhardi independently in 1806, and separated again from epidote on crystallographic grounds by Brooke, in 1823. Descloizeaux has confirmed Brooke's conclusion by optical examinations, and further has shown that the crystallization is orthometric, instead of clinometric. Thulite is referred to the species by Descloizeaux, together with the lime-epidote from most of the localities mentioned in connection with the analyses. The angle *i*-2 ∧ *i*-*ĭ* in thulite is near 152°. Brooke remarks upon the isomorphism of the species with euclase.

Zoisite was so named after Baron von Zois, from whom Werner received his first specimens; and *Thulite*, after Thule, an ancient name of Norway.

The original zoisite is that of the Saualpe in Carinthia. Other localities are as mentioned. The gray mineral of Fichtelgebirge in Baireut, was referred here by Bernhardi (l. c., 1806), and both to epidote. Thulite occurs at Souland in Tellemark, in Norway, with bluish idocrase (cyprine), yellowish-white garnet, epidote, and fluorite; also at the iron mine of Klodeberg near Arendal; and at Traversella in Piedmont, forming small veins with talc and actinolite in granite.

Saussurite forms with smaragdite the euphotide of the Alps. a rock which, as a result of glacier action, is widely distributed in boulders over the valley of the Rhone, and the country about Lake Geneva; the boulders, as ascertained by Prof. Guyot, were derived from the chain of the Sassgrat, through the valley of the Sass, and are distributed to a distance of 150 m. from this place of origin. Found also in serpentine, in the Schwarzwald, but more or less altered (anal. 28). Hunt showed that both the very high specific gravity and composition identified the mineral with zoisite. (For other minerals that have passed under the name of saussurite, see Garnet, Meionite, Labradorite.)

In the United States, found in *Vermont*, at Willsboro, in columnar masses; at Montpelier, bluish-gray along with calcite, in mica schist. In *Mass.*, at Chester, in mica schist; at Goshen, Chesterfield, Hinsdale, Heath, Leyden, Williamsburg, Windsor. In *Conn.*, at Milford. In *Penn.*, in W. Bradford and W. Goshen, Chester Co.; in Kennet township and E. Marlboro; at Unionville, white (*Unionite*) with corundum and euphyllite. In *Tenn.*, at Ducktown copper mines.

Neither zoisite nor epidote has yet been found among furnace or laboratory products.

On cryst., B. & M., p. 306; Descl., Min., i. 238. The crystal figured above by the author (and from the cabinet of Prof. Brush) is ⅛ in. long, but was attached by one side to a large imperfect crystal, and hence its planes were irregularly developed. The left 1-*ī* and 2-4 were minute and somewhat rounded. The angle *I* ∧ *i*-*ī* by Descloizeaux's measurement, is 121° 40′, as given above: Descloizeaux obtained also for *i*-*ī* ∧ *i*-2=162° 20′, ½-*ĭ* ∧ ½-*ĭ*, top,=120° nearly; for *i*-*ĭ* ∧ *i*-2=107° 13′, whence *i*-2 ∧ *i*-2=145° 34′, and Miller found 107° 12′, whence 145° 36′.

Zoisite is closely isomorphous with epidote. If the figure 266 under epidote (p. 28) is placed with the longer planes vertical, it then represents very nearly the form of zoisite; the angle of this prism *i*-*ī* ∧ 1-*ī* is 115° 24′, and −1 ∧ −1=109° 35′; and correspondingly, the prismatic angle of zoisite is 116° 40′, and the brachydome 1-*ĭ* has the summit angle 109° 20′. The position given the crystals of epidote by Haüy has therefore a crystallogenic interest, and the name he applied to the species peculiar significance.

280A. JADEITE. Nephrite or Jade pt. Jadeite *Damour*, C. R., lvi. 861.

Massive, with traces of a foliated columnar structure on a surface of fracture.

H.=6·5—7. G.=3·33—3·35, fr. China, Damour; 3·32, fr. Yunnan, China, Brush; 3·32, fr. ornaments in ancient Swiss lake-dwellings, Fellenberg. Lustre subvitreous, pearly on surfaces of cleavage. Color apple-green to nearly emerald-green, bluish-green, leek-green, greenish-white, and nearly white. Streak uncolored. Translucent to subtranslucent. Fracture splintery.

Comp.—O. ratio for $\dot{R}$, $\bar{R}$, $\ddot{Si}$=1 : 2 : 6, with the protoxyds mainly soda; $(\frac{1}{3}(\frac{2}{3}\dot{Na}+\frac{1}{3}\dot{R})^3+\frac{2}{3}\bar{Al})^2\ddot{Si}^3+8\ddot{Si}$; or, with half the excess of silica basic;=, if $\dot{R}$=$\dot{Ca}$, Silica 58·4, alumina 22·2, lime 6·0, soda 13·4=100. It has the O. ratio and constituents of dipyre, while like zoisite in is very high specific gravity, as remarked by T. S. Hunt, who refers the species to the epidote group (C. R., June, 1863), and gives the species the same position in that group as dipyre in the scapolite group.

Analyses: 1, Damour (l. c.); 2, Fellenberg (Nat. Ges. Bern, 1865, 112):

	$\ddot{\mathrm{Si}}$	$\overset{\cdots}{\mathrm{Al}}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Na}}$	$\dot{\mathrm{K}}$	$\dot{\mathrm{H}}$	
1. China	59·17	22·58	1·56	1·15	2·68	12·93	*tr.*	——	=100·07 Damour.
2. Swiss Lake-hab.	58 89	22·40	1·66	1·28	3·12	12·86	0·49	0·20, $\dot{\mathrm{Zn}}$ 0·73	=101·03 Fell.

In an imperfect analysis of a specimen from the province of Yunnan, China, obtained by R. Pumpelly, Wm. Cook found (priv. contrib.) $\ddot{\mathrm{Si}}$ 59·35, $\overset{\cdots}{\mathrm{Al}}$ 24·07, $\dot{\mathrm{Mg}}$ *tr.*, $\dot{\mathrm{Ca}}$ 0·77, $\dot{\mathrm{Na}}$ 13·01, $\dot{\mathrm{K}}$ *tr.*, $\dot{\mathrm{H}}$ 0·30=97·60. The analysis shows that Mr. Pumpelly rightly indentifies this stone. the feitsui of the Chinese. with jadeite (Geol. China, etc., 117, 118, 1866, Smithson. Contrib., No. 202).

Pyr., etc.—B.B. fuses readily to a transparent blebby glass. Not attacked by acids after fusion, and thus differing from saussurite.

Obs.—Jadeite is one of the kinds of pale green stones used in China for making ornaments, and passing under the general name of jade or nephrite. Mr. Pumpelly remarks that the *feitsui* is perhaps the most prized of all stones among the Chinese. He also observes that the *chalchihuitl* of the ancient Mexicans, of which he had seen many specimens, is probably the same mineral. But W. P. Blake identifies this name with the turquois from the vicinity of Santa Fe (Am. J. Sci., II. xxv. 227).

281. PARTSCHINITE. Partschin *Haid.*, Ber., iii. 440, 1847, Ber. Ak. Wien, xii. 480.

Monoclinic. $I \wedge I=91°\ 52'$, $C=52°\ 16'$, $O \wedge i\text{-}i=127°\ 44'$, $O \wedge 1\text{-}\grave{i}=$ 148°, $O \wedge I=116°\ 5'$, $1\text{-}\grave{i} \wedge 1\text{-}\grave{i}$, ov. $O,=116°$, $O \wedge \tfrac{1}{2}=126°\ 51'$.

H.=6·5—7. G.=4·006, v. Hauer. Lustre a little greasy, feeble. Color yellowish, reddish. Subtranslucent. Fracture subconchoidal.

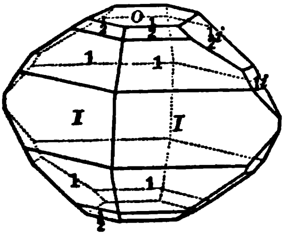
Comp.—O. ratio for $\dot{\mathrm{R}}$, $\overset{\cdots}{\mathrm{R}}$, $\ddot{\mathrm{Si}}$, 1 : 1 : 2, as in garnet, and near spessartine. Von Hauer obtained (l. c., ½) $\ddot{\mathrm{Si}}$ 35·63, $\overset{\cdots}{\mathrm{Al}}$ 18·99, $\dot{\mathrm{Fe}}$ 14·17, $\dot{\mathrm{Mn}}$ 29·23, $\dot{\mathrm{Ca}}$ 2·77, $\dot{\mathrm{H}}$ 0·38.

Obs.—In very small dull crystals and rounded fragments, in the auriferous sands of Ohlapian, Transylvania.

282. GADOLINITE. Schwarzer Zeolith (fr. Ytterby) *Geyer*, Crell's Ann., 1788. Ytterbit (Silicate of Alumina, Ox. Iron, and a new earth) *Gadolin*, Ak. H. Stockh., 1794; *Ekeberg*, ib., 1797 (naming the earth YTTRIA). Gadolinit *Klapr.* (Ak. Berlin, 1800), Beitr., iii. 52, 1802.

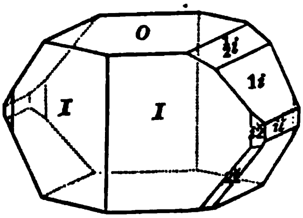
Orthorhombic. $I \wedge I=116°$, $O \wedge 1\text{-}\bar{i}=114°\ 24'$; $a : b : c=2{\cdot}2054 : 1 : 1{\cdot}6003$, Nordenskiöld, or near zoisite, if a be made $\tfrac{1}{2}a$. Observed planes:

273.



Ytterby.

274.



Ytterby.

O; vertical, I, $i\text{-}\bar{i}$, $i\text{-}\breve{i}$, $i\text{-}\breve{2}$; brachydomes, $\tfrac{1}{2}\text{-}\breve{i}$, $1\text{-}\breve{i}$, $2\text{-}\breve{i}$; macrodomes, $\tfrac{1}{4}\text{-}\bar{i}$, $\tfrac{1}{2}\text{-}\bar{i}$; octahedral, 1, $\tfrac{1}{2}$, 1-2, $2\text{-}\breve{2}$, $\tfrac{3}{2}\text{-}\breve{\tfrac{3}{2}}$, $2\text{-}\breve{4}$. Cleavage none.

$O \wedge 1\text{-}\breve{i}=125^\circ\ 58'$ $O \wedge 1=111^\circ\ 2'$ $I \wedge i\text{-}\breve{i}=122^\circ$
$O \wedge 2\text{-}\breve{i}=109\ 57$ $2\text{-}\breve{i} \wedge 2\text{-}\breve{i}$, top, $=39\ 54$ $I \wedge i\text{-}2=160\ 40'$
$O \wedge \frac{1}{2}\text{-}\breve{i}=146\ 26$ $\frac{1}{2}\text{-}\breve{i} \wedge \frac{1}{2}\text{-}\breve{i}$, top, $=110\ 52$ $I \wedge 1=158\ 58$
$O \wedge I=90$ $1\text{-}\breve{i} \wedge 1\text{-}\breve{i}$, top, $=71\ 56$ $i\text{-}\breve{2} \wedge 1\text{-}\breve{2}$, ov. $i\text{-}\breve{i}$, $=122\ 40$

H.=6·5—7. G.=4—4·5; of Ytterby 4·097—4·226, but after heatin 4·286—4·456, H. Rose; 4·35, from Hitteröe, Scheerer. Lustre vitreou Color black, greenish-black; in thin splinters nearly transparent, an grass-green to olive-green. Streak greenish-gray. Double refraction i Hitteröe crystals, sometimes distinct, with optical axes very divergent, i others often wanting. In the mass subtranslucent—opaque. Fractu conchoidal.

Comp., Var.—Gadolinite varies widely in its crystals, and physical and chemical characte even in specimens from the same locality, and much more so in those of different. The cryst are usually rough and irregular, and sometimes oblique in different directions. Haüy (Min., 182 Phillips (Min., 1823), Levy (Min. Heuland, ii. 46), Kupffer, Scheerer (Gæa Norvegica, 313), a Waage (Forh. Selsk. Christiania, 1864, and Jahrb. Min, 1867, 696) have made it *monoclinic;* a Brooke and Miller (Min., 322, using the same cryst. examined by Phillips), Scheerer (Jahrb. Mi 1861, 184), A. E. Nordenskiöld (Œfv. Ak. Stockh., 1859, 287), and Maskelyne and v. Lang (Pl Mag., IV. xxviii. 145) have made it orthorhombic:

	Phillips, fr. Kararfvet.	Levy.	Scheerer, fr. Hitteröe.	Waage, fr. Hitteröe.
$O \wedge i\text{-}i$	98°	96° 30′	———	90° 36′
$O \wedge \frac{1}{2}\text{-}i$	150	149 49	———	146 38
$O \wedge 1\text{-}i$	—	———	125° 45′	127 12
$I \wedge I$	115	115	116	116

	B. & M., fr. Kararfvet.	Nordenskiöld, fr. Kararfv. & Broddbo.	Scheerer, fr. Ytterby.	Lang, fr. Ytterby.
$O \wedge i\text{-}\bar{i}$	90°	90°	90°	90° ±
$O \wedge 1\text{-}\breve{i}$	—	144 2′	144 30′	145 32′
$O \wedge \frac{1}{2}\text{-}\breve{i}$	—	124 34	125 58	———
$I \wedge I$	119 30′	116	116 30	———

Maskelyne and v. Lang state that the crystals from Ytterby are sometimes oblique in the directi of one diagonal, and sometimes in that of the other; they adopt Nordenskiöld's calculated resu Waage, who makes the form monoclinic, enumerates the planes O, I, $i\text{-}i$, $i\text{-}\breve{2}$, 1, −1, ½, −½, 1-2, ½ $1\text{-}i$. His measurements were made with the reflective goniometer, and agree well with his c culated results; which, in addition to the above, are, $O \wedge I=89^\circ\ 31'$, $O \wedge 1=111^\circ\ 29$, $O \wedge -1$ $112^\circ\ 21'$, $O \wedge \frac{1}{2}\text{-}i=136^\circ\ 7'$, $1 \wedge -1=136^\circ\ 10'$, $I \wedge 1=158^\circ\ 8'$, $I \wedge -1=158^\circ\ 2'$. Waage points out relation in angles to epidote, observing that the prismatic angle, 116°, which is nearly that zoisite, corresponds to $\frac{2}{3}\text{-}i \wedge \frac{2}{3}\text{-}i$ in epidote (=115° 32′).

The Ytterby crystals examined by v. Lang were partly altered. Descloizeaux found cryst from this locality part a mixture of double and singly refracting material, and part without an action on polarized light. Amid the diversity of results it is impossible to decide which is t correct form.

The variations in composition are also considerable. The Ytterby, Finbo, and Broddbo gadolini afford approximately the formula $\dot{R}^2\,\dddot{S}i$; that of Hitteröe, $\dot{R}^8\,\dddot{S}i^3$, the O. ratio between the bas and silica being approximately 4 : 3, as in euclase. That analyzed by Bahr and Bunsen has t O. ratio 3 : 2.

Analyses: 1, 2, Berzelius (Afhandl., iv. 148, 389); 3–6, Berlin (Dissert. Gadol. Upsal., 184 and Œfv. Ak. Stockh., 1845, 86); 7, Berzelius (l. c.); 8, Richardson (Thom. Min., i. 410)· 9, 1 Scheerer (De Foss. Allanit, etc., Berolini, 1840, and Pogg., lvi. 479); 11, König (Ann. Ch. Pharm cxxxvii. 33):

	$\dddot{S}i$	$\dddot{B}e$	$\dot{Y}$	$\dot{C}e$	$\dot{F}e$	$\dot{C}a$	
1. Finbo	25·80	—	45·00	16·69	10·26	—,	ign. 0·60=98·35 Berzelius.
2. Broddbo	24·16	—	45·93	16·90	11·34	—,	ign. 0·60=98·93 Berzelius.

		$\ddot{\text{Si}}$	$\bar{\text{Be}}$	$\dot{\text{Y}}$	$\dot{\text{Ce}}$	$\dot{\text{Fe}}$	$\dot{\text{Ca}}$	
3.	Ytterby	25·62	—	50·00	7·90	14·44	1·30,	$\dot{\text{Mg}}$ 0·54, $\bar{\text{Al}}$ 0·48, $\dot{\text{K}}$ 0·19, $\dot{\text{Na}}$ 0·18=100·65 Berlin.
4.	"	25·26	—	45·53	6·08	20·28	0·50,	$\dot{\text{Mg}}$ 0·11, $\bar{\text{Al}}$ 0·28, $\dot{\text{K}}$ 0·21, $\dot{\text{Na}}$ 0·20=98·45 Berlin.
5.	"	24·65	2·13	49·60	7·64[a]	15·03	0·46,	$\dot{\text{Mg}}$. $\dot{\text{Mn}}$ *tr.*=99·51 Berlin.
6.	"	24·85	4·80	51·46	5·24[a]	13·01	0·50,	$\dot{\text{Mn}}$, $\dot{\text{Mg}}$ 1·11=100·97 Berlin.
7.	Kararfvet	29·18	2·00	47·30	3·40	$\bar{\text{Fe}}$ 8·00	8·15,	$\bar{\text{Mn}}$ 1·30, $\dot{\text{H}}$ 5·20=99·53 Berzelius
8.	"	24·65	11·05	45·20	4·60	$\bar{\text{Fe}}$ 14·55	—,	$\dot{\text{H}}$ 0·50=100·55 Richardson.
9.	Hitteröe	25·78	9·57	45·67	1·81	11·68	0·34,	$\bar{\text{La}}$ 4·75=100·71 Scheerer.
10.	"	25·59	10·18	44·96	—	12·13	0·23,	$\bar{\text{La}}$ 6·33=99·42 Scheerer.
11.	——?	22·61	6·96	34·64	17·38[b]	9·76	0·83,	$\bar{\text{Fe}}$ 4·73, $\dot{\text{Mg}}$ 0·15, $\dot{\text{Na}}$ 0·88, $\dot{\text{H}}$ 1·93=99·37 König

[a] With oxyd of Lanthanum. [b] $\dot{\text{E}}$ 2·93, $\dot{\text{Ce}}$ 2·86, $\dot{\text{D}}$ 8·88, $\dot{\text{La}}$ 3·21.

Of Berlin's analyses, the first two were of the glassy gadolinite.

The oxygen ratio between the bases and silica in anal. 1 is 1 : 1·02; in 2, 1 : 1; in 3, 1 : 0·94; in 4, 1 : 0·94; in 5, 1 : 0·85; in 6, 1 : 0·92; in 9, 10, 1 : 0·72. Connell obtained, for a specimen labelled Fahlun, $\ddot{\text{Si}}$ 27·00, $\bar{\text{Be}}$ 6·00, $\bar{\text{Fe}}$ 14·50, $\dot{\text{Y}}$ 36·50, $\bar{\text{Ce}}$ 14·33, $\dot{\text{Ca}}$ 0·50=98·83 (Edinb. N. Phil. J., 1836, June); which, taking the iron as protoxyd, gives the oxygen ratio for $\dot{\text{R}}+\bar{\text{Be}}$, $\ddot{\text{Si}}$, 1 : 0·92.

Pyr., etc.—The glassy variety is unchanged in the closed tube, but if heated B.B. the assay gives for a moment a bright light, as if it had taken fire, swells up, cracks open, and becomes grayish-green in color without fusing. The splintery variety swells into cauliflower-like ramifications and becomes white, rarely glowing. With borax gives an iron reaction. Only slightly acted upon by salt of phosphorus. Decomposed by muriatic acid with gelatinization.

Obs.—Gadolinite occurs principally in the quarries of Kararfvet, Broddbo, and Finbo, near Fahlun in Sweden; also at Ytterby, near Stockholm; at each place indistinctly crystallized, and in rounded masses, which are often encircled with a yellow crust, and imbedded in coarse-grained granite. At Kararfvet crystals have been obtained 4 in. long. It has also been met with at Disko in Greenland; in trap near Galway, Ireland; imbedded in granite in Ceylon; at Brevig and Hitteröe in the southern part of Norway, crystals sometimes 4 in. across and twins at this last locality.

Named after the Russian chemist, Prof. Gadolin.

283. MOSANDRITE. *Erdmann*, Jahresb., xxi. 178, 1841.

Orthorhombic? $I \wedge I$ about 117° 16′, $I \wedge i\text{-}\breve{i}$=121° 10′ to 120° 40′, $i\text{-}\breve{i} \wedge i\text{-}\breve{2}$ =139° 40′ to 141°, $I \wedge i\text{-}\breve{2}$=160° to 161°, $i\text{-}\breve{i} \wedge i\text{-}\breve{3}$=151° 20, Descl. Cleavage: *i-ĭ* perfect. Crystals long prisms, usually flattened parallel to *i-ĭ*, and longitudinally striated. Also massive and fibrous.

H.=4. G.=2·93–3·03. Lustre of cleavage-face between vitreous and greasy, of other surfaces resinous. Color reddish-brown, but altering to dull greenish or yellowish-brown. Streak-powder pale yellow or grayish-brown. Thin splinters translucent, bright red by transmitted light. Double refraction feeble; optic-axial plane vertical, and normal to *i-ĭ*; acute bisectrix negative, and apparently at right angles to *i-ĭ*, Descl.

Comp.—Analysis by Berlin (Pogg., 156, 1853):

$\ddot{\text{Si}}$	$\ddot{\text{Ti}}$	$\bar{\text{Ce}}$, $\bar{\text{La}}$, $\dddot{\text{D}}$	$\dot{\text{Fe}}$	$\dot{\text{Mg}}$	$\dot{\text{Ca}}$	$\dot{\text{Na}}$	$\dot{\text{K}}$	$\dot{\text{H}}$
29·93	9·90	26·56	1·83	0·75	19·07	2·87	0·52	8·90=100·33

There is some $\bar{\text{Mn}}$ with the $\bar{\text{Fe}}$. Reckoning the $\ddot{\text{Ti}}$ with the bases, as forming part of a sesquioxyd, as in sphene and keilhauite, the oxygen ratio of the protoxyds, sesquioxyds, and silica is nearly 1 : 2 : 3, or of bases and silica 1 : 1 (precisely 16·57 : 15·86), affording the formula $(\frac{1}{3}\dot{\text{R}}^3+\frac{2}{3}\bar{\text{R}})^2\ddot{\text{Si}}^2+1\frac{1}{2}\dot{\text{H}}$. This, excluding the water, is the formula of epidote, to which the species may be related.

Pyr., etc.—In the closed tube gives water. B.B. fuses with intumescence at 3 to a brown glass. With salt of phosphorus in R.F. gives a violet bead (titanic acid) and with borax in O.F.

gives an amethystine bead (manganese). Decomposed by muriatic acid, with separation of silica and formation of a dark red solution, which, on heating, gives off chlorine and becomes yellow.

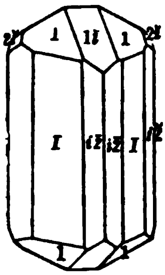
Obs.—Occurs at Brevig, in syenite, with leucophanite, eucolite, elæolite, ægirite, black mica on the island of Lammanskäret near Brevig, Norway. Readily undergoes alteration.

Descloizeaux observes that mosandrite may be regarded approximately as isomorphous with zoisite, in which $i\text{-}\bar{i} \wedge i\text{-}\bar{3}=151^\circ\ 48'$, $I \wedge I=116^\circ\ 16'$ (Min., i. 533).

284. ILVAITE. Yenite (fr. Elba) *Lelièvre*, J. d. M., xxi. 65, 1807. Ilvait *Steffens*, Orykt., i. 356, 1811. Lievrit *Wern*, Hoffm. Min., ii. a, 376, 1812. Wehrlit *v. Kob*, Grundz., 313, 1838.

Orthorhombic. $I \wedge I=112^\circ\ 38'$, $O \wedge 1\text{-}\bar{i}=146^\circ\ 24'$; $a:b:c=0{\cdot}66608:1:1{\cdot}5004$. Observed planes: O; vertical, I, $i\text{-}\bar{i}$, $i\text{-}\breve{i}$, $i\text{-}\breve{2}$, $i\text{-}\breve{\tfrac{3}{2}}$, $i\text{-}\bar{2}$, $i\text{-}\bar{3}$, $i\text{-}\breve{4}$, $i\text{-}\breve{\tfrac{5}{3}}$?; domes, $1\text{-}\bar{i}$, $3\text{-}\bar{i}$, $\tfrac{1}{2}\text{-}\breve{i}$, $2\text{-}\breve{i}$; pyramids, 1; in zone $i\text{-}\bar{i}$: 1, $2\text{-}\bar{2}$, $3\text{-}\bar{3}$, $4\text{-}\bar{4}$; in zone $i\text{-}\breve{i}$: 1, $2\text{-}\breve{2}$, $3\text{-}\breve{3}$.

275



$O \wedge 3\text{-}\bar{i}=116^\circ\ 39'$
$O \wedge 2\text{-}\breve{i}=138\ 29$
$O \wedge 1=141\ 24$
$O \wedge \tfrac{1}{2}\text{-}\breve{i}=167\ 31$
$O \wedge 2\text{-}\breve{i}=138\ 29$
$1 \wedge 1$, mac.,$=139\ 32$

$1 \wedge 1$, brach.,$=117^\circ\ 27'$
$i\text{-}\breve{2} \wedge i\text{-}\breve{2}=143\ 8$
$1\text{-}\bar{i} \wedge 1\text{-}\bar{i}=112\ 49$
$i\text{-}\bar{2} \wedge i\text{-}\bar{2}$, brach.,$=106\ 15$
$I \wedge i\text{-}\breve{2}=160\ 34$
$I \wedge i\text{-}\bar{2}=164\ 45$

Lateral faces usually striated longitudinally. Cleavage: parallel to the longer diagonal, indistinct. Also columnar or compact massive.

H.=5·5—6. G.=3·7—4·2; 3·994, fr. Elba, Haidinger; 3·9796, ib., Stromeyer; 3·825—4·061, ib., Lelièvre; 3·711, fr. Nassau, Tobler. Lustre submetallic. Color iron-black, or dark grayish-black. Streak black, inclining to green or brown. Opaque. Fracture uneven. Brittle.

Comp.—O. ratio, from Tobler's anal. (No. 7), for $\dot{R}$, $\bar{R}$, $\ddot{Si}=3:2:5$, whence $(\tfrac{3}{5}\dot{R}^3+\tfrac{2}{5}\bar{R})^2\ddot{Si}^3$ =Silica 32·8, sesquioxyd of iron 23·4, prot. id. 31·5, lime 12·3=100; and, as the specimens were partly in crystals (having the planes $i\text{-}\breve{2}$, $1\text{-}\bar{i}$, I, 1), this may be the normal composition of the species. This variety is of low specific gravity, and contains much manganese.

The other analyses show a deficiency of silica for a unisilicate. In Rammelsberg's (No. 3) the O. ratio for $\dot{R}$, $\bar{R}$, $\ddot{Si}$, $\dot{H}=11{\cdot}08:6{\cdot}76:15{\cdot}90:1{\cdot}42$; or for $\dot{R}+\bar{R}$, $\ddot{Si}$, $\dot{H}=9:8:0{\cdot}75$. In anal. 2, the last ratio is 7 : 6 : 0·4, and in No. 5, 6 : 5 : 0.

Städeler found water a constant ingredient, and, as it was not expelled below ignition, regards it as basic. His closely-agreeing analyses give for $\dot{R}+\bar{R}$, $\ddot{Si}$, $\dot{H}$ the O. ratio 9 : 8 : 1, and for $\dot{Ca}$, $\dot{Fe}$, $\bar{Fe}$, 2 : 4 : 1. If $\dot{H}$ be basic, the O. ratio of bases and silica is 5 : 4, which is expressed in the formula $(\dot{H}^3, \dot{R}^3, \bar{R})^5\,\ddot{Si}^6$.

But in view of the variation in ratio in the analyses of the Elba mineral, and its opacity, we may reasonably infer that impurities are present (as staurolite exemplifies, p. 388), and that these impurities are mainly hydrated oxyd of iron, of the species göthite, which mineral loses its water at a high temperature. Allowing for this admixture, all ilvaite may come under the general formula $(\dot{R}^3, \bar{R})^2\ddot{Si}^3+m\,\bar{Fe}\dot{H}$: with the O. ratio for bases and silica 7 : 6, m would equal $\tfrac{1}{3}$.

Analyses: 1, Stromeyer (Unters., 372); 2, same with v. Kobell's estimation of the iron (Schw. J., lxii. 166), 3, Rammelsberg (Pogg., l. 157, 340, Min. Ch., 740); 4, 5, Wackernagel and Franke (Min. Ch., ib.); 6, Städeler (J. pr. Ch., xcix. 70); 7, Tobler (Ann. Ch. Pharm., xcix. 122):

	$\ddot{Si}$	$\bar{Al}$	$\bar{Fe}$	$\dot{Fe}$	$\bar{Mn}$	$\dot{Mn}$	$\dot{Ca}$	$\dot{H}$
1. Elba	29·28	0·61	——	52·54	1·59	——	13·78	1·27=99·07 Stromeyer.
2. "	29·28	0·61	23·00	31·90	1·59	——	13·78	1·27=101·43, Str., Kob.
3. "	29·83	——	22·55	32·40	——	1·50	12·44	1·60=100·32 Ramm.
4. "	29·45	——	25·79	28·60	——	0·94	15·49	——=100·27 Wackernagel.
5. "	29·61	——	21·09	32·71	——	1·55	14·47	——=99·43 Franke.
6. "	$\tfrac{2}{3}$ 29·34	——	20·84	34·13	——	1·01	12·78	2·43=100·53 Städeler.
7. Nassau	33·80	——	22·57	24·02	——	6·78	11·68	1·12=99·47 Tobler.

Werner placed lievrite in his system next to epidote.

Pyr., etc.—B.B. fuses quietly at 2·5 to a black magnetic bead. With the fluxes reacts for iron Some varieties give also a reaction for manganese. Gelatinizes with muriatic acid.

Obs.—First found on the Rio la Marina, and at Cape Calamita, on Elba, by M. Lelièvre, in 1802, where it occurs in large solitary crystals, and aggregated crystallizations in dolomite with pyroxene, etc. Also found at Fossum in Norway; in Siberia; near Andreasberg in the Harz; at the mine of Temperino in Tuscany, granular, in limestone with actinolite; near Predazzo, Tyrol, in granite; at Schneeberg in Saxony; at Skeen in Norway; at Hebrun in Nassau; at Kangerdluarsuk in Greenland.

Reported as formerly found at Cumberland, R. I., in slender black or brownish-black crystals, traversing quartz along with magnetite and hornblende; also at Milk Row quarry, Somerville, Mass.

On cryst., Descloizeaux, Ann. d. M., V. viii. 402, and his Mineralogie, 1862, from whom the above angles are taken; his calculations were made from $1 \wedge 1$ and $1\text{-}\breve{\imath} \wedge 1\text{-}\breve{\imath}$. The observed angle $I \wedge I$ was about 111°. Also Hessenberg, Min. Not., No. III. 1.

Named *Ilvaite* from the Latin name of the island (Elba) on which it was found; *Lievrite* after its discoverer; *Yenite* (should have been Jenite) in commemoration of the battle of Jena, in 1806. The Germans, and later the French, have rightly rejected the name *yenite*, on the ground that commemorations of political hostility or triumph are opposed to the spirit of science. Descloizeaux adopts *Ilvaite*.

A boulder from near Bytown, Canada, analyzed by T. S. Hunt, gave (Logan's Rep., 1853, 1863) $\ddot{S}i$ 27·80—28·20, $\ddot{\bar{F}}e$ 10·80, $\dot{F}e$ 56·52, $\dot{M}g$ 2·59, $\dot{C}a$ 0·64, ign. 1·20=99·55; and is referred by him to lievrite. It is black, submetallic, and magnetic, with two oblique cleavages; H.=5·5; G.=4·15—4·16; and in powder it gelatinizes with acids. The composition is essentially that of *fayalite;* and the substance, although stated to contain some black mica and red granular garnet, has been supposed to be a furnace slag.

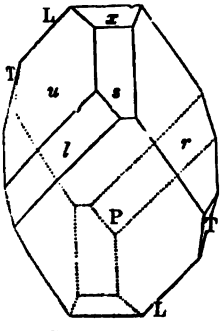
Wehrlite is probably lievrite, as suggested by Zipser. It is massive granular. H.=6—6·5. G.=3·90. Analysis by Wehrle, $\ddot{S}i$ 34·60, $\ddot{\bar{F}}e$ 42·38, $\ddot{\bar{M}}n$ 0·28, $\ddot{\bar{A}}l$ 0·12, $\dot{F}e$ 15·78, $\dot{C}a$ 5·84, $\dot{H}$ 1·00 =100. B.B. fuses with difficulty on the edges. Imperfectly soluble in muriatic acid. From Szurraskō, Hungary.

If $i\text{-}\breve{\tfrac{3}{2}}$ be taken as I in lievrite, the form becomes very nearly tetragonal, affording $I \wedge I$ within half a minute of 90°, $O \wedge 1\text{-}\breve{\imath}=146° 24'$, $1\text{-}\breve{\imath} \wedge 1\text{-}\breve{\imath}=112° 49'$.

285. AXINITE. Espéce de Schorl (fr. Oisans) *Schreiber*, 1781, de Lisle's Crist., ii. 353, 1783. Schorl violet, Schorl transparent lenticulaire (fr. Oisans), *de Lisle*, ib., and J. de. Phys., xxvi. 66, 1785. Thumerstein (fr. Thum) *Wern.*, Bergm. J., 54, 261, 1788. Glasschörl *Blumenb.*, Nat., 1791. Schorl violet, Yanolite, *Delameth.*, Sciagr., i. 287, 1792. Axinite *H.*, J. d. M., v. 264, 1799, Tr., iii. 1801. Thumite.

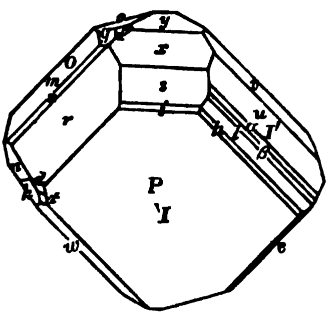
Triclinic. Crystals usually broad, and acute-edged.

276



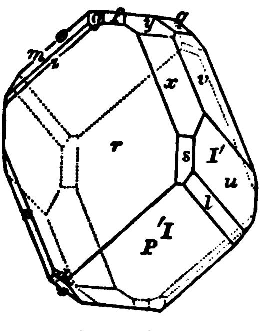
Dauphiny.

277



Dauphiny.

278



Cornwall.

Making $m=O$, $P='I$, $u=I'$, a (brachyd.) : b (macrod.) : c=0·49266 : 1 : 0·45112. Observed planes, v. Rath :

In zone P, m, P ; $r={}'1$, $z={}'2$, $m=O$, $e=-1$
" P, u, P ; $h=i\text{-}'3$, $l=i\text{-}\bar{i}$, $\beta=i\text{-}\bar{5}'$, α, $u=I'$, $v=i\text{-}\breve{i}$, $w=i\text{-}'3$
" P, s, P ; $i=-3\text{-}3$, $s=2\text{-}'\bar{i}$, $x=1'$, $y=2\text{-}\breve{i}'$, $c=-3\text{-}3$, $q=-5\text{-}\bar{5}$
" P, n ; $d=4\text{-}'2$, $n=3\text{-}'3$.
" $m\ (O), y, v$; $y=\frac{2}{3}\text{-}\breve{i}'$. $f=1\text{-}\breve{i}'$, $y=2\text{-}\breve{i}'$, $v=i\text{-}\breve{i}$, $b=2\text{-}'\breve{i}$
" $m\ (O), o, w, m$; $o=-\frac{3}{2}\text{-}3$, $c=-3\text{-}3$, $w=i\text{-}'3$, $k=6\text{-}'3$, $n=3\text{-}'3$, $\delta=$
" $r\ (1'), d, w, y$; $d=4\text{-}'2$, $t=7\text{-}'\frac{7}{2}$, $w=i\text{-}'3$, $y=2\text{-}\breve{i}'$

With also $h^2=2\text{-}\frac{8}{3}'$. Interfacial angles:

$P \wedge r=134°\ 45'$	$P \wedge u=135°\ 31'$	$u \wedge v=147°\ 31'$
$P \wedge z=116\ 24$	$P \wedge s=146\ 42$	$u \wedge l=164\ 26$
$P \wedge m\ (O)=90\ 4$	$P \wedge y$, ov. s, $=100\ 48$	$r \wedge s=143\ 35$
$P \wedge l=151\ 5$	$P \wedge w$, adj., $=119\ 31$	$r \wedge x=139\ 13$
$P \wedge e$, adj., $=134\ 40\frac{1}{2}$	$u \wedge s=152\ 3$	$r \wedge u=115\ 38$

Cleavage: $i\text{-}\breve{i}$ (v) quite distinct; in other directions indistinct. A
massive, lamellar, lamellæ often curved; sometimes granular.

H.=6·5–7. G.=3·271, Haidinger; a Cornish specimen. Lustre hig
glassy. Color clove-brown, plum-blue, and pearl-gray; exhibits trichrois
different colors, as cinnamon-brown, violet-blue, olive-green, being seen
different directions. Streak uncolored. Transparent to subtransluce
Fracture conchoidal. Brittle. Pyroelectric, with two axes, the analogue (
and antilogue (T) poles being situated as indicated in figure 276 (G. Ros
Double refraction strong.

Comp.—O. ratio for $\dot{R}$, $\bar{R}$, $\ddot{B}$, $\ddot{Si}$, 1 : 1·8 : 0·5 : 3·6; whence for $\dot{R}+\bar{R}+\ddot{B}$, $\ddot{Si}$, 3·3 : 3·6, or 1 :
whence $(\dot{R}^3)^2\ddot{Si}^3+2\bar{R}^2\ddot{Si}^3+\frac{1}{2}\ddot{B}^2\ddot{Si}^3=(\dot{R}^3, \bar{R}, \ddot{B})^2\ddot{Si}^3$. According to Rose, $\dot{R}^3(\ddot{Si}, \ddot{B})^2+2\bar{R}(\ddot{Si},$
Analyses: 1, Hisinger (Min. Schwed., 170); 2, Wiegmann (Schw. J., xxxii. 462); 3–6, Ramme
berg (Pogg., 1, 363):

	$\ddot{Si}$	$\ddot{B}$	$\bar{Al}$	$\bar{Fe}$	$\bar{Mn}$	$\dot{Ca}$	$\dot{Mg}$	$\dot{K}$
1. Wermland	41·50	—	13·56	7·36	10·00	25·84	—	—, ign. 0·30=98·56 Hising
2. Treseburg	45·00	2·00	19·00	12·25	9·00	12·50	0·25	—=100 Wiegmann.
3. Dauphiny	43·68	5·61	15·63	9·45	3·05	20·67	1·70	0·64=100·43 Ramm.
4. "	43·46	*und.*	16·30	10·25	2·74	19·90	1·55	*und.* Ramm.
5. Treseburg	43·74	—	15·66	11·94	1·37	18·90	1·77	—, $\ddot{B}$, $\dot{K}$ and loss 6·62 Ram
6 Ural	43·72	—	16·92	10·21	1·16	19·97	2·21	—, $\ddot{B}$, $\dot{K}$ and loss 5·81 Ram

Rammelsberg states that, in the last two analyses, 4·5 of the last entry in each is not too la
an estimate for the boric acid.

Pyr., etc.—B.B. fuses readily with intumescence, imparts a pale green color to the O.F., a
fuses at 2 to a dark green to black glass; with borax in O.F. gives an amethystine bead (ma
ganese), which in R.F. becomes yellow (iron). Fused with a mixture of bisulphate of potash a
fluor on the platinum loop colors the flame green (boric acid). Not decomposed by acids, b
when previously ignited, gelatinizes with muriatic acid.

Obs.—Axinite occurs in implanted glassy clove-brown crystals, at St. Cristophe, near Bou
d'Oisans in Dauphiny, with albite, prehnite, and quartz; at Santa Maria, Switzerland; at the s
ver mines of Kongsberg, in smaller crystals; with hornblende or magnetic iron in Normark
Sweden; in Cornwall, of a dark color, at the Botallack mine, where it also occurs massive, for
ing a peculiar kind of rock with garnet and tourmaline; at Trewellard, at Carn Silver near L
morran creek, and at Boscawen Cliffs in St. Burien; in Devonshire, at Brent Tor, 4 m. north
Tavistock; at Thum near Ehrenfriedersdorf in Saxony. It occurs with gray cobalt near Coqui
bo, Chili, at the mine La Buitre; at Phipsburg, Maine, with yellow garnet and idocrase; at Wal
Maine; at Cold Spring, N. Y.

For recent articles on cryst., Descl. Min., i. 515; Hessenberg, Min. Not., No. V. p. 27, f. 2
v. Rath, Pogg., cxxviii. 20, 227. Figs. 2, 3, and the above list of planes and angles, are from
Rath. Fig. 1 is from Rose and Riess on the Pyroelectricity of Axinite, Schrift. Ak. Berlin, lix. 37

Axinite admits of a high polish, but is deficient in delicacy of color.

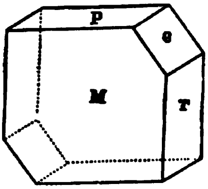
Well named from ἀξίνη, *an axe*, in allusion to the form of the crystals. The name *yanolite* is of earlier date; but it means *violet-stone*, and violet is not a characteristic color of the mineral.

Alt.—Crystals altered to chlorite occur on Dartmoor in Devonshire, England.

286. DANBURITE. Danburite *Shepard*, Am. J. Sci., xxxv. 137, 1839.

Triclinic. Approximate angles, P ∧ M=110° and 70°, M ∧ T=54°, and 126°, P ∧ T=93° nearly, P ∧ e=135°. Cleavage: distinct, parallel to M and P, less so parallel to T. Crystals imbedded, and often an inch broad. Also disseminated massive, without regular form.

279



H.=7. G.=2·95, Silliman, Jr.; 2·957, 2·958, Brush. Color pale yellow, whitish. Lustre vitreous, but usually rather weak. Translucent to subtranslucent. Very brittle.

Comp.—*O* ratio for $\dot{R}$, $\bar{B}$, $\ddot{S}i$=1 : 3 : 4; $\dot{C}a^2\ddot{S}i+\bar{B}^2\ddot{S}i^3=(\frac{1}{4}\dot{C}a^2+\frac{3}{4}\bar{B})^2\ddot{S}i^2$=Silica 48·9, boric acid 28·4, lime 22·7=100. Analyses: 1, 2, Smith and Brush (Am. J. Sci., II. xvi. 365):

	$\ddot{S}i$	$\bar{B}$	$\bar{A}l$ $\bar{F}e$	$\ddot{M}n$	$\dot{C}a$	$\dot{M}g$	ign.
1.	48·10	27·73	0·30	0·56	22·41	0·40	0·50=100.
2.	48·20	27·15	1·02		22·33	*undet.*	0·50=99·20.

Erni was the first to detect the boric acid, but as he admits (Erni's Mineralogy simplified, p. 147), his analysis was incorrect—the mineral not containing the 10 p. c. of alkalies announced by him, as directly proved by Smith and Brush. Shepard stated (l. c.) that the mineral had 8 p. c. of water without boric acid; and yet it is certain that the mineral was the same that was investigated by Smith and Brush.

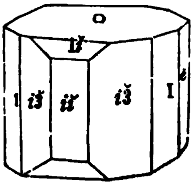
Pyr., etc.—Yields no water in the closed tube. B.B. fuses at 3·5 to a colorless glass, and imparts a green color to the O.F.; this is heightened by moistening the assay with sulphuric acid before heating. Not decomposed by muriatic acid, but sufficiently attacked for the solution to give the reaction of boric acid with turmeric paper. When previously ignited gelatinizes with muriatic acid.

Obs.—Occurs with orthoclase and oligoclase in dolomite at Danbury, Connecticut. It has some resemblance to chondrodite in color, lustre, and brittleness, but is distinctly cleavable, although the planes of cleavage are often irregular; it may be readily recognized by its pyrognostic characters.

287. IOLITE. Spanischer Lazulith *v. Schlottheim*, Hoff Mag. Min., i. 169, 1801. Iolith (fr. Spain) *Wern.*; *Karst.* (with descr.), Tab., 46, 92, 1808. Iolithe *H.*, Tabl., 61, 221, 1809 Dichroit *Cordier*, J. d. M., xxv. 129, 1809, J. de Phys., lxviii. 298, 1809. Steinheilite *Gadolin*, Mem. Ac. St. Pet., vi. 565. Peliom (fr. Bodenmais) *Wern.*, Hoffm. Min., iv. b, 117, 1817. Cordierite *Lucas*, Tabl., ii. 219, 1813; *H.*, Tr., iii. 5, 1822. Hard Fahlunit. Luchssaphir, Wassersaphir in Germ., Saphir d'eau in Fr., *of Ceylon Jewelry*.

Orthorhombic. In stout prisms often hexagonal. *I* ∧ *I*=119° 10′ and 60° 50′, *O* ∧ 1-ĭ=150° 49′. Observed planes: *O*; vertical, *I*, *i*-ī, *i*-ĭ, *i*-3̆; domes, ½-ĭ, 1-ĭ, 2-ĭ; pyramids, ⅓, ½, 1, 3-3̆. *O* ∧ 1=132° 12′, *O* ∧ ½=150° 7′, *I* ∧ *i*-3̆=150°, *i*-ĭ ∧ *i*-3̆ =150° 25′, *i*-3̆ ∧ *i*-3̆=120° 50′. Cleavage: *i*-ĭ distinct; *i*-ī and *O* indistinct. Crystals often transversely divided or foliated parallel with *O*. Twins: composition-face *I*. Also massive, compact.

280



H.=7—7·5. G.=2·56—2·67; 2·5969, Greenland, Stromeyer; 2·65—2·6643, Haddam, Thomson; Ostgothland 2·64, Südermanland 2·61, Schütz; 2·605, Mursinka, Kokscharof. Lustre vitreous. Color various shades of blue, light or dark, smoky-blue;

pleochroic, being often deep blue along the vertical axis, and brownish yellow or yellowish-gray perpendicular to it. Streak uncolored. Trans parent—translucent. Fracture subconchoidal. Double refraction feeble bisectrix negative, normal to *O*.

Comp.—O. ratio for bases and silica 4 : 5 or 1 : 1¼. The state of oxydation of the iron is sti unascertained, and hence there is uncertainty as to the proportion between the protoxyds an sesquioxyds. The ratio usually deduced for $\dot{R}$, $\ddot{R}$, $\ddot{Si}$ is 1 : 3 : 5. The formula 2 $\dot{R}\ddot{Si}+\ddot{R}^3$ S which corresponds to this ratio,=, if $\dot{Mg}$: $\dot{Fe}$=2 : 1, Silica 49·4, alumina 33·9, magnesia 8· protoxyd of iron. 7·9=100.

Analyses: 1–3, Stromeyer (Unters., 329, 431); 4, 5, Schütz (Pogg., liv. 565); 6, Scheere (Pogg., lxviii. 319); 7, Hermann (Kokscb. Min. Russl., iii. 257); 8, Stromeyer (Untersuch., 32 431); 9, Bonsdorff (Schw. J., xxxiv. 369); 10, Schûtz (Pogg., liv. 565); 11, Thomson (Min., 278); 12, C. T. Jackson (This Min., 1844, 406, G. Rep. N. Hamp., 184):

	$\ddot{Si}$	$\bar{Al}$	$\dot{Fe}$	$\dot{Mn}$	$\dot{Mg}$	$\dot{Ca}$	$\dot{H}$
1. Bodenmais	48·35	31·71	8·32	0·33	10·16	—	0·59=99·46 Stromeyer.
2. Greenland	49·17	33·11	4·34	0·04	11·45	—	1·20=99·31 Stromeyer.
3. Fahlun	50·25	32·42	4·01	—	10·85	—	1·66, $\bar{Mn}$ 0·68=99·87 Stromeye
4. Ostgothland	48·6	30·5	10·7	0·1	8·2	—	1·5, undec. 0·2=100·3 Schütz.
5. Südermanland	49·7	32·0	6·0	0·1	9·5	0·6	2·1, undec. 0·6=100·6 Schütz.
6. Krageröe	(?) 50·44	32·95	—	—	12·76	1·12	1·02, $\bar{Fe}$ 1·07=99·36 Scheerer.
7. Mursinka	50·65	30·26	4·10	0·60	11·09	—	2·66, $\dot{Li}$ 0·64=100 Hermann.
8. Finland	48·54	31·73	5·69	$\bar{Mn}$ 0·70	11·80	—	1·69=99·65 Stromeyer.
9. "	49·95	32·88	5·00	0·03	20·45	—	1·75=100·06 Bonsdorff.
10. "	48·9	30·9	6·3	0·3	11·2	—	1·9, undec. 1·6=101·1 Schütz.
11. Haddam, Ct.	49·62	28·72	11·58	1·51	8·64	0·23	—=100·30 Thomson.
12. Unity, Me.	48·11	32·50	7·92	0·28	10·14	—	0·50=99·49 Jackson.

Pyr., etc.—B.B. loses transparency and fuses at 5—5·5. Only partially decomposed by acid Decomposed on fusion with alkaline carbonates.

Obs.—Iolite occurs in granite, gneiss, hornblendic, chlorite and talcose schist, and allied rock with quartz, orthoclase or albite, tourmaline, hornblende, andalusite, and sometimes beryl. Als rarely in volcanic rocks.

At Bodenmais, Bavaria, it is met with in granite, in crystals, along with pyrrhotine, blend chalcopyrite; the variety is the *peliom* of Werner, named from πελιος in allusion to its smoky blu color. It occurs in quartz at Ujordlersoak in Greenland; in granite at Cape de Gata, in Spain at Krageröe in Norway; Orijerfvi, in Finland (*steinheilite*); Tunaberg, in Sweden; Finspaong i Ostgothland; Brunhult in Sudermanland; Fahlun (*hard fahlunite*); Lake Laach, with sanidin at Campiglia Maritima, Tuscany, in a trachytic rock, containing also mica, quartz, and sanidi Ceylon affords a transparent variety, in small rolled masses of an intense blue color, the *sapphi d'eau* of jewellers.

At Haddam, Conn., associated with tourmaline in a granitic vein in gneiss; sparingly at th chrysoberyl locality, in an altered or fahlunite condition; abundant in quartz with garnet an yellowish-green feldspar, near the Norwich and Worcester Railway, between the Shetucket an Quinnebaug, where the gneiss has been quarried for the road. At Brimfield, Mass., on the roa leading to Warren, near Sam Patrick's with adularia, in gneiss; also good at Richmond, N. H in talcose rock, along with anthophyllite.

Iolite is occasionally employed as an ornamental stone, and when cut exhibits different color in different directions.

Named *Iolite* from ἴον, *violet*, and λίθος, *stone*; *Dichroite*, from its dichroism; *Cordierite*, after Cordie the geologist, who first studied the crystal of the species; *Steinheilite* by Gadolin after Mr. Steinhei Lucas and Haüy, who adopt *cordierite*, rejected the earlier names *iolite* and *dichroite* because th former is not always applicable, and the latter is equally applicable to various other stones. *Ep dote*, *pyroxene*, and a multitude of other names, if judged by the same code, would be found to hav no better claim to recognition.

Alt.—The alteration of iolite takes place so readily by ordinary exposure, that the mineral is mo commonly found in an altered state, or enclosed in the altered iolite. This change may be a sin ple hydration (*fahlunite*, etc.); or a removal of part of the protoxyd bases by carbonic acid; the introduction of oxyd of iron; or of alkalies, forming pinite and mica. The first step in th change consists in a division of the prisms of iolite into plates parallel to the base, and a pearl foliation of the surfaces of these plates; with a change of color to grayish-green and greenis gray, and sometimes brownish gray. As the alteration proceeds, the foliation becomes more con plete; afterward it may be lost. The mineral in this altered condition has many names: as *hydrous iolite*, *pinite*, *cataspilite*, *fahlunite*, *bonsdorffite*, *esmarkite*, *chlorophyllite*. *gigantolite*, *praseolite* *aspasiolite*. Pinite, as far as it is altered iolite, includes properly the alkaline kinds. Fahlunite and the following, excepting the last, correspond to iolite + aq. In most cases if the water of the altered iolite be included with the bases, the oxygen ratio between the bases and silica becomes 1 : 1; it seems, therefore, quite probable that the strong tendency of iolite to take up water is owing to the fact that its silica (whose amount of oxygen exceeds that of the bases by one-fourth) is not saturated with bases. Regarding the water of the altered mineral as basic, *esmarkite*, *chlorophyllite*, *gigantolite*, and *praseolite* will have the formula ($\dot{\mathrm{R}}^3$, $\dot{\mathrm{H}}$) $\ddot{\mathrm{Si}}$; and *fahlunite* and *bonsdorffite*, containing twice as much water as the preceding, would have the formula ($\dot{\mathrm{R}}^3$, $\bar{\bar{\mathrm{R}}}$) $\ddot{\mathrm{Si}}+\dot{\mathrm{H}}$. If 1 : 3 : 5 : 0 be the oxygen ratio for $\dot{\mathrm{R}}$, $\bar{\bar{\mathrm{R}}}$, $\ddot{\mathrm{Si}}$, $\dot{\mathrm{H}}$ in iolite, 1 : 3 : 5 : 1 will be the ratio for *esmarkite*, etc., and 1 : 3 : 5 : 2, for *fahlunite*, etc. *Weissite*, *iberite*, *huronite* are names of other minerals supposed to be altered iolite.

For the distinguishing characters and analyses of the different kinds of altered iolite, see PINITE, FAHLUNITE, and CATASPILITE, under HYDROUS SILICATES.

MICA GROUP.

The minerals of the Mica group are alike in having (1) the prismatic angle 120°; (2) eminently perfect basal cleavage, affording readily very thin, tough, laminæ; (3) potash almost invariably among the protoxyd bases and alumina among the sesquioxyd; (4) the crystallization either hexagonal or orthorhombic, and therefore the optic axis, or optic-axial plane, at right angles to the cleavage surface.

Soda is sparingly present in some micas, and is characteristic of the hydrous species paragonite (p. 487). Lithia, rubidia, and cæsia occur in lepidolite. Fluorine is often present, probably replacing oxygen. Titanium is found sparingly in several kinds, and is a prominent ingredient of one species, astrophyllite. It is usually regarded as in the state of titanic acid replacing silica; but, for reasons elsewhere given, it is here made basic.

1. *O. ratio for bases and silica* 1 : 1.

288. **PHLOGOPITE.** (1) Contains magnesia, with little or no iron, and much alumina. (2) O. ratio for $\dot{\mathrm{R}}$, $\bar{\bar{\mathrm{R}}}$ between 2 : 1 and 5 : 3. (3) Optic-axial angle 3°—20°. (4) Folia tough, and, if not altered, elastic.

289 **BIOTITE.** (1) Contains magnesia and iron, with much alumina. (2) O. ratio for $\dot{\mathrm{R}}$, $\bar{\bar{\mathrm{R}}}$ about 1 : 1 (rarely 1 : 1½ or 1 : 2.) (3) Optically uniaxial, but often slightly biaxial through irregularity. (4) Folia tough and elastic.

290. **LEPIDOMELANE.** (1) Contains much iron and little magnesia, with much of the alumina replaced by sesquioxyd of iron. (2) O. ratio for $\dot{\mathrm{R}}$, $\bar{\bar{\mathrm{R}}}$ about 1 : 3. (3) Optically like biotite. (4) Folia brittle, hardly at all elastic.

291. **ANNITE**; lepidomelane having the O. ratio for $\dot{\mathrm{R}}$, $\bar{\bar{\mathrm{R}}}$=1 : 2.

292. **ASTROPHYLLITE.** (1) Contains much titanium, zirconium, etc., with little alumina. (2) O. ratio for $\dot{\mathrm{R}}$, $\bar{\bar{\mathrm{R}}}$ between 2 : 1 and 5 : 3, nearly as in phlogopite. (3) Optic-axial angle *exceeding* 90°. (4) Folia brittle, but slightly elastic.

2 *O. ratio for bases and silica* 1 : 1½ to 1 : 2.

293. **MUSCOVITE.** (1) Contains potash almost alone among protoxyds, with no magnesia, or rarely a little; and alumina as the principal sesquioxyd. (2) O. ratio for $\dot{\mathrm{R}}$, $\bar{\bar{\mathrm{R}}}$ 1 : 6 to 1 : 12, and for $\dot{\mathrm{R}}+\bar{\bar{\mathrm{R}}}$, $\ddot{\mathrm{Si}}$ mostly 1 : 1½. (3) Optic-axial angle 40° —75°. (4) Folia tough, elastic, except in some hydrous or altered kinds.

294. **LEPIDOLITE.** (1) Contains lithia, rubidia, and cæsia, with potash as the principal protoxyd, and with alumina as the principal sesquioxyd. (2) O. ratio for $\dot{\mathrm{R}}+\bar{\bar{\mathrm{R}}}$, $\ddot{\mathrm{Si}}$ mostly 1 : 1½. (3) Optic-axial divergence 70°—78°.

295. **CRYOPHYLLITE.** (1) Same constituents as lepidolite. (2) O. ratio for $\dot{\mathrm{R}}+\bar{\bar{\mathrm{R}}}$, $\ddot{\mathrm{Si}}$=1 : 2. (3) Optic-axial angle 50°—60°. (4) Folia tough, elastic.

The species of the Mica group graduate into the hydrous micas of the Margarodite group (p.); and through these they also approach the foliated species of the Talc and Chlorite groups, especially the latter.

The micas were regarded as of one species until 1792, when lepidolite was made distinct. The earlier synonymy therefore may be conveniently given here.

Pliny probably included the mineral mica with the *Lapis specularis* (xxxvi. 45) or *Selenite*; a the shavings or scales of *Lapis specularis* strown over the "Circus Maximus," to produce agreeable whiteness, were probably those of a soft silvery mica schist. His *Hammochrysos* al (xxxvii. 73, named from ἄμμος, *sand*, χρυσός, *gold*) was probably sand from a yellowish mica schi which abounds by the road-side in many mica-schist regions. Agricola speaks of the decepti character of this silvery and golden dust, as cited below. This silvery and golden mica in scal is the *Cat-silver* and *Cat-gold* of mediæval Europe. The following is the synonymy of the mine since the time of Pliny:

Mica, Ammochrysos, colore argento ita simile sit, ut pueros et rerum metallicarum imperit decipere possit, *Germ.* Glimmer, Katzen-Silber, *Agric.*, Foss., 254, 447, Interpr., 466, 1546. Spec laris lapis adulterinus flexilis sexangulorum *Capeller*, Prodr. Cryst., 26, 1723. Mica [Talc n included], Vitrum Muscoviticum, V. Rutheniticum, Skimmer, VAR. alba (Kattsilver), flava (Ka gull), rubra, viridis [Chlorite fr. Sahlberg], nigra, squamosa, radians, fluctuans, hemispheri *Wall.*, Min., 129, 131, 1747. Mica pt. [rest Talc, Chlorite], Verre de Moscovie, etc., *Fr. Trl.* Wa i. 241, 1753. Mica, Glimmer, Vitrum Muscoviticum (in plates), Mica squamosa (in scales) *Cron* Min., 88, 1758. Isinglass (in large plates), Glimmer or Mica (in small scales) pt. (rest Ta Chlorite) *Hill*, Foss., 10, 13, 1771. Glimmer [Chlorite and Talc excluded] *Wern.*, Bergm. J., 1789.

The word *mica* has been said to come from the Latin *mica*, *a crumb* or grain, as it was forme applied especially to the mineral in scales. It is usually derived, however, from the Latin *mica* signifying (like the German name *Glimmer*) *to shine*.

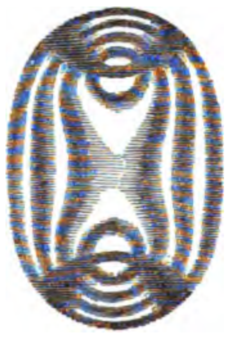
288. PHLOGOPITE. Magnesia-Mica pt. Rhombic Mica. Rhombenglimmer pt. Phlogo (fr. Antwerp, N. Y.) *Breith.*, Handb., 398, 1841.

Orthorhombic. $I \wedge I = 120°$, and habit hexagonal. Prisms usuall oblong six-sided prisms, more less tapering, with irregular side rarely, when small, with polish lateral planes. Cleavage basa highly eminent. Not known i compact massive forms.

H. = 2·5—3. G. = 2·78—2·8 Lustre pearly, often submetallic, c cleavage surface. Color yellowis brown to brownish-red, with ofte something of a copper-like refle tion; also pale brownish-yellov green, white, colorless. Transpa ent to translucent in thin foli Thin laminæ tough and elasti Optical-axial divergence 3°—20 rarely less than 5°; in fig. 28 which represents the optical character of the mica of Natural Bridge, 15°.

281

282



Antwerp.

Comp.—Mostly $(\frac{7}{11}\dot{R}^3+\frac{4}{11}\ddot{\bar{R}})^2\ddot{Si}^3$; the bases include magnesia and little or no iron. Possib for all $(\frac{2}{3}\dot{R}^3+\frac{1}{3}\ddot{\bar{R}})^2\ddot{Si}^3$, as in anal. by Rammelsberg. Phlogopite is a true *Magnesia mica*.

Analyses: 1, Meitzendorff (Pogg., lviii. 157); 2–4, Craw (Am. J. Sci., II. x. 383); 5, Ran melsberg (ZS. G., xiv. 758); 6, Svanberg (Ak. H. Stockh., 1839, 176); 7, Delesse (Bull. G. Fr II. ix. 121); 8, id. (Ann. d. M., V. x. 519); 9, C. Bromeis (Pogg., lv. 112):

	$\ddot{Si}$	$\ddot{\bar{Al}}$	$\ddot{\bar{Fe}}$	$\dot{Mg}$	$\dot{Ca}$	$\dot{Na}$	$\dot{K}$	$\dot{H}$	F	
1. Jefferson Co., N. Y. (§)	41·30	15·35	1·77	28·79	—	0·05[a]	9·70	0·28	3·30	Meitzend.
2. Edwards, N. Y.	40·15	17·36	—	28·10	—	0·63	10·56	—	4·20=101	Craw

[a] With some lithia

	$\ddot{\text{Si}}$	$\ddot{\bar{\text{Al}}}$	$\dot{\text{Fe}}$	$\dot{\text{Mn}}$	$\dot{\text{Mg}}$	$\dot{\text{Ca}}$	$\dot{\text{Na}}$	$\dot{\text{K}}$	$\dot{\text{H}}$	F	
3. Edwards, N. Y.	40·36	16·45	—	—	29·55	—	4·94	7·23	0·95	—	=99·48 Crawe.
4. "	40·36	16·08	—	—	30·25	—	4·39	6·07	—	2·65	=99·80 Crawe.
5. Gouverneur	41·96	13·47	2·12	0·55	27·12	0·34	*tr.*	9·37	0·60	2·93	=98·96 Ramm.
6. Sala	42·46	12·86	7·11	1·06	25·39	—	—	6·03	3·17	0·62	, Mg 0·36, Ca 0·10 =99·16 Svanberg
7. Vosges	37·54	19·80	1·61	0·10	30·32	0·70	1·00	7·17	1·51	0·22	=99·97 Delesse.
8. " *bn., gnh.*	41·20	12·37	9·51[a]	1·50[b]	19·03	1·63	1·28	7·94	2·90	1·06	, $\dot{\text{Li}}$ 0·22=98·64 Delesse
9. Herrchenberg, *br.*	42·89	6·09	$\ddot{\bar{\text{Fe}}}$ 10·59	—	24·33	0·76	0·36	13·15	2·30	—	=100·47 Brom.

[a] Includes 5·08 of Fe^2O^3. [b] Reckoned as 1·67 Mn^2O^3.

The Sala mica of No. 6 has not been examined optically; yet, as it agrees nearly in atomic proportions with phlogopite, it appears to belong here. It was dark green in color, and inelastic, and is called chlorite by Svanberg; the analysis is here cited from the original paper by Svanberg. Crawe's analyses afford the O. ratio 1·77 : 1 : 2·69=7 : 4 : 11, and Meitzendorff's nearly the same. The silico-fluorids in the former are about $\frac{1}{23}$, and in the latter $\frac{1}{30}$. G of No. 5, 2·81, Rammelsberg. Analysis 7, by Delesse, affords the O. ratio 3 : 2 : 5; and 8, about 4⅓ : 3 : 9. The latter mica is a brown or greenish kind from the rock called by Delesse, Minette, occurring at Servance in the Vosges; the ratio may become that of biotite when the state of oxydation of the iron is ascertained; G.=2·842. No. 9 gives the ratio 12¼ : 6 : 22¼; it is from near L. Laach.

Pyr., etc.—In the closed tube gives a little water. Some varieties give the reaction for fluorine in the open tube, while most give little or no reaction for iron with the fluxes. B.B. whitens and fuses on the thin edges. Completely decomposed by sulphuric acid, leaving the silica in thin scales.

Obs.—Phlogopite is especially characteristic of serpentine, and crystalline limestone or dolomite.

Occurs in limestone in the Vosges (anal. 7, 8). Includes probably the mica found in limestone at Alt-Kemnitz, near Hirschberg; that of Baritti, Brazil, of a golden-yellow color, having the optical angle 5° 30′ and parallel to the shorter diagonal (Grailich); and a brown mica from limestone of Upper Hungary, affording Grailich the angle 4°—5°.

Occurs at the following localities in the U. States; specimens from which afforded the optical angles annexed, all measured by B. Silliman, Jr. (Am. J. Sci., II. x. 372), excepting one by Blake (ib., xii. 6):

1. Pope's Mills, St. Lawrence Co., N. Y., glassy transparent	7°—7° 30′	B. S.
2. Edwards, N. Y., rich reddish brown	10?	"
3. St. Lawrence Co.,? N. Y., yellowish	10?	"
4. Vrooman's Lake, N. Y., in long crystals of a yellow color	10 30—10 50	"
5. Edwards, N. Y., rich yellowish-brown color	11	"
6. Warwick, Orange Co., N. Y., in limestone, yellowish	11?	"
7. Falls of the Grand Calumet, Canada, yellowish-green crystals many inches long	13—13 12	"
8. Pope's Mills, St. Lawrence Co., N. Y., large crystals, fine yellowish-brown	13 30	"
9. Edwards, N. Y.; 2d specimen, yellowish-brown	13 30	"
10. Church's Mills, Rossie, N. Y., resembles the Pope's Mills	13 30—14	"
11. Near Skinner's Bridge, Rossie, N. Y., silvery-yellow mica	14	"
12. Carlisle, Mass., rich yellowish-brown	14	"
13. Rossie, N. Y., near Mrs. Story's, light yellowish	15	"
14. Pope's Mills, St. Lawrence Co., brownish-yellow hexagonal crystal	15	"
15. Natural Bridge, Jefferson Co., N. Y., rich yellow; associated with serpentine; same as analyzed by Meitzendorff	15	"
15. bis., ib., ib., another specimen	16	"
16. Edwards, N. Y., white silvery, curved crystals	15 30—16 30	"
17. Vicinity of Rossie, N. Y., rich yellow-brown; probably the same as Gouverneur	16 7—16 15	"
18. Essex, N. Y., in limestone, deep rich brown color	16 30	"
19. Upper Ottawa, Canada, reddish-yellow, transparent	17 30—18	"
20. Moriah, Essex Co., N. Y., very dark smoky red	Est'd 16—17	"
21. Somerville, N. Y., faint brownish	5—7	"
22. Burgess, Canada West, bronzy, almost metallic, semi-transparent if thin; opaque in plates a line thick; slightly elastic only; found with apatite in sandstone	Angle very small	"

23. Franklin, N. J., bronzy-yellow	About 14°	B.
24. Burgess, Canada West, whitish-yellow	About 10	"
25. Fine, St. Lawrence Co., N. Y., very dark olive-brown	Est'd 10—12	"
26. Amity, N. Y., opaque silvery white	10—12	"
27. Warwick, Pa., brownish olive-green	About 10	Blak

Phlogopite occurs also at Gouverneur, N. Y., of a brownish copper-red; at Sterling Mine, M ris Co., N. J., rich yellowish-brown, inclining to red, in limestone; at Suckasunny mine, N. deep olive-brown, inclining to yellow, in limestone; Newton, N. J., yellow, in limestone; Loc wood, Sussex Co., N. J., deep olive-brown, like the mica of Fine, N. Y., in limestone; at St. rome, Canada, reddish-coppery. The crystals at Clarke's Hill, St. Lawrence Co., are very lar sometimes nearly two feet long; fig. 281 represents one in the cabinet of W. W. Jefferis, whi is 20 in. long, 4 in. thick at top, and 8½ in. at centre, and weighs 57½ pounds. Senarmont fou one deep bottle-green mica of unknown locality having the angle 15°.

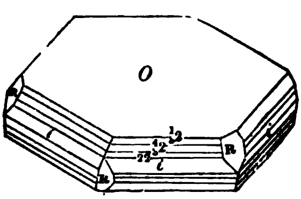
Named from φλογωπις, *fire-like*, in allusion to the color.

Alt.—The phlogopites are quite liable to change, losing their elasticity, becoming pearly lustre, with often brownish spots, as if from the hydration of the oxyd of iron. In some cas an alteration to steatite and serpentine has been observed. A serpentine pseudomorph after phlo opite from Somerville, St. Lawrence Co., N. Y., afforded Lewinstein (ZS. Ch. Pharm., 1860, $\ddot{S}i$ 47·24, $\ddot{\bar{A}}l$ 2·32, $\dot{M}g$ 38·23, $\dot{F}e$ 1·10, $\dot{N}a$ 0·67, $\dot{K}$ 0·57, $\dot{H}$ 14·87=100.

289. BIOTITE. Magnesia-Mica pt., Hexagonal Mica, Uniaxial Mica. Astrites meroxen (fr. Vesuv.) *Breith.*, Handb., 382, 1841. Rubellan=Astrites trappicus, *Breith.*, ib. 379. Bio *Hausm.*, Handb., 671, 1847. Rhombenglimmer (fr. Greenwood Furnace) *Kenngott*, Pogg., lxx 661.

Hexagonal. $R \wedge R = 62° \; 57'$, crystals fr. Vesuvius, Hessenberg; a: 4·911126. Habit often monoclinic. Observed planes: O; rhombohedron R, $\frac{2}{5}$, $-\frac{1}{2}$; prism, i-2; pyramids, $\frac{1}{3}$-2, $\frac{4}{9}$-2, $\frac{2}{3}$-2, 1-2, $\frac{4}{3}$-2, 2-2, $\frac{5}{3}$-2, $\frac{8}{3}$-2, 4-2 $\frac{2}{5}$-R the form fr. Greenwood Furnace, the rest fr. Vesuvian crystals.

283



$O \wedge R = 100°$
$O \wedge \frac{1}{3}\text{-}2 = 121 \; 25'$
$O \wedge \frac{2}{3}\text{-}2 = 106 \; 59$
$O \wedge 1\text{-}2 = 101 \; 30\frac{1}{2}$
$O \wedge \frac{4}{3}\text{-}2 = 98° \; 41'$
$O \wedge 2\text{-}2 = 95 \; 49$
$O \wedge 4\text{-}2 = 92 \; 55$
$O \wedge \frac{2}{5} = 113 \; 47$

Prisms commonly tabular. Cleavage: bas highly eminent. Often in disseminated scale sometimes in massive aggregations of cleavab scales.

H.=2·5—3. G.=2·7—3·1. Lustre splendent, and more or less pear on a cleavage surface, and sometimes submetallic when black; lateral su faces vitreous when smooth and shining. Colors usually green to blac often deep black in thick crystals, and sometimes even in thin laminæ, u less the laminæ are very thin; such thin laminæ green, blood-red, or brow by transmitted light; rarely white. Streak uncolored. Transparent opaque. Optically uniaxial. Sometimes biaxial with slight axial dive gence, from exceptional irregularities, but the angle not exceeding 5° an seldom 1°.

Comp., Var.—Biotite is a magnesia-iron mica, part of the alumina being replaced by sesq oxyd of iron, and protoxyd of iron and magnesia existing among the protoxyd bases. Black is t prevailing color, but brown to white also occur. The results of analyses vary much, and for t reason already stated—the non-determination, in most cases, of the degree of oxydation of t iron; and the exact atomic ratio for the species and its limits of variation are therefore not pr cisely understood. The O. ratio, which appears to be dominant, is 1 : 1 : 2, giving the formu $(\frac{1}{2}\dot{R}^3+\frac{1}{2}\ddot{\bar{R}})^2\ddot{S}i^3$, which is the formula of garnet. In some cases the ratio is apparently ne

1 : 1½ : 2½ and 1 : 2 : 3; and through species containing much iron it passes to micas of the species annite and lepidomelane.

The analyses below are arranged in two divisions; (A) having the O. ratio approximately 1 : 1 : 2; (B) having other various ratios.

Analyses: A. 1, v. Kobell (Kastn. Arch. Nat., xii. 29); 2, 3, Smith & Brush (Am. J. Sci., II. xvi. 45); 4, v. Hauer (Ber. Ak. Wien, xii. 485); 5, Smith & Brush (l. c.); 6, J. L. Smith (Am. J. Sci., II. xlii. 91); 7, v. Kobell (l. c.); 8, v. Kobell (J. pr. Ch., xxxvi. 309); 9, Bromeis (Pogg., lv. 112); 10, Chodnef (Pogg., lxi. 381); 11, Chodnef, with oxyd of iron by Mitscherlich (J. pr. Ch., lxxxvi. 1); 12, Kjerulf (J. pr. Ch., lxv. 187); 13, H. Rose (Gilb. Ann., lxxi. 13); 14, C. Bromeis (Bischof's Lehrb. Geol., ii. 1418); 15, Bukeisen (Kenng. Ueb., 1856-57, 86); 16, Scheerer (ZS. G., xiv. 60); 17, Kiebel (ib.); 18, A. Streng (B. H. Ztg., xxiii. 54); 19, Klaproth (Beitr., v. 78); 20, H. Rose (Pogg., i. 75); 21, v. Kobell (Kastn. Arch. Nat., xii. 29).

B. 22, 23, Scheerer and Rube (ZS. G., xiv. 56); 24, Varrentrapp (Pogg., lxi. 381); 25, Delesse (Ann. Ch. Phys., III. xxv. 14); 26, Svanberg (Ak. H. Stockholm, 1839, 172); 27, Kjerulf (l. c.); 28, Svanberg (l. c., 177); 29, Haughton (Q. J. G. Soc., xviii. 418); 30, H. Rose (No. 20 above), 31, v. Kobell (No. 21 above), with Mitscherlich's determination of the iron.

A. *O. ratio approximately* 1 : 1 : 2.

		S̈i	A̶⃛l	F̶⃛e	Ḟe	Ṁn	Ṁg	Ċa	Ṅa	K̇	Ḣ	F
1.	Monroe	40·00	16·16	7·50	——	——	21·54	——	——	10·83	3·00	0·50, T̈i 0·2= 99·76 K.
2.	"	39·88	14·99	7·68	——	——	23·69	——	1·12	9·11	1·30	0·95, Cl 0·44= 99·16 S. & B.
3.	"	39·51	15·11	7·99	——	——	23·40	——	10·20		1·35	0·95 Cl 0·44= 98·95 S. & B.
4.	"	40·21	19·99	7·96	——	——	21·15	1·55	0·90	5·22	2·89	——=98·97 H.
5.	Putnam Co.	39·62	17·35	5·40	——	——	23·85	——	1·01	8·95	1·41	1·20, Cl 0·27= 99·06 S. & B.
6.	Chester, Ms.	39·08	15·38	7·12	——	0·31	23·58	——	2·63	7·50	2·24	0·76=98·60. S.
7.	Greenland	41·00	16·88	4·50	5·05	——	18·86	——	——	8·76	4·30	*tr.*=99·35 K.
8.	Bodenmais	40·86	15·13	13·00	——	——	22·00	——	——	8·83	0·44	——=100·26 K.
9.	Vesuvius	39·75	15·99	8·29	——	——	24·49	0·87	——	8·78	0·75	——gangue 0·1 =98·62 B.
10.	" (½)	40·91	17·79	11·02	——	——	19·04	0·30	——	9·96	——	——=99·02 C.
11.	"	40·91	17·79	8·00	7·03	——	19·04	0·30	——	9·96	——	——=98·03 C.
12.	"	44·63	19·04	4·92	——	——	20·89	——	2·05	6·97	0·17	——=98·97 K.
13.	L. Baikal	42·01	16·05	4·93	——	——	25·97	——	——	7·55	——	0·65=97·16 R.
14.	L. Laach	43·02	16·85	11·63	——	——	18·40	0·71	1·15	8·60	——	——=100·36[a] B
15.	Tyrol	38·43	15·71	14·49[c]	——	*tr.*	17·28	*tr.*	——	11·42	2·76	——=100·09 B.
16.	Brand	37·18	17·53	6·20	15·35	M̶n 0·31	9·05	0·79	2·93	5·14	3·62	——T̈i 2·47= 100·57 S.
17.	"	37·06	16·78	6·07	15·37	*tr.*	9·02	0·57	2·86	5·96	3·77	——T̈i 3·64[b]= 101·10 K.
18.	Harzburg	36·17	18·09	8·70	13·72	——	11·16	0·52	*tr.*	7·59	2·28	0·36=98·59 S.
19.	Siberia	42·50	11·50	22·00	——	2·0	9·00	——	——	10·00	1·00	——=98, K.
20.	Miask	40·00	12·67	19·03	——	0·63	15·70	——	——	5·61	——	2·00 T̈i, F̶⃛e 1·63. =97·27 R.
21.	"	42·12	12·83	20·78	——	——	16·15	——	——	8·58	1·07	——=101·53 K.

B. *O. ratio approximately* 1 : 2 : 3, 1 : 1½ : 2½, *etc.*

		S̈i	A̶⃛l	F̶⃛e	Ḟe	Ṁn	Ṁg	Ċa	Ṅa	K̇	Ḣ	F
22.	Freiberg	37·50	17·87	12·93	9·95	0·20	10·15	0·45	3·00	0·83.	3·48	——T̈i 3·06= 99·42 S.
23.	"	36·89	15·00	16·29	6·95	——	9·65	1·75	——	6·06	4·40	——T̈i 3·16= 100·15 R.
24.	Zillerthal	39·85	16·07	13·21	——	——	15·60	0·42	[13·68, loss incl.],			Varr.
25.	Alpe, *dk.gn.*	41·22	13·92	26·90	——	1·09	4·70	2·58	1·40	6·05	0·90	1·58=100·34 D

[a] Much ammoniacal water given off on ignition, and anal. made on the mineral after thus drying.

[b] Containing F̶⃛e and A̶⃛l.

[c] As published, protoxyd.

	$\ddot{\mathrm{Si}}$	$\dddot{\bar{\mathrm{Al}}}$	$\dddot{\bar{\mathrm{Fe}}}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Mn}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Na}}$	$\dot{\mathrm{K}}$	$\dot{\mathrm{H}}$	F
26. Pargas	42·58	21·68	10·39	——	0·75	10·27	1·04	——	8·45	3·35	0·51=99·02
27. Eifel, *br.-bn.*	43·10	15·05	25·89	——	——	10·82	0·81	0·82	4·62	1·50	——$\ddot{\mathrm{Ti}}$ 1·03= 103·59
28. Rosendahl	44·41	16·86	——	20·71	0·45	11·26	1·50	——	4·05	1·13	0·41=101·6
29. Gar. Wood	44·40	21·52	10·72	3·96	1·28	6·14	2·70	0·74	6·18	1·20	——=98·84
30. Miask	40·00	12·67	1·97	15·39	0·63	15·70	*tr.*	——	5·61	——	2·10 $\ddot{\mathrm{Ti}}$ 1·63 95·7
31. "	42·12	12·83	2·53	15·32	——	16·15	——	——	8·58	1·07	——=98·60

In anal. 5, G.=2·80, the mica talc-like, pale ywh.-gn. by transmitted light, inelastic, wa probably somewhat altered; 6, chlorite-like, with emery, etc.; 8, G.=2·7; 16, 17, from the gebirge; 18, from gabbro, opt. char. not given; 22, 23, bronze-brown to black, in gneiss; 25, of protogine of Alps; 29, from granite, Ireland.

In the Vesuvian biotite, anal. 12, O. ratio for $\dot{\mathrm{R}}$, $\dddot{\bar{\mathrm{R}}}$, $\ddot{\mathrm{Si}}$=10·05 : 10·36 : 23·17; anal 10, 9 12·33 : 21·24=1 : 1⅓ : 2⅓; anal. 11 (10 as modified by Mitscherlich), 9·25 : 9·93 : 21·24. Anal. as it stands, gives the ratio 1 : 1¼ : 2¼; 18, 1 : 1 : 1¾; 22 to 29, nearly 1 : 2 : 3, but some d ciency of protoxyds in 27. 28, making the ratio nearer 1 : 2¾ : 4. The last two, 30, 31, are analyses by Rose and v. Kobell, Nos. 20, 21, with the $\dot{\mathrm{Fe}}$ and $\dddot{\bar{\mathrm{Fe}}}$ as recently determined by Mitscherlich. Mitscherlich's results change the ratio from 1 : 1 : 2 to nearly 5 : 3 : 10, or the ra approximately of phlogopite; and if his determination should be sustained, the Siberian m analyzed would appear to be phlogopite.

A *chrome magnesia mica* (*Chromglimmer*) of a green color, from Schwarzenstein, in Zillerthal, forded Schafhäutl (Ann. Ch. Pharm., xlvi. 325) over 5 p. c. of oxyd of chromium, and the O. ra for the whole 6·4 : 9·6 : 24·75=2 : 3 : 8. He obtained $\ddot{\mathrm{Si}}$ 47·68, $\dddot{\bar{\mathrm{Al}}}$ 15·15, $\dddot{\bar{\mathrm{Cr}}}$ 5·90, $\dddot{\bar{\mathrm{Fe}}}$ 5·72, 1·05, $\dot{\mathrm{Mg}}$ 11·58, $\dot{\mathrm{Na}}$ 1·17, $\dot{\mathrm{K}}$ 7·27, $\dot{\mathrm{H}}$ 2·86=98·38.

Pyr., etc.—Same as phlogopite, except that with the fluxes it gives strong reactions for iro

Obs.—Biotite was first shown to be optically *uniaxial* by Biot, after whom it is named; a later, to be hexagonal in crystallization by Marignac (Bibl. Univ., 1847, Suppl. vi. 300); Broo and Miller (Min., 387); Kokscharof (Min. Russl., ii. 291); and quite recently, and after care measurements, by Hessenberg (Min. Not., No. vii. 15, 1866). But still the crystals are oft slightly biaxial, as first remarked by Silliman (Am. J. Sci., II. x. 372, 1850), and W. P. Bla (ib., xii. 6, 1851); and later by Dove (Ber. Ak. Berlin, 1853), Senarmont (Ann. Ch. Phys., I xxxiii. 391, xxxiv. 171), Grailich (Lehrb. d. Kryst., 1856), and others. On the ground of t biaxial character observed, Descloizeaux, in his Min., i. 88, 1862, made the species orthorhomb Blake examined specimens from Greenwood Furnace; a silvery-white var. fr. Easton, Pa.; crimson from Topsham, Me.; a fiery-red, by transmitted light, from Moriah, Essex Co., N. Y.; dark bottle-green from Moor's Slide, Ottawa, Canada; and seven different varieties from Vesuvi But the divergence, which was in all very small, was not measured. One of the uniaxial mic examined by Biot is stated by him to have come from Topsham, Me. Kokscharof found so crystals from Vesuvius true uniaxial.

The following are the results of measurements by Senarmont and Grailich (two or three of t micas perhaps phlogopites):

1. *Axial plane parallel to the longer diagonal.*

1. Greenwood Furnace	0°—1°	Grailich.
2. Pellegrino, Tyrol; hexagonal; in limestone	0 —1	"
3. Karosulik, Greenland; sea-green	1 —2	Grailich.
4. Lake Baikal; dark brown	1 —2	"
5. Adun-Tschilon, Siberia; reddish-brown, in dolomite (phlogopite?)	1 —2	"
6. Ceylon; clear green, transparent	1 —2	Senarmont.
7. Philadelphia; clear olive-green (phlogopite?)	3 —4	"

2. *Axial plane parallel to the shorter diagonal.*

1. Vesuvius; so-called meroxene	0°—1°	Grailich.
2. Vesuvius; dull green to colorless	1	"
3. Vesuvius; brownish-green	2	"
4. Vesuvius; bluish	3	"
5. Vesuvius; greenish-black in pumice	4	"
6. L. Baikal; deep brown, transparent, hexagonal	1	Senarmont.

7. **Easton, Pa.**; silvery white	1°—2°	Grailich.
8. **Fassa, Tyrol**; resembling meroxene	1 —3	"
9. **Easton, Pa.**; green	3 —4	"

Grailich found the angle 0°, or zero, in mica from Zillerthal; Norway, dark green; Kariat, dark olive-green; Retzbanya, greenish to colorless; Goshen, pistachio-green; Leonfelden, black; Magura, dark red; Altenberg, dark bluish; Horn, black; Besztercze, dark; Anaksirksarklich, liver-brown.

The Vesuvian biotite found on Mt. Somma (Meroxene of Breith.) occurs in brilliant crystals with numerous polished facets. Other foreign localities are named in connection with the analyses. The mica from Greenwood Furnace, Monroe, N. Y., analyzed by von Kobell (anal. 1), occurs in large and very regular rhombic prisms (sometimes 5 or 6 in. across) oblique from an *acute* edge; and also in tetrahedral pyramids; the faces of the pyramids incline to the cleavage plane at 113° to 114°; v. Kobell gives for the angle $R \wedge R$ (faces of the pyramid) 71° to 72°. This is the same mica with that analyzed by Smith and Brush (anal. 2, 3), as Prof. Brush has assured himself by an examination of von Kobell's specimens at Munich.

Alt.—***Rubellan*** is considered an altered biotite; it occurs in small hexagonal forms, of a red color, in a kind of wacke. Steatite is also a result of the alteration of this species, as in granite at Brünn and Thierscheim. Among the above analyses, several indicate incipient change by the water and chlorine present. Mica, altered to magnetite, has been observed in the Tyrol.

The ***Eukamptite*** of Kenngott (Ueb., 1853, 58, 1855, and described under the name *Chlorit ähnliches Mineral* in Ber. Ak. Wien, xi 609, 1853) is a hydrous biotite, probably a result of alteration, from Presburg, Hungary. It is between mica and chlorite in its characters. Color nearly black, but in very thin folia brown to hyacinth-red or reddish-yellow; H.=2—2·5; G.=2·73 Composition, according to an analysis by v. Hauer (l. c.). $\ddot{\text{Si}}$ 38·13, $\dddot{\overline{\text{Al}}}$ 21·60, $\dot{\text{Fe}}$ 19·92, $\dot{\text{Mn}}$ 2·61, $\dot{\text{Mg}}$, by loss, 13·76, $\dot{\text{H}}$ 3·98=100, giving the oxygen ratio for $\dot{\text{R}}$, $\dddot{\overline{\text{R}}}$, $\ddot{\text{Si}}$, $\dot{\text{H}}$=1 : 1 : 2 : ½. The *Voigtite* of Schmid may also be a hydrated biotite. See under HYDROUS SILICATES, p. 393.

290. LEPIDOMELANE. *Hausmann*, Gel. Anz. Gött., 945, 1840.

Hexagonal? In small six-sided tables, or an aggregate of minute scales. Cleavage basal, eminent, as in other micas.

H.=3. G.=3·0. Lustre adamantine, inclining to vitreous, pearly. Color black, with occasionally a leek-green reflection. Streak grayish-green. Opaque, or translucent in very thin laminæ. Somewhat brittle, or but little elastic. Optically unaxial; or biaxial with a very small axial angle.

Comp.—An iron-potash mica. O. ratio for bases and silica 1 : 1; for $\dot{\text{R}}$, $\dddot{\overline{\text{R}}}$, mostly 1 : 3, but varying to 1 to more than 3; of doubtful limits, on account of the doubts as to the state of the iron in most of the analyses. 1 : 3 for the ratio of $\dot{\text{R}}$, $\dddot{\overline{\text{R}}}$ gives $(\frac{1}{4}\dot{\text{R}}^3+\frac{3}{4}\dddot{\overline{\text{R}}})^2\ddot{\text{Si}}^3$. Differs from biotite in the smaller proportion of protoxyds and little alumina and magnesia, but appears to agree with it in optical characters.

Analyses: 1, Soltmann (Pogg., l. 664); 2, Svanberg (Ak. H. Stockh., 178, 1839); 3–7, Haughton (J. G. Soc., xv. 129, xviii. 413, Phil. Mag., IV. xviii. 259); 8, Illing (Gieb. u. Heintz, ZS. Nat., 1854, 339):

	$\ddot{\text{Si}}$	$\dddot{\overline{\text{Al}}}$	$\dddot{\overline{\text{Fe}}}$	$\dot{\text{Fe}}$	$\dot{\text{Mn}}$	$\dot{\text{Mg}}$	$\dot{\text{Ca}}$	$\dot{\text{Na}}$	$\dot{\text{K}}$	$\dot{\text{H}}$	
1. Wermland	37·40	11·60	27·66	12·43	——	0·26		——	9·20	0·60=99·49	Soltm.
2. Abborforss	39·45	9·27	35·78	1·45	2·54	3·29	0·31	——	5·06	1·83, Ca 0·32, F 0·29=99·58	Svanb.
3. Jonesed, Sw.	39·70	12·25	23·55	0·96	1·00	7·25	4·48	0·47	7·30	1·00=99·76	Haughton.
4. Carlow Co.	35·55	17·08	28·70	3·55	1·95	3·07	0·61	0·35	9·45	4·30=99·61	Haughton.
5. Ballygihen	36·20	15·95	27·19	0·64	1·50	5·00	0·50	0·16	8·65	3·90=99 69	Haughton.
6. Glenveagh	36·16	19·40	26·31	0·62	0·40	4·29	0·58	0·48	9·00	2·40=99·64	Haughton.
7. Canton	35·50	20·80	19·70	7·74	1·70	4·48	0·56	0·10	9·00	0·25=99·81	Haughton.
8. Haindorf, Silesia	36·98	20·25	23·14	——	——	6·16	2·96	5·44	8 52	——=103·45	Illing.

The original lepidomelane, anal. 1, affords the O. ratio 1 : 3 : 4. The Irish variety (anal. 4, 5, 6, 7) affords as a mean result, 1 : 3·3 : 4·1; No. 4 is from Ballyellin, and 5, 6, from Donegal Co. The Abborforss mica affords 1 : 4·6 : 6·2; but if the water be made basic, 1 : 3·1 : 4·3; and anal. 8 corresponds to 1 : 3·2 : 3·8; both near 1 : 3 : 4. The mineral of the last has G.=3·96, and is very fusible.

Pyr., etc.—B.B. at a red heat becomes brown and fuses to a black magnetic globule. Easily decomposed by muriatic acid, depositing silica in scales.

Obs.—A scaly-massive mineral at Persberg in Wermland, Sweden, containing imbedded pris of hornblende, the scales half a line or so across; mica-like at Abborforss in Finland; in gran in Ireland, at Ballyellin in Carlow Co., Leinster, at Ballygihen in Donegal Co., and at Cant mostly in largish crystals or plates (¼ inch across and larger). The Donegal and Leinster Co. m is optically uniaxial, according to Haughton. The granite contains also a white muscovite (anal. 8–11, under MUSCOVITE); and in some cases the black and white form parts of the sa crystal; and, where so, the optic-axial divergence of the muscovite was diminished, accordi to some trials, 20°. Named from λεπίς, *scale*, and μέλας, *black*.

Alt.—Haughton gives the following as the composition of an altered form of the black m of Donegal Co., Ireland (Nos. 5, 6, above); it was from Castlecaldwell: S̈i 31·60, Äl 19·68, 23·35, Ḟe 4·04, Ṁn 1·20, Ṁg 7·03, Ċa 0·45, Ṅa 0·74, K̇ 3·90, Ḣ 8·68=100·67. It approaches chlorite.

PTEROLITE of Breithaupt (B. H. Ztg., xxiv. 336) appears to be an altered lepidomelane, o pearly lustre, and a color between olive-green and liver-brown; scaly massive in texture. In analysis by R. Müller he found part of the mineral soluble in heated muriatic acid and part n and in analyses of the whole and the parts separately, the following results:

	S̈i	Äl	F̶e	Ḟe	Ṁg	Ċa	Ṅa	K̇	
1. The whole	39·38	6·65	19·89	16·43	0·56	5·47	2·81	7·86	1
2. Sol. part	36·08	4·99	25·98	14·28	——	5·43	3·68	7·96	1
3. Insol. part	50·14	12·03	——	23·43	——	6·88	——	7·52	–

The O. ratio for the soluble part is 2 : 3 : 5; for the insoluble, 3 : 2 : 10. It occurs at Brev Norway, with astrophyllite, wöhlerite, ægirite, etc.

A Brevig mica afforded A. Dufrance (ZS. G., xiv. 100) S̈i 35·93, Äl 10 98, F̶e 9·82, Ḟe 26· Ṁn 0·72, Ṁg 5·13, Ċa 1·04, Ṅa 5·18, K̇ 0·24, Ḣ 4·30, T̈i 0·99=101·26. It is probably an alter mica, as shown by the amount of soda present.

BASTONITE is a mica in large plicated plates, of a greenish-brown color, greasy lustre, ve small optical angle, easily fusible into a black enamel, discovered by Dumont in a quartzite fr Bastoigne, Duchy of Luxembourg (Descl. Min., 498, 1862).

A brownish-black mica from Renchthal, in the Schwarzwald, with slight optic-axial angle a pearly metalloidal lustre, afforded Nessler (Jahresb., 1863, 820) S̈i 38·34, Äl 33·80, F̶e 13·73, 7·40, Ṁg 0·36, Ṅa 0·56, K̇ 4·22, Ḣ 1·36, F *tr.*, T̈i 0·60=100·37.

291. ANNITE *Dana*. The lepidomelane of Cape Ann, described and analyzed by J. P. Coo (Am. J. Sci., II. xliii. 222), differs, according to the analyses, in having the O. ratio 1 : 2 : 3, inste of 1 : 3 : 4. In optical and other physical characters it is like lepidomelane. It occurs in plat and disseminated scales; H.=3; G.=3·169; color black; streak dark green; opaque, except very thin folia. Cooke obtained:

	S̈i	Äl	F̶e	M̶n	Ḟe	Ṁg	L̇i	K̇	Ṅa, Ṙb	Ḣ	SiF^3	
A. (⅔)	39·55	16·73	12·07	0·60	17·48	0·62	0·59	10·66	*tr.*	1·50	0·62	=100·42.
B.	37·39	16·66	13·74	0·64	19·03	0·59	——	10·20	——	1·75	——	=100.

Anal. B is deduced from A on the supposition that the mineral was mixed intimately (as result of contemporaneous crystallization) with cryophyllite, an associated species at the localit and that the amount of lithia indicated the proportion of cryophyllite. O. ratio deduced for t latter for Ṙ, R̶, S̈i, Ḣ=6·2 : 12·1 : 19·9 : 1·6. It may be found that the biotites having the O. rat for Ṙ, R̶=1 : 2 should be here placed.

Occurs in the Cape Ann granite, with cryophyllite, orthoclase, albite, and zircon (cyrtolite).

292. ASTROPHYLLITE. Astrophyllit *Scheerer*, B. H. Ztg., xiii. 240, 1854.

Orthorhombic; habit monoclinic. *I* ∧ *I*=120°. Usually in tabula prisms; often lengthened into strips with parallel sides in the direction o the shorter diagonal. Observed form a narrow tabular crystal, terminatin in front in two planes of an octahedron, and below these one of a macr dome; the front angle of the former 160°, and the edge between the plane inclined to *O* 125°; *O* on the macrodome 130°. Cleavage: basal eminent Sometimes in stellate groups.

H.=3. G.=3·324, Pisani. Lustre submetallic, pearly. Color bronze yellow to gold-yellow. Powder resembling that of mosaic gold. Translu cent in thin leaves. Laminæ only slightly elastic. Optic-axial divergence 118°—124°; bisectrix normal to the cleavage-surface; Descl.

Comp.—Perhaps $(\dot{R}^3,\overset{\cdots}{R})^2\,\ddot{S}i^3$, the titanium oxyd being included with the bases. The protoxyds include prot. of iron and manganese, with potash, soda, etc.; the sesquioxyds those of iron and aluminum; the deutoxyds that of titanium, and perhaps that of zirconium. Analyses: 1, Pisani (C. R., lvi. 846); 2, 3, 4, Scheerer, Meinecke, and Sieveking (Pogg., cxxii. 113):

	$\ddot{S}i$	$\ddot{T}i$	$\ddot{Z}r$	$\overset{\cdots}{A}l$	$\overset{\cdots}{F}e$	$\dot{F}e$	$\dot{M}n$	$\dot{M}g$	$\dot{C}a$	$\dot{L}i$	$\dot{N}a$	$\dot{K}$	ign.	
1.	33·23	7·09	4·97	4·00	3·75	28·58	9·90	1·27	1·13	*tr.*	2·51	5·82	1·86=99·11	P.
2.	32·21	8·24	——	3·02	7·97	21·40	12·63	1·64	2·11	——	2·24	3·18	4·41=99·05	S.
3.	32·35	8·84	——	3·46	8·05	18·06	12·68	2·72	1·86	——	4·02	2·94	4·53=99·51	M.
4.	33·71	8·76	——	3·47	8·51	25·21	10·59	0·05	0·95	——	3·69	0·65	4·85=100·44	S.

Pisani's analysis gives for the O. ratio of $\dot{R}$, $\ddot{R}$, $\overset{\cdots}{R}$, $\ddot{S}i$, $\dot{H}$, 9·78 : 4·07 : 2·99 : 17·72 : 1·65=approximately (water excluded) 10 : 4 : 3 : 17; or for bases and silica 1 : 1; and Sieveking's analysis affords 9·28 : 4·17 : 3·42 : 17·97 : 4·31=(water excluded) 1 : 1 for bases and silica.

Pyr., etc.—B.B. swells up and fuses easily to a black magnetic enamel. With soda or borax, a strong manganese reaction. Decomposed by muriatic acid with a separation of silica in scales.

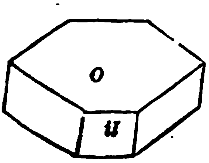
Obs.—Occurs at Brevig, Norway, in zircon-syenite, imbedded in lamellar feldspar, and associated with catapleiite, and large prisms of black mica.

293. MUSCOVITE. Common Mica; Potash Mica; Biaxial Mica; Oblique Mica. Glimmer, Zweiaxiger Glimmer, *Germ.* Muscovite *Dana*, Min., 356, 1850. Phengit *v. Kob.*, Taf., 62, 1853. Nacrite (fr. Maine) *Thom.*, Rec. Gen. Sci., 332, 1836. Fuchsite, Chromglimmer pt., *Schafhäutl*, Ann. Ch. Pharm., xliv. 40, 1842. Talcite (fr. Wicklow) *Thomson*, Rec. Gen. Sci., iii. 332, 1836 [not Talcite *Kirwan*=massive scaly talc]. Adamsite *Shep.*, Hitchcock's Rep. G. Vt., i. 484, 1857.

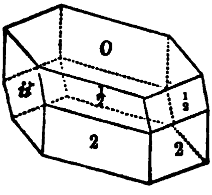
Orthorhombic. $I \wedge I$=120° Habit monoclinic. Observed planes: O; vertical, I, i-$\breve{i}$, i-$\bar{i}$, i-$\breve{3}$; domes, 6-$\breve{i}$, 4-$\breve{i}$, 2-$\breve{i}$, $\frac{12}{7}$-$\breve{i}$, 1-$\bar{i}$, $\frac{2}{3}$-$\bar{i}$; octahedral (or hemi-octahedral) 4, 3, $\frac{5}{2}$, 2, $\frac{4}{3}$, $\frac{3}{2}$, 1, $\frac{12}{7}$, $\frac{1}{2}$, $\frac{1}{3}$, $\frac{2}{7}$; 6-$\breve{3}$, $\frac{3}{2}$-$\breve{3}$, $\frac{3}{4}$-$\breve{3}$.

$O \wedge 4$=94° 20′	$O \wedge \frac{1}{2}$=121° 16′	$O \wedge 1$-i=106° 53′
$O \wedge 2$=98 38	$O \wedge 1$-$\bar{i}$=125 2	$O \wedge 2$-$\breve{i}$=98 38
$O \wedge \frac{4}{3}$=102 50	$O \wedge \frac{2}{3}$-$\breve{i}$=114 29	$O \wedge 4$-$\breve{i}$=94 20
$O \wedge 1$=106 53½	$O \wedge 6$-$\breve{i}$=92 54	$O \wedge 6$-$\breve{3}$=92 31

284

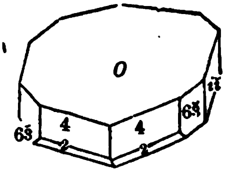


285



Miask, Ural.

286



Binnen Valley.

Cleavage: basal eminent; occasionally also separating in fibres parallel to a diagonal. Twins: often observable by internal markings, or by polarized light; composition parallel to I consisting of six individuals thus united; sometimes a union of I to i-$\bar{i}$. Folia often aggregated in stellate, plumose, or globular forms; or in scales, and scaly massive.

H.=2—2·5. G.=2·75—3·1. Lustre more or less pearly. Color white, gray, brown, hair-brown, pale-green, and violet, yellow, dark olive-green rarely rose-red; often different for transmitted and reflected light, and d ferent also in vertical and transverse directions. Streak uncolored. Tran parent to translucent. Thin laminæ flexible and elastic, very toug Double refraction strong; optic-axial angle 44°—78°.

Comp.—O. ratio for $\dot{R}+\bar{R}$, $\ddot{Si}$ 1 : 1¼; rarely 1 : 1½, and for $\dot{R}$, $\bar{R}$ either, approximately. 1 : 1 : 9, or 1 : 12; $\dot{R}$=potash ($\dot{K}$) almost solely. These ratios may hereafter prove to be differe after a correct determination in each case of the degree of oxydation of the iron. Fluorine present, but not over 1 p. c. has in any case been detected.

Water is often present, especially where the latter ratio is 1 : 6 or 1 : 9; and it sometim amounts to 5 p. c.; and the kinds containing 3 to 5 p. c. of water have been referred to the sp cies *Margarodite*; making the water basic in such kinds, the O. ratio for bases and silica becom 1 : 1, as in other unisilicates. The hydrous kinds so graduate into the anhydrous that the ana ses are here brought all together, although the species *margarodite* is introduced on page 4 The ratio 1 : 1¼ may indicate that muscovite is a combination of 3 parts of a unisilicate and 2 a bisilicate, as in the formula 3 $(\dot{R}^3, \bar{R})^2\ \ddot{Si}^3 + 2\ (\dot{R}^3, \bar{R})\ \ddot{Si}^3$. But if the mineral is a true unisilicate, its relation to biotite and phlogopite would indicate, but with an excess of silica, the formula may $(\dot{K}^3, \bar{R})^2\ \ddot{Si}^3 + 1\frac{1}{2}\ \ddot{Si}$; or else with half the excess of silica basic. With the O. ratio 1 : 6 for $\dot{R}$ and the bases correspond to $\frac{1}{7}\dot{K}^3+\frac{6}{7}\bar{R}$; with 1 : 9, to $\frac{1}{10}\dot{K}^3+\frac{9}{10}\bar{R}$; with 1 : 12, to $\frac{1}{13}\dot{K}^3+\frac{12}{13}\bar{R}$.

The analyses are here arranged in groups; *first*, according as the oxygen ratio between t bases ($\dot{R}+\bar{R}$) and silica ($\ddot{Si}$) is 1 : 1¼, or 1 : 1½; and *subordinately*, into those in which the oxyg ratio between the protoxyds ($\dot{R}$) and sesquioxyds ($\bar{R}$) is either 1 : 6 approximately, or 1 : 9, or 12. It is to be remarked that the incipient alteration of a mica, attended with the introduction a little magnesia, lime, or soda ($\dot{Mg}$, $\dot{Ca}$, or $\dot{Na}$), with a removal or not of some potash ($\dot{K}$), mig increase the proportion of protoxyds and thus change the latter ratio from 1 : 12 to 1 : 6, or pr duce the intermediate gradations.

Analyses: A. 1. *O. ratio of* $\dot{R}$, $\bar{R}$, 1 : 6; 1, Delesse (Ann. d. M., IV. xvi. 202); 2, Rammelsbe (Pogg., lxxxi. 38); 3, Schafhäutl; 4–6, Smith & Brush (Am. J. Sci., II. xvi. 46, 47, xv. 210); 7, Haughton (Phil. Mag., IV. ix. 272); 9, Sullivan (J. G. Soc. Dublin, iv. 155); 10–13, Haught (l. c., and Q. J. G. Soc., xviii. 414, xx. 280).

2. *O. ratio of* $\dot{R}$, $\bar{R}$, 1 : 9; 14, Kussin (Ramm., 4th Suppl., 75, and Min. Ch., 657); 15, Roth (Z G., vii. 15); 16, Schafhäutl (Ann. Ch Pharm., xliv. 40); 17, 18, Fuchs (Jahrb. Min., 1862, 79 19, Apjohn (Q. J. Sci. Dublin, i. 119); 20, E. Boricky (Ber. Ak. Wien. liv. 287).

3. *O. ratio of* $\dot{R}$, $\bar{R}$, 1 : 12; 21, 22, H. Rose (Schw. J. xxix. 282, Gilb. Ann., lxxi. 13, Pogg., i. 75 23, Svanberg (Ak. H. Stockh., 1839, 155); 24–26, H. Rose (l. c.); 27, J. D. Darrack (This Mi 1850, 357); 28, v. Hauer (Ber. Ak. Wien, xlvii 216).

B. 29, v. Rath (Pogg., xcviii. 285); 30, Kjerulf (Ramm. Min. Ch., 658); 31, v. Rath (Pogg., x 288):

A. Oxygen ratio of $\dot{R}+\bar{R}$ to $\ddot{Si}$ 1 : 1¼, or nearly. In 1, 1 : 1·25; 2, 1 : 1·24; 3, 1 : 1·26; 4, 5, 1·25; 6, 1 : 1·2; 7, 1 : 1·2; 8, 1 : 1·24; 9, 1 : 1·22; 10, 1 : 1·28; 12, 1 : 1·26; 13, 1 : 1·25; 14, 1·23; 15, 1 : 1·12; 16, 1 : 1·25; 17, 1 : 1·35; 18, 1 : 1·21; 19, 1 : 1·2; 20, 1 : 1·26; 21, 1 : 1·23.

1. *O. ratio of* $\dot{R}$, $\bar{R}$, 1 : 6. (MARGARODITE in part.)

	$\ddot{Si}$	$\bar{Al}$	$\bar{Fe}$	$\dot{Mg}$	$\dot{Ca}$	$\dot{Na}$	$\dot{K}$	$\dot{H}$	F
1. St. Etienne	46·23	33·08	3·48	2·10	——	1·45	8·87	4·12	*tr.*, $\dot{Mn}$ *tr* =99·28 Delesse.
2. ?	47·84	32·66	3·05	1·28	0·29	1·55	10·25	2·43	——=99·06 Ramm.
3. Zillerthal	47·05	34·90	1·50	1·95	——	4·07	7·96	1·45	——=98·88 Schafh.
4. Monroe, Ct.	46·50	33·91	2·69	0·90	——	2·70	7·32	4·63	0·82, Cl 0·31=99·78 S. & B.
5. " "	45·70	33·76	3·11	1·15	——	2·85	7·49	4·90	0·82, Cl 0·31=100·09 S. & B
6. Litchfield, Ct.	44·60	36·23	1·34	0·37	0·50	4·10	6·20	5·26	*tr.* =100·60 S. & B.
7. Dublin Co.	48·47	31·42	4·79	1·13	1·38	1·44	10·71	5·43	——=99·77 Haughton.
8. Glendalough,	44·71	31·13	4·69	0·90	1·09	1·27	9·91	6·22	——=99·92 Haughton.
9. Glenmalure	47·41	36·21	3·11	1·57	1·29	2·51	5·51	2·87	0·86=100·84 Sullivan.
10. Mt. Leinster	44·64	30·18	6·35	0·72	——	*tr.*	12·40	5·32	——=99·61 Haughton.
11. Donegal, *white*	44·80	29·76	8·80	0·71	0·45	0·32	12·44	2·00	——, $\dot{Mn}$ 0·48=99·76 Haugl
12. " "	45·24	35·64	2·24	0·71	0·51	0·54	10·44	4·00	——, $\dot{Fe}$ 0·70, $\dot{Mn}$ 0·24=100 Haughto
13. Ytterby, "	44·64	35·36	3·52	0·36	0·90	1·44	10·68	2·80	——, $\dot{Fe}$ 0·3, $\dot{Mn}$ 0·2=100·20

2. *O. ratio of* $\dot{R}$, $\bar{R}$ 1 : 9 approximately (MARGAROTITE or DAMOURITE in part) (in 13, 1 : 10 n 14, 1 : 9·1; in 15, 1 : 7·5).

14. Zsidovacs	48·07	38·41	*tr.*	——	——	——	10·10	3·42	——, $\dot{Mn}$ *tr.*=100 Kussin.

	S̈i	A̶l	F̶e	Ṁg	Ċa	Ṅa	K̇	Ḣ	F	
15. Lisens, Tyrol	44·71	35·29	4·12	0·39	0·98		8·82	5·69	——	=100 Roth.
16. Zillerth., *Fuchsite*	47·95	34·45	1·80	0·71	0·59	0·37	10·75	—	0·85,	C̶r 3·95=100·92 Schafh.
17. Harz, *black*	45·02	35·00	6·67	3·08	0·13	1·04	3·89	3·31	1·16,	M̶n 1·75=101·05 Fuchs.
18. " "	44·55	34·63	6·60	3·04	0·13	1·08	3·85	3·28	1·16,	M̶n 1·73=100 Fuchs.
19. Ross Hill, I.	46·42	37·92	0·46	0·17	0·67	1·54	9·63	4·40	——	=101·21 Apjohn.
20. Dobrowa	48·74	37·96	—	2·41	2·63	—	3·07	5·45	——	=100·26 Boricky.

3. *O. ratio of* Ṙ, R̶ 1 : 12 (in 15, 1 : 12·4; in 21, 1 : 12·5; 22, 1 : 9·5; 23, 1 : 13·3; 24, 1 : 11·9; 25, 1 : 12·4; 26, 1 : 11·2).

	S̈i	A̶l	F̶e	Ṁg	Ċa	Ṅa	K̇	Ḣ	F	
21. Utö	47·50	37·20	3·20	—	—	—	9·60	2·63	0·53,	Ṁn 0·81=101·47 Rose.
22. Broddbo.	46·10	31·60	8·65	—	—	—	8·39	1·00	1·06,	Ṁn 1·26=98·06 Rose.
23. "	47·97	32·35	5·37	—	—	—	8·31	3·32	0·72,	Ṁn 1·50=99·54 Sv.
24. Fahlun	46·22	34·52	6·04	2·11[a]	—	—	8·22	0·98	1·03	=99·12 Rose.
25. Kimito	46·36	36·80	4·53	—	—	—	9·22	1·84	0·67	=99·42 Rose.
26. Ochotsh	47·19	33·80	4·47	2·58[a]	0·13	—	8·35	4·07	0·28	=100·87 Rose.
27. Unionville	46·75	39·20	*tr.*	1·02	0·39	—	6·56	4·90	——	=98·82 Darrack.
28. Rio Janeiro, *bnh.*	47·60	35·70	4·31	0·59	0·43	—	6·07	4·04	——	=98·74 Hauer.

[a] Mn O included.

B. Oxygen ratio of Ṙ + R̶ to S̈i 1 : 1½, or nearly.

	S̈i	A̶l	F̶e	Ṁg	Ċa	Ṅa	K̇	Ḣ	F	
29. Hirschberg	49·04	29·01	5·56	0·75	0·17	0·50	11·19	4·65	——	=100·87 Rath.
30. "	51·73	28·75	5·87	0·62	—	2·14	8·28	—	0·83	=99·72 Kjerulf.
31. Pargas	50·10	28·05	5·46	0·40	2·41	1·26	7·56	3·37	——	=99·11 Rath.

In anal. 1, G.=2·817, grayish-white, in graphic granite; 2, G.=2·831, silver-white, with black tourmaline; 4, 5, with topaz and fluorite; 6, G.=2·76, colorless, pearly, with cyanite; 8, G.=2·793, gray, silvery, trp.; 10, gray, silvery, trp.; 14, G.=2·817, white; 15, white, pseud. after andalusite; 16, 18, G.=3·123, in hexag. scales, from granite, opt. char. not given; 19, G.=2·802, in coarsely grouped masses of intersecting laminæ; 20, G.=2·85; 28, G.=2·86; 29, G.=2·867, green, pseud. after orthoclase; 30, pseud. after orthoclase; 31, G.=2·833, silvery white, 11·11, Ċa C̈ removed, pseud. after scapolite.

The rose-colored micas of Goshen, Mass., afforded Mallet (Am. J. Sci., II. xxiii. 180) K̇ 9·08, Ṅa 0·99, L̇i 0·64.

A greenish-black mica, constituting a micaceous schist or rock in Derby, Vt.—the so-called *Adamsite* of Shepard—consists, according to G. J. Brush (Am. J. Sci., II. xxxiv. 216), S̈i 47·76, A̶l and F̶e 36·29, Ċa 0·24, Ṁg 1·85, alkalies (by loss) 8·77, ign. 5·09, and has all the ordinary characters of common mica.

Thomson gives for the composition of a mica reported to come from Orange Co., N. Y. (Min., i. 360) S̈i 49·28, A̶l 23·67, F̶e 7·31, K̇ 15·29, Ċa 6·13, L̇i 0·06=101·89. Little reliance can be placed on the analysis.

A schist, formerly called *talcose schist*, from Zillerthal in Tyrol, and named *didymite* by Schafhäutl (Ann. Ch. Pharm., 1843, J. pr. Ch., lxxvi. 136, not *didrimite*, as sometimes written) is near muscovite in its composition. It is feeble pearly, and grayish-white in color; H.=1·5—2; G.=2·75. Schafhäutl obtained S̈i 40·69, A̶l 18·15, F̶e 5·25, Ṅa 1·23, K̇ 11·16, Ḣ 0·60, Ċa C̈ 22·74=99·82. It has also been called *amphilogite*. Probably only a mica schist.

A variety of muscovite (1) composed of scales arranged in plumose forms is called *plumose* mica; and another (2) having a diagonal cleavage, cleaving sometimes into thread-like pieces, *prismatic* mica. An emerald-green variety (8) is the *fuchsite* or chrome-mica, containing sometimes nearly 4 p. c. of oxyd of chrome.

Pyr., etc.—In the closed tube gives water, which with brazil-wood often reacts for fluorine. B.B. whitens and fuses on the thin edges (F.=5·7, v. Kobell) to a gray or yellow glass. With fluxes gives reactions for iron and sometimes manganese, rarely chromium. Not decomposed by acids. Decomposed on fusion with alkaline carbonates.

Obs.—Muscovite is the most common of the micas. It is one of the constituents of granite, gneiss, mica schist, and other related rocks, and is occasionally met with in granular limestone, trachyte, basalt, lava; and occurs also disseminated sparingly in many fragmental rocks. Coarse lamellar aggregations often form the matrix of topaz, tourmaline, and other mineral species in granitic veins.

Siberia affords laminæ of mica sometimes exceeding a yard in diameter; and other remarkable foreign localities are at Finbo in Sweden, and Skutterud in Norway. See above for other localities. *Fuchsite* or *chrome* mica occurs at Greiner in the Zillerthal, at Passeyr in Tyrol, and on the Dorfner Alp, as well as at Schwarzenstein.

In *N. Hamp.*, at Acworth, Grafton, and Alstead, in granite, the plates at times a yard acro and perfectly transparent. In *Maine*, at Paris; at Buckfield, in fine crystals; at Unity, of a gree color, on the estate of James Neal (Thomson's *nacrite*, wrongly referred to Brunswick). In *Mass.*, Chesterfield, with tourmaline and albite; at Barre and South Royalston, in two localities, with bery at Mendon and Brimfield; at Chester, Hampden Co., faint greenish; at Goshen, rose-red (sometime misnamed lepidolite); prismatic mica, at Russell. In *Conn.*, at Monroe, of a dusky-brown colo having internal hexagonal bands of a darker shade; at Trumbull, at the topaz vein in coars radiated aggregations (called margarodite); at Litchfield, with cyanite, colorless and pearl (margarodite), G.=2·76; in brown hexagonal crystal at the Middletown feldspar quarry; Haddam, pale brownish, with columbite, and also similar at another locality with garnets. *N. York*, 6 m. S.E. of Warwick, crystals and plates sometimes a foot in diameter, in a vein feldspar; a mile N.W. of Edenville, in six-sided and rhombic prisms; silvery, near Ede ville; in St. Lawrence Co., 8 m. from Potsdam, on the road to Pierrepont, in plates 7 in. across town of Edwards, in large prisms, six-sided or rhombic; Greenfield, near Saratoga, in reddis brown crystals with chrysoberyl; on the Croton aqueduct, near Yonkers, in rhombic prisms wit a transverse cleavage. In *Penn.*, in fine hexagonal crystals of a dark brown color at Pennsbur near Pennsville, Chester Co; at Unionville, whitish; Delaware Co., at Middletown, smoky brow with hexagonal internal bands, which are due to magnetite (see p. 150); at Chesnut Hill, near th Wissahiccon, a green variety; at Leiperville, Delaware Co., faint greenish. In *N. Jersey*, in crysta at Newton and Franklin. In *Maryland*, at Jones's Falls, a mile and three-quarters from Balti more; the plates show by transmitted light a series of concentric hexagons, the sides of whic are parallel with the sides of a hexagonal prism.

Marignac obtained $O \wedge 4 = 94°\ 50'$, and $O \wedge 2 = 98°\ 30'$ (fig. 286); $O \wedge 1 = 107°\ 5'$, from a Vesu vian crystal. Kokscharof $O \wedge 1 = 106°\ 53'\ 30''$, Vesuvian crystal; Zepharovich 107° 3' for th same angle, and 116° 13' for $O \wedge \frac{2}{3}$-ĭ (Ber. Ak. Wien, liv. 286).

The following table contains the optic-axial angle, as measured in the air, for various musco vites:

1. *American*; as measured by B. Silliman in 1850 (l. c.).

		Apparent Angle.
1.	New York Island, 4 m. from city, violet-gray	56° 20′—56° 40′
2.	Royalston, Mass., dark brown, fine crystal	57 30
3.	ib. ib. ib. ib. another	58—59
4.	Pennsbury, Penn., smoky brown, striated	59
5.	Philadelphia, greenish-gray, banded	60 30—61
6.	ib., near Fairmount, smoky brown, resembles No. 4	60—62 30
7.	Oxford, Maine, light brown	62 42—63
8.	Monroe, Conn., brown with patches	64 30—65 30
9.	Royalston, Mass., violet-brown, in thick plates	65
10.	Local. ?; greenish-gray; in crystals	65 30—66
11.	Falls road, 2½ m. from Baltimore, transparent brown	65 30—65 40
12.	Near Ellicott's Mills, Md., ib. ib.	66 30
13.	"Jones Falls," near Baltimore, blackish-green, symmetrically banded	66 15—66 30
14.	Greenfield, Conn., greenish-yellow	66 30—67
15.	Haddam, Conn. (Quarry Hill), clear brownish-green	67
16.	Grafton, New Hampshire, light brown, transparent	67 30
17.	Unionville, Penn., white, corundum locality	67—67 28
18.	Acworth, N. H., greenish-gray, in granite.	67 15—67 30
19.	Grafton, N. H., another specimen, light brown, with quartz and tourmaline	68 5—68 20
20.	Templeton, Mass., transparent brown	69 30—69 40
21.	Orange, Mass., ib. ib., beautiful crystals	69 30—69 40
22.	Willimantic Falls, Conn., brownish-green, transparent	69 30—69 50
23.	Pennsbury, Penn., brown crystals; another locality	69 27—70
24.	Royalston, Mass., dark brown; 2d locality	69 40—70
25.	Grafton, N. H., light brown; 3d specimen	69—69 30
26.	Middletown, Conn., brownish, feldspar quarry	70—70 30
27.	Chester, Hampden Co., Mass., greenish-white	70—70 30
28.	Norwich, Mass., greenish-yellow; spodumene locality	70 30
29.	Pennsbury, Penn. (3d local.), brownish-green	70—70 30
30.	Goshen, Mass., greenish-yellow, with spodumene	70—70 30
31.	Greenfield, N. Y., brownish; chrysoberyl locality	70 45—71
32.	Haddam, Conn., brownish; in large plates	70

	Apparent Angle.
33. Gouverneur, N. Y., brownish-white, in boulder	70°
34. Templeton, Mass. (2d spec.), transparent brown	70 15′
35. Leiperville, Del. Co., Pa., faint greenish, plicated	70 30—71
36. Jefferson Co, N. Y., greenish; in a boulder	71—71 30
37. Hebron, Maine, light brown, transparent	71 40—71 50
38. Norwich, Mass., yellowish-green, transparent	71 45
39. Haddam, Conn., ib.; columbite locality	71 30—71 45
40 E. Chester, Westchester Co., N. Y., yellowish-green boulder	71 30—72
41. Paris, Maine, ib.	72 15—72 30
42. ib., ib. ib.	72 30
43. Brunswick, Maine, whitish-brown, silvery	72 37—72 50
44. Gouverneur, N. Y.?, rose color; no lithia	73—73 5
45. Orange, N. H., gray, with flattened tourmaline, quartz, and feldspar	73—74
46. Pounal, Maine, nearly colorless; lithia? mica	74 50—75
47. Goshen, Mass., yellowish-green, with indicolite	75
48. ib. ib. ib. ib.	75 30—76
49. Lenox, Mass., rose-colored, with albite	75—75 30

2. Muscovites, measured by Senarmont, Grailich, etc.

(1) *Optical axes situated in the plane of the longer diagonal.*

	Appar. Angle.	
1. Philadelphia; transparent; clear olive-green	57—58	Sen.
2. Siberia, in white quartz; silvery, imperf. transparent	57—58	"
3. Arendal, greenish-brown	58	Grailich.
4. Zillerthal, in albite; silvery, imperf. transparent	58—59	Sen.
5. Arendal, in a feldspathic rock; transparent; pale	58—59	"
6. Loc. ——?; transparent; clear brown	58—59	"
7. Warwick; yellowish-brown	59	Grailich.
8. Couzeran?; silvery, greenish-gray, with concave surface of cleavage	60	Sen.
9. St. Gothard, in quartzose gneiss; hexag.; silvery; clear gray	60	"
10. Schwarzenbach, Austria, pale green	61 12	Grailich.
11. Miask; transparent; clear olive-green	62—63	Sen.
12. Katherinenburg; transparent; clear pale rose	63—64	"
13. Nertschinsk	65	Grailich.
14. Rothenkopf, Tyrol; green	66	"
15. Gloria, near Rio Janeiro, Brazil; colorless	66 36	"
16. Schaitansk; imperfectly transparent; rose-colored	67	Sen.
17. Brittany; transparent, rhombic octahedrons; blonde	68	"
18. Kimito, Finland; rhombic octahedrons; transparent; clear blonde	67—68	"
19. Finland; crystals silvery; grayish-green	67—68	"
20. Aberdeen; transparent; blonde	68	"
21. Josephs-Alpe, Austria; G.=2·718	69 10	Grailich.
22. Cape Gozaz, Brazil; pinchbeck-brown	69 25	"
23. Middletown, Ct.; colorless; G.=2·852	70	"
24. Katherinenburg; rhombic prisms in feldspar; transparent; nearly blonde	69—70	Sen.
25. Loc. ——?; colorless; but affords a central region an outer region	70 60	" "
26. Nulluk, Greenland	70 36	Grailich.
27. Presburg, Hungary	70 40	"
28. Kassigiengoyt, Greenland; green	71	"
29. Kakunda, Brazil; pinchbeck-brown	71 25	"
30. Cam, Bohemia; blonde	71 40	"
31. Minas Geraes, Brazil; pale green	71 50	"
32. ib. ib.; pale brown	72 20	"
33. Hörlberg, Bavaria; pinchbeck-brown	72 25	"
34. Chesterfield, Mass.; G.=2·827; greenish-yellow	72 30—73 30	"
35. Serra de Conceiçao, Brazil	74	"
36. Galmeikirchen, Upper Austria; gray	74 36	"
37. Miask, Ural; pinchbeck-brown	75 25	"
38. Siberia; gray or colorless; G.=2·802	75—76	"

	Appar. Angle.	
39. Chesterfield, Mass., rose	75°	Grah
40. Goshen ?, Mass., rose-colored	76 10—76 40	"
41. Presburg, Hungary	76 12	"
42. Alençon; hexag.; transparent; grayish-blonde	76—77	Ser

(2) *Optical axes in the diametral plane of the shorter diagonal.*

43. Saxony; hexag.; silvery, clear gray; transp., macled	44	Ser
44. Kollin, Prussia; gray, in granite	50 12	Grail
45. Zinnwald and Schlaggenwald; in granite. Lepidolite?	51 50	"
46. Tyrol; in granite, gray	52 12	"
47. Siberia; colorless	60 30	Ser
48. Piedmont; rhombic; silvery reflection; grayish-green by trp.	63	"
49. St Féréole, near Brive; transparent; olive-green	65	"
50. Milan; hexag.; greenish-white; silvery; unctuous, not elastic	65	"
51. Fossum, Norway; hexag.; clear olive-green	66	"
52. Scotland; brown; in large thick crystals	68	"
53. Tarascon (Ariége); rhombic; transparent; colorless	69	"
54. Ural. in graphic granite; silvery lustre; color blonde	72	"
55. Utö; rhombs: lustre silvery; yellowish-blonde	72—73	"

Haughton found for the mica of Dublin Co., Ireland, 53° 8′; of Glenmalure 67° 11′; of Glen lough valley, 70° 4′; of Mt. Leinster, 72° 18′; of Lough Dan, 70°.

On examining different micas pressed between two plates of glass, and subjecting them changes of temperature, Senarmont found no perceptible change in the optical axes.

Grailich shows that, with slight exceptions, the angle increases with the specific gravity in mica of a given locality. Thus seven micas from Presburg, Hungary, gave the following:

Specific gravity	2·714	2·735	2·755	2·782	2·790	2·793	2·796
Angle	69·7	70·0	70·5	71·2	72·3	72·4	72·0

Muscovite was so named by the author in 1850, from *Vitrum Muscoviticum* or *Muscovy-gl* formerly a popular name of the mineral. *Fuchsite* was named after the chemist, Fuchs.

Talcite of Thomson (l. c.), from Wicklow, Ireland, is nothing but margarodite, according to G and Lettsom (Min., 203), who say that it invests crystals of andalusite. Thomson, as his desc tion implies, considered the andalusite prisms and investing mica all one mineral—the talci and in view of this, the analyses need not here be cited Thomson's *nacrite*, from "Brunswi Me.," is the green mica of Unity, Me.

Alt.—Mica at times becomes hydrated, losing its elasticity and transparency, and often so portion of the potash; and at the same time it may take up magnesia, lime, or soda The occ rence of water, magnesia, lime, and soda in some micas, especially the margarodites, has b attributed to incipient alteration. See analyses under A, 1, and A, 2.

These changes may be promoted by waters containing carbonates of these bases. R. Bl (Jahrb. Min., 1865, 269) gives the following analysis by Dr. Wolkenhaar of an altered m (biotite?) from the dioryte of Schemnitz, which had lost nearly all its alumina and consis largely of carbonates: $\ddot{\text{Si}}$ 33·34, $\dddot{\bar{\text{Al}}}$ 3·53, $\dot{\text{Fe}}$ 16·01, $\dot{\text{Mn}}$ 0·89, $\dot{\text{Mg}}$ 2·06, $\dot{\text{Ca}}$ 21·73, $\dot{\text{Na}}$ 2·26, $\dot{\text{K}}$ 0· $\ddot{\text{C}}$ 20·06=100·44. The carbonic acid would require the $\dot{\text{Ca}}$ 21·73, and $\dot{\text{Mg}}$ 2·06, with $\dot{\text{Fe}}$ 1· making 45 p. c. of carbonates. Mica occurs altered to *steatite* and *serpentine*, and Tscherm mentions cases of alteration to amphibole and stilpnosiderite.

294. LEPIDOLITE. Violetfarbigen Zeolith (fr. Rozena) *v. Born*, Orell's Ann., ii. 196, 17 Lilalith (ib.) *v. Born.* Schuppenstein *Germ.* Lepidolith *Klapr.*, Schrift. Ges. Berl., xi. 1794, Bergm. J., ii. 80, 1792, Beitr., i. 21, 279, 1795, ii. 191. Lepidolite *Kirw.*, i. 208, 17 Lithionglimmer *C. Gmelin*, Gilb. Ann., lxiv. 371, 1820. Lithia Mica. Lithionit *v. Kob.*, T 54, 1853. Rabenglimmer, Siderischer Fels-Glimmer (fr. Altenberg), *Breith.*, Char., 1823, 18 Handb., 404, 1841. Zinnwaldit *Haid.*, Handb., 521, 1845.

Orthorhombic. $I \wedge I = 120°$. Forms like those of muscovite. Clea age: basal, highly eminent. Also massive scaly-granular, coarse or fine. H.=2·5—4. G.=2·84—3. Lustre pearly. Color rose-red, violet-gr or lilac, yellowish, grayish-white, white. Translucent. Optic-axial angle 70°—78°; sometimes 45°—60°.

Comp.—O. ratio for bases and silica mostly 1 : 1½; for $\dot{R}$, $\overline{R}$, between 1 : 3 and 1 : 4½. The protoxyds ($\dot{R}$) include, besides potash, lithia, rubidia, and cæsia; and in the Zinnwald mica, thallium has been detected. Fluorine is present, and the ratio to oxygen mostly 1 : 12, as in the Rozena, as analyzed by Rammelsberg; other ratios obtained are: in the Ural, Chursdorf, Utö, and Rozena micas, 1 : 20; in the Altenberg (Stein), 1 : 60; in the Zinnwald, 1 : 14, 1 : 11, 1 : 12; in the Juschakova, 1 : 8; in Turner's Altenberg, 1 : 25. But there is much uncertainty connected with all the determinations of the fluorine.

The O. ratio for the bases and silica 1 : 1½ corresponds to a combination of 1 unisilicate to 2 of bisilicate, or the formula $(\dot{R}^3, \overline{R})^2 \ddot{S}i^3 + 2 (\dot{R}^3, \overline{R}) \ddot{S}i^3$; and also to simply a unisilicate with accessory silica $(\dot{R}^3, \overline{R})^2 \ddot{S}i^3 + 2 \ddot{S}i$.

Analyses: 1, Klaproth (Beitr., i., ii., v.); 2, Gmelin (l. c.); 3, Kralovanski (Schw. J., liv. 230); 4, Rammelsberg (5th Suppl., 120); 5, Regnault (Ann. d. M., III. xiii. 151); 6, 7, Gmelin; 8, Turner (Edinb. J. Sci., iii., vi. 61); 9, Klaproth; 10, Lohmeyer (Pogg., lxi. 377); 11, Stein (Ramm. 5th Suppl., 119); 12, Rammelsberg (ib.); 13–16, Turner (l. c.); 17, 18, Rosales (Pogg., lviii. 154); 19, Turner (l. c.); 20, Stein (J. pr. Ch., xxviii. 295):

	$\ddot{S}i$	$\overline{A}l$	$\overline{F}e$	$\overline{M}n$	$\dot{M}g$	$\dot{N}a$	$\dot{L}i$	$\dot{K}$	$\dot{H}$	Cl	F
1. Rozena	54·40	38·25	0·75		—	—	—	4·00	[2·50]	—	—=100 Kl.
2. "	49·06	33·61	—	1·40	0·41	—	3·59	4·18	[4·24]	0·11	3·40=100 G.
3. "	49·08	34·01	—	1·08	0·41	—	3·58	4·19	[4·15]		3·50 =100 Kr.
4. Cornwall	51·70	26·76	—	1·29	0·24	1·15	1·27	10·29	—	—	7·12, $\dot{C}a$ 0·40, $\overline{\overline{P}}$ 0·16 =100·38 R.
5. "	52·40	26·80	—	$\dot{M}$ 1·50	—	—	4·85	9·14	—	—	4·18=98·87 R.
6. Chursdorf	52·25	28·35	—	$\dot{M}$ 3·66	—	—	4·79	6·90	*tr.*	—	4·81=100·76 G.
7. Zinnwald	46·23	14·14	17·97	$\dot{M}$ 4·57	—	—	4·21	4·90	0·83	—	8·10=100·94 G,
8. "	44·28	24·53	$\dot{F}e$ 11·38	$\dot{M}$ 1·66	—	—	4·09	9·47	—	—	4·88=100·24 T.
9. "	47·00	20·00	$\dot{F}e$ 15·50	1·75	—	—	—	14·50	—	—	—=98·75 Kl.
10. "	42·97	20·59	14·18	0·83	—	1·41	1·60	10·02	[0·22]	0·21	6·35=98·38 L.
11. "	48·65	17·67	$\overline{F}e$ 14·57	$\dot{M}$ 1·24	0·53	0·71	2·41	8·60	—	—	8·16=102·54 S. [R.
12. "	46·52	21·81	$\dot{F}e$ 21·48[a]	$\dot{M}$ 1·96	0·44	0·39	1·27	9·09	—	—	7·47, $\overline{\overline{P}}$ 0·13=100·66
13. Utö	50·91	28·17	—	$\dot{M}$ 1·08	—	—	5·67	9·50	—	—	3·90=99·23 T.
14. "	50·85	28·30	—	$\dot{M}$ 1·23	—	—	5·49	9·04	—	—	4·94=99·35 T.
15. Cornwall	50·82	21·33	$\dot{F}e$ 9·08	—	—	—	4·05	9·86	—	—	4·56=99·70 T.
16. "	40·06	22·90	27·06	$\dot{M}$ 1·79	—	—	2·00	4·30	—	—	2·16=100·27 T.
17. Juschakova	48·92	19·08	—	5·59	—	2·23	2·77	10·96	—	1·31	10·44, $\dot{C}a$ 0·14 R.
18. "	46·62	21·05	—	4·12	—	—	*und.*	*und.*	—	1·01	10·01, $\dot{C}a$ 0·12, rest *und.* R.
19. Altenberg	40·19	22·49	$\dot{F}e$ 19·78	$\dot{M}$ 2·02	—	—	3·06	7·49	—	—	3·80=98·83 T.
20. Juschakova	47·01	20·35	14·34	$\dot{M}$ 1·53	—	—	4·33	9·62	1·53	0·40	1·43=100·54 S.

[a] 6·80 Fe O included.

In a recent analysis of the Rozena lepidolite, made since the discovery of the metals rubidium and cæsium, Cooper obtained (Pogg., cxiii. 348):

$\ddot{S}i$	$\overline{A}l$	$\overline{F}e$	$\dot{M}g$	$\dot{C}a$	$\dot{R}b$	$\dot{C}s$	$\dot{L}i$	LiF	NaF	KF	$\dot{H}$
50·32	28·54	0·73	0·51	1·01	0·24	*tr.*	0·70	0·99	1·77	12·06	3·12=99 99

The proportion of fluorine was determined by the loss. Reckoning the fluorine as oxygen, the O. ratio for $\dot{R}$, $\overline{R}$, $\ddot{S}i$ is 1 : 4·25 : 8·43. O. D. Allen (Am. J. Sci., II. xxxiv. 369) found in the Hebron lepidolite cæsium 0·3, and rubidium 0·14; and later (p. 373) 0·3 of rubidium nearly.

Rammelsberg's analysis of the Zinnwald lepidolite (anal. 12) gave him the O. ratio 1·15 : 3 : 6·2, or nearly 1 : 3 : 6; and that of the Rozena (anal. 4) 1 : 4·4 : 9·13, or approximately 1 : 4½ : 9, but for which he proposes 1 : 4½ : 7½, since the specimen he analyzed contained free quartz in visible grains, and his silica might consequently have been too high [the ratio 1 : 1½ between the bases and silica would require 1 : 4½ : 8¼]. From Rosales's analysis of the Juschakova (anal. 17), he deduces the ratio 1 : 2·8 : 6·4, or approximately, as he observes, 1 : 3 : 6.

Anal. 11 is cited by Breithaupt for his *rabenglimmer;* G.=3·146—3·190; color greenish-black to dark green.

The Zinnwald mica has been called *zinnwaldite.*

More chemical investigations are required before the species lepidolite can be correctly sul divided or comprehended. Physically it is hardly distinct from muscovite.

Pyr., etc.—In the closed tube gives water and reaction for fluorine. B.B. fuses with intume cence at 2—2·5 to a white or grayish glass, sometimes magnetic, coloring the flame purplish-re at the moment of fusion (lithia). With the fluxes some varieties give reactions for iron and mai ganese. Attacked but not completely decomposed by acids. After fusion, gelatinizes with mu riatic acid.

Obs.—Occurs in granite and gneiss, especially in granitic veins, and is associated sometime with cassiterite, red, green, or black tourmaline, amblygonite, etc. Found near Utö in Sweden grayish-white at Zinnwald in Bohemia; at Altenberg, Chursdorf, and Penig in Saxony; Juschakov in the Ural; lilac or reddish-violet at Rozena in Moravia; near Chanteloube, Dept. Haute Vienn France; at Campo on Elba; brown at St. Michael's Mount in Cornwall; Argyll in Scotlard Tyrone in Ireland.

In the United States, a granular and a broad foliated variety at Paris, and also at Hebron, Me with red tourmaline and amblygonite; granular near Middletown, Conn. The rose mica c Goshen, Mass., is muscovite.

The optical axes lie in the plane of the longer diagonal in the following lepidolites; the angle of divergence observed are as follows:

Paris, Me.; whitish-green; with green tourmaline	74°—74° 30′	Silliman.
" rose-colored	74	Grailich.
Siberia	75 40	"
Rozena, Moravia	76	"
Penig, Saxony	76 30	"

A "lepidolite" from Bournon's collection gave Senarmont 55°; and a Zinnwald mica, silver or greenish-blonde, 46°—47°. Grailich made the angle of mica from Zinnwald and Schlagger wald 51° 10′. Each of these varieties, giving comparatively small angles, have the plane of th axes *brachydiagonal;* and the small angle may arise from an interlamination of a brachydiagona kind with a macrodiagonal.

Named lepidolite from λεπίς, *scale*, after the earlier German name *Schuppenstein*, alluding to th scaly structure of the massive variety of Rozena.

295A. SNARUMITE *Breith.* (B. H. Ztg., xxiv. 364, 1865). A mica-like cleavage in one directio and another transverse imperfect. Occurs massive and in tufts columnar in structure, wit H.=4—5·5, the least on cleavage-surface; G.=2·826; lustre on cleavage-face pearly. elsewher vitreous; color mostly reddish-white, colorless, grayish-white. It is, according to Richter (l. c. a silicate of alumina, lithia, soda, and potash. Comes from the shore of the Snarum-Elf, nea "narum, in Norway.

295. CRYOPHYLLITE. *J. P. Cooke*, Am. J. Sci., II. xliii. 217, 1867.

Orthorhombic. $I \wedge I = 120°$. In six-sided prisms. Cleavage: basa highly eminent, as in the Mica group. Twins: composition-face i-$\breve{i}$. Als massive, an aggregate of scales.

H.=2—2·5. G.=2·909. Lustre of cleavage-face bright pearly inclin ing to resinous. Color by transmitted light dull emerald-green, transvers to axis brownish-red. Streak grayish, slightly greenish. Thin folia toug and elastic. Optic-axial angle 55° to 60°; plane of axes brachydiagonal Cooke.

Comp.—O. ratio for $\dot{\mathrm{R}}$, $\overline{\mathrm{R}}$, $\ddot{\mathrm{Si}}=3:4:14$; for $\dot{\mathrm{R}}+\overline{\mathrm{R}}$, $\ddot{\mathrm{Si}}$, 1 : 2; whence the formula ($\frac{3}{7}\dot{\mathrm{R}}^3+\frac{4}{7}\overline{\mathrm{R}}$ $\ddot{\mathrm{Si}}^3$, in which $\dot{\mathrm{R}}$=protoxyd of iron, potash, and lithia, with a trace of soda, rubidia, and cæsia But if the micas are unisilicate in type, the formula may be $(\frac{3}{7}\dot{\mathrm{R}}^3+\frac{4}{7}\overline{\mathrm{R}})^2\,\ddot{\mathrm{Si}}^3+3\,\ddot{\mathrm{Si}}$; or else, wit half the excess of silica basic. Analysis: Cooke (l. c.):

	$\ddot{\mathrm{Si}}$	$\overline{\mathrm{Al}}$	$\overline{\mathrm{Fe}}$	$\overline{\mathrm{Mn}}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{K}}$	$\dot{\mathrm{Li}}$	$\dot{\mathrm{Na}}$. $\dot{\mathrm{Rb}}$	SiF^2
($\frac{1}{3}$)	51·49	16·77	1·97	0·34	7·98	0·76	13·15	4·06	*tr.*	8·42=99·94.

Pyr., etc.—In the flame of a candle fuses easily; and B.B., with some intumescence to a grayish enamel (F.=1·5—2), giving the flame a lithia reaction. In fine powder decomposed by th dilute mineral acids, the silica separating as a powder. The fluorine is not expelled even at a re heat.

Obs.—Occurs in the granite of Cape Ann, with danalite and lepidomelane (annite).

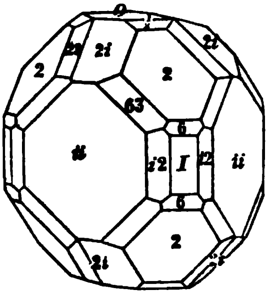
SCAPOLITE GROUP.

A list of the species of the Scapolite group, with their oxygen ratios and formulas, and the ratios of the non-alkaline to the alkaline protoxyd bases, is given on page 252. Although the oxygen ratios vary from 1 : 1 : 2, 1 : 2 : 3, 1 : 3 : 4, to 1 : 2 : 4 and 1 : 2 : 6½, the species are closely alike in the square-prismatic forms of their crystals, in the small number and the kinds of occurring planes, and in the angles. The variation in the basal angle of the fundamental octahedron (1 : 1) for the species of the group is less than 40′, the extremes being 64° 13′ (sarcolite) and 63° 40′ (meionite). The species are white or grayish-white in color, except when impure, and then rarely of dark color; the hardness 5—6·5; G.=2·5—2·8 (2·932? in sarcolite). The alkali present, when any, is soda, with only traces of potash.

Meionite was the first species of the Scapolite group distinctly recognized. It is, however, probable that scapolite was included with lamellar pyroxene under the name of *White Schörl-Spar* (Skörlspat) by Cronstedt, who mentions Pargas, in Finland, as one of its localities. The names *Wernerite* and *Scapolite* were both introduced by d'Andrada (of Portugal) in the same article (Scherer's J., iv. 35, 38, 1800), and applied to specimens from the same region in Norway. Wernerite is the *first* of the two in the article. Haüy used the names *Wernerite* and *Scapolite* (supposing the species distinct) in his Traité of 1801. But in his Mineralogical Course for 1804 or 1805 arbitrarily set aside the latter for *Paranthine*. Monteiro, a friend of d'Andrada, and speaking in his behalf, protested in 1809 (J. de Phys., lxviii. 177) against the change, and after arguing that wernerite and scapolite were identical, both on chemical and crystallographic grounds, urged the adoption of the name *Wernerite* for the species. In the following pages the name Scapolite is retained for the group, so that the minerals may all be called *scapolites*, as those of the feldspar group are called feldspars, and those of the mica and chlorite groups, respectively micas and chlorites; and the name Wernerite is applied to the most prominent division of the old species. This course meets satisfactorily the question of priority, and also the convenience of the science.

296. SARCOLITE. Sarcolite *Dr. Thompson* (of Naples), 1807. [Not Sarcolite du Vicentin (= Gmelinite) *Faujas*, *Vauq.*, Ann. d. Mus., ix. 249, 1807, xi. 42.] Analcime carnea *Mont. & Cov.*, Min. Vesuv., 1825.

287



Tetragonal; $O \wedge 1\text{-}i = 156° \ 5'$; $a = 0·4435$. Observed planes as in the annexed figure; hemihedral in the planes 2-3, only the alternate occurring. $O \wedge 2 = 128° \ 33'$, $2 \wedge 2$, pyr., 132° 52, $O \wedge \frac{4}{3} = 157° \ 19'$, $I \wedge 2 = 141° \ 27'$; $I \wedge 6 = 104° \ 52\frac{1}{2}'$; $1 \wedge 1$ (not occurring planes), bas.,=64° 13′. Crystals small.

H.=6. G.=2·545, Brooke; 2·932, Rammelsberg. Lustre vitreous. Color flesh-red to rose-red, reddish-white. Transparent to subtransparent. Extremely brittle.

Comp.—O. ratio for $\dot{R}, \bar{R}, \ddot{S}i = 1 : 1 : 2$; $(\frac{1}{2}(\frac{8}{11}\dot{C}a + \frac{1}{10}\dot{N}a)^3 + \frac{1}{2}\bar{\bar{A}}l)^3 \ddot{S}i^3$ = Silica 39·7, alumina 22·8, lime 33·4, soda 4·1=100. Analyses: 1, Scacchi (Quadri Crystallographici, Naples, 66, 1842); 2, Rammelsberg (Pogg., cix. 570):

		$\ddot{\mathrm{Si}}$	$\bar{\mathrm{A}}\mathrm{l}$	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\mathrm{N}}\mathrm{a}$	
1.		42·11	24·50	32·43	2·93	=101·97 Scacchi.
2.	(⅓)	40·51	21·54	32·36	3·30, $\dot{\mathrm{K}}$ 1·20	=98·91 Ramm.

corresponding nearly to the composition of idocrase.

Pyr., etc.—B.B. fuses to a white enamel. With acids gelatinizes.

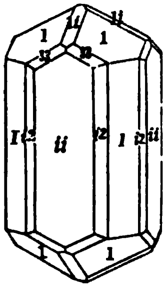
Obs.—Of rare occurrence at Mt. Somma.

Named from *σάοξ*, *flesh*, and *λίθος*, *stone*, in allusion to the color.

The crystallization was first correctly ascertained by Brooke (Ed. J. Sci., i. 189, 1824). Haüy had pronounced it cubic (Tr., iii. 1822). Kokscharof found *O* ∧ 2=128° 38′, and *O* ∧ 2-*i*=138 30′ (Min. Russl., ii. 110). Rammelsberg gives (l. c.) *O* ∧ 2=128° 45′, and *O* ∧ 2-*i*=138° 27′. The above figure is from Hessenberg (Min. Not., No. I.). The plane usually made 1 is here made 2, in order that the lettering of the crystals may correspond with that of the crystals of other species of the Scapolite group.

297 MEIONITE. Hyacinte blanche de la Somma *de Lisle*, Crist., ii. 289, 290, Pl. iv. f. 118, 1783. Meionite *H.*, Tr., ii. 1801.

288



Tetragonal: *O* ∧ 1-*i* = 156° 18′; *a*=0·439. Observed planes: *O*; vertical, *I*, *i*-*i*, *i*-3, *i*-2; pyramids, 1, 1-*i*; zirconoids, 1-3, 3-3; sometimes hemihedral in the planes 3-3, the alternate being wanting. *O* ∧ 1=148° 10′, 1 ∧ 1, pyr.,=136° 11′, basal 63° 40′. Cleavage: *i*-*i* and *I* rather perfect, but often interrupted.

H.=5·5–6. G.=2·6–2·74; 2·734–2·737, fr. Somma, v. Rath. Lustre vitreous. Colorless to white. Transparent to translucent; often much cracked within.

Comp.—O. ratio for $\dot{\mathrm{R}}$, $\bar{\mathrm{R}}$, $\ddot{\mathrm{Si}}$=1 : 2 : 3; $(\frac{1}{3}(\frac{10}{11}\dot{\mathrm{C}}\mathrm{a}+\frac{1}{11}\dot{\mathrm{N}}\mathrm{a})^3+\frac{2}{3}\bar{\mathrm{A}}\mathrm{l})^2\ddot{\mathrm{Si}}^3$=Silica 41·6, alumina 31·7, lime 24·1, soda 2·6=100. Analyses: 1, L. Gmelin (Schw. J., xxv. 36, xxxv. 348); 2, Stromeyer (Unters., 378); 3, Wolff (De Comp. Ekeberg., etc., Ramm., 2d Suppl., 133); 4, v. Rath (De Comp. Wern., Pogg., xc. 87); 5, Damour (L'Institut, 1862, 21):

		$\ddot{\mathrm{Si}}$	$\bar{\mathrm{A}}\mathrm{l}$	$\dot{\mathrm{F}}\mathrm{e}$	$\dot{\mathrm{M}}\mathrm{g}$	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\mathrm{N}}\mathrm{a}$	$\dot{\mathrm{K}}$	
1.	Somma	40·8	30·6	1·0	——	22·1	2·4	——,	$\ddot{\mathrm{C}}$ and ign. 3·1=100 Gmelin.
2.	"	40·53	32·73	——	——	24·24	1·81		$\dot{\mathrm{F}}\mathrm{e}$ 0·18=99·50 Stromeyer.
3.	"	42·07	31·71	——	——	22·43	0·45	0·31.	ign. 0·31=97·29 Wolff.
4.	"	42·55	30·89	0·41	0·83	21·41	1·25	0·93,	" 0·19=98·46 Rath.
5.	"	41·80	30·40	——	0·46	19·00	2·51	0·86,	" 3·17, gangue 0·46=98·66 Dam.

An opaque meionite examined by Gmelin having G.=2·65, lost 1·6 by ignition, and afforded some carbonic acid, it containing carbonate of lime.

Pyr., etc.—B.B. fuses with intumescence at 3 to a white blebby glass. Decomposed by acid without gelatinizing (v. Rath). Gmelin states it to be fusible with difficulty on the edges, and both Gmelin and v. Kobell state that it gelatinizes with muriatic acid. An examination of a specimen received from Scacchi fully confirms vom Rath's conclusions.

Obs.—Occurs in small crystals in geodes, usually in limestone blocks, on Monte Somma, near Naples.

Rammelsberg obtained (Pogg., xciv. 434) for 1 ∧ 1, basal, 63° 48′; over summit, 116° 12′; 1 ∧ 1, pyr.,=136° 12′; the former gives *O* ∧ 1=148° 6′, and 1 ∧ 1, pyr., 136° 8′. Kokscharof found 1 ∧ 1, pyr.,=136° 10′–136° 11½′ (Min. Russl., ii. 105); Scacchi, 136° 11′ (l. c.); vom Rath, for crystals from L. Laach, 135° 58½ (Pogg., cxix. 262), giving *a*=0·442.

Named by Haüy from *μείων*, *less*, the pyramid being less acute than in idocrase.

298. PARANTHITE. Paranthine pt. Skapolit, Scapolit, pt. Wernerit pt. Skapolit (fr. Storgord in Pargas) *N. Nordenskiöld*, Schw. J., xxxi. 417, 1821; id. (fr. Tunaberg) *Walmstedt*, His. Min. Geog. ueb. Wöhler, 98, 1826.

Tetragonal. Forms like those of wernerite; difference in angle, if any, undetermined. Observed planes: prismatic, *I*, *i-i*; octahedral, 1, 1-*i*; zirconoid, 3-3, Nord. Fig. 288, excepting the planes *i*-2 wanting (form observed at Ersby). Cleavage lateral. Also massive.

H.=5·5. G.=2·736, Pargas, Nordenskiöld; 2·849, Tunaberg, Walmstedt. Lustre between pearly and vitreous; outer surface sometimes a little waxy. Color white, grayish-white, gray, pale grayish-green, sea-green, approaching celandine-green. Translucent.

Comp.—O. ratio for $\dot{\text{R}}$, $\ddot{\bar{\text{R}}}$, $\ddot{\text{Si}}$=1 : 3 : 4; $(\frac{1}{4}\dot{\text{C}}\text{a}^3+\frac{3}{4}\ddot{\bar{\text{A}}}\text{l})^2\ddot{\text{S}}\text{i}^3$=Silica 43·0, alumina 36·9, lime 20·1=100.

Analyses: 1–3, N. Nordenskiöld (l. c.); 4, Walmstedt (l. c.); 5, Wolff (Comp. Ekeberg. Diss. Berolini, 1843):

	$\ddot{\text{Si}}$	$\ddot{\bar{\text{Al}}}$	$\ddot{\bar{\text{Fe}}}$	$\dot{\text{Mg}}$	$\dot{\text{Ca}}$	$\dot{\text{Na}}$	$\dot{\text{K}}$	$\dot{\text{H}}$
1. Ersby, *trl. cryst.*	43·83	35·43	—	—	18·96	—	—	1·03=99·25 Nord.
2. " *cryst.*	43·00	34·48	—	—	18·44	—	—	1·60=97·52 Nord.
3. Storgard	41·25	33·58	—	0·54	20·36	—	—	3·32=99·05 Nord.
4. Tunaberg, *cryst.*	43·83	35·28	0·68	—	19·37	—	—	—=99·06 Walmst.
5. Pargas, Ersby? *wh. or gnh.*	45·10	32·76	—	0·68	17·34	0·76	—	1·04=98·18 Wolff.
6 Pargas, *gnh. cryst.*	45·46	30·96	—	—	17·22	2·29	1·31	1·29=98·53 Rath.

Anal. 1, G.=2·736; 3, G.=2·749; 4, G.=2·849; 5, G.=2·712; 6, G.=2·654.

Anal. 1, 2, 4, correspond to the O. ratio 1 : 3 : 4 (more nearly 1 : 3·1 : 4·3); anal 3, to 1 : 2·6 : 3·6; anal. 4, to 1 : 3 : 4·3; anal. 5, to 1 : 3 : 4·6; each corresponding very nearly to the O. ratio for bases and silica 1 : 1.

An Ersby specimen afforded Hartwall and Hedberg (Jahresb., iv. 155) $\ddot{\text{Si}}$ 48·77, $\ddot{\bar{\text{Al}}}$ 31·05, $\dot{\text{Ca}}$ 15·94, $\dot{\text{Na}}$ 3·25, ign. 0·61=99·62; which gives the O. ratio 1·1 : 3 : 5·3, or a considerable excess of silica, with some soda. It is probably the same mineral with that of anal 5, altered.

Pyr., etc.—The Tunaberg crystals B.B. fuse easily with intumescence to a globule.

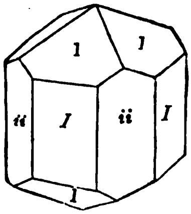
Obs.—Occurs in greenish 4- and 8-sided prisms, some of them terminated, at Tunaberg in Sweden; also at Ersby and Storgard in the parish of Pargas, Finland.

An analysis by Laugier of "Paranthine" from Arendal afforded him (J. de Phys., lxviii. 36, 180. 1809) $\ddot{\text{Si}}$ 45·0, $\ddot{\bar{\text{Al}}}$ 33·0, $\ddot{\bar{\text{Fe}}}$, $\dot{\text{Mg}}$ 1·0, $\dot{\text{Ca}}$ 17·6, $\dot{\text{Na}}$ 1·5, $\dot{\text{K}}$ 0·5, which agrees closely with the last analysis by Wolff. The name *paranthine*, substituted for scapolite (and for Arendal specimens) by Haüy, was consequently connected in France, almost as soon as introduced, with the above composition, and continued so to be for nearly 20 years afterward, Berzelius giving the formula $\dot{\text{C}}\text{a}^3\ \ddot{\text{S}}\text{i}+3\ \ddot{\bar{\text{A}}}\text{l}\ \ddot{\text{S}}\text{i}$ (and also the name *paranthine*) in his N. Syst. Min., 1819, 216. Although Laugier's analysis of the Arendal scapolites is not confirmed by later analysts, the name *paranthite* may well be retained for this section of the Scapolite group.

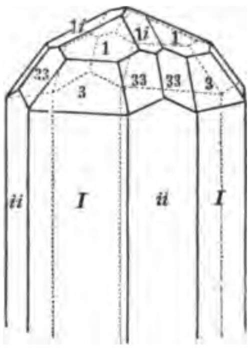
299. **WERNERITE.** Wernerite (fr. Norway) *d'Andrada*, J. de Phys., li. 244, 1800, Scherer's J., iv. 85, 1800. Scapolite (fr. Norway) *d'Andrada*, ib., 246, and ib. 38, 1800. Rapidolith *Abildgaard*, Ann. Ch., xxxii. 195, 1800. Wernerite, Scapolite, *H.*, Tr., iii. iv. 1801. Skapolith, Arcticit [=Wernerite] *Wern.*, 1803, Ludwig's Wern., ii. 210, 1804. Paranthine [=Scapolite of Arendal] *H.*, Lucas Tabl., 205, 1806; H. Comp. Tabl., 45, 1809. Fuscit (fr. Arendal) *Schumacher*, Verzeichn., 104, 1801. Chelmsfordite *J. F. & S. L. Dana*, Outl. Min. G. Boston, 44, 1818. Nuttallite (fr. Bolton) *Brooke*, Ann. Phil., II. vii. 316, 1824. Glaukolith (fr. L. Baikal) *v. Fischer*. Sokoloff's Bergwerks J.; John. Chem. Unters., ii. 82, 1810; Glaucolite.

Tetragonal: $O \wedge 1\text{-}i = 156° \ 14\frac{1}{2}'$; a=0·4398. Observed planes: O; vertical, *I*, *i-i*, *i*-2, *i*-3; pyramids, 1, 3; zirconoid, 3-3. 3-3 and *i*-2 often hemihedral, right or left, half of the eight planes being either wanting, or (as in f. 291, a top view) much smaller than the other half.

289



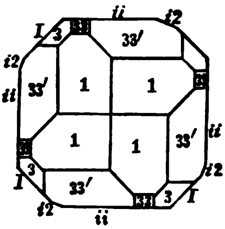
290



R. Slüdianka.

$O \wedge 1 = 148^\circ\ 6'$
$I \wedge 1 = 121\ 54$
$I \wedge i\text{-}2 = 161\ 34$
$I \wedge i\text{-}3 = 153\ 26$
$i\text{-}i \wedge i\text{-}3 = 161\ 34$
$i\text{-}i \wedge i\text{-}2 = 155\ 26$
$1 \wedge 1$, pyr., $= 136\ 7$
$1 \wedge 1$, bas., $63\ 48$
$1\text{-}i \wedge 1\text{-}i$, pyr., $= 146\ 53$

291



Hirwensalo, Finland.

Cleavage: *i-i* and *I* rather distinct, but interrupted. Also massive, granular, or with a faint fibrous appearance; sometimes columnar.

H. = 5–6. G. = 2·63–2·8. Lustre vitreous to pearly externally, inclining to resinous; cleavage and cross-fracture surface vitreous. Color white, gray, bluish, greenish, and reddish, usually light; streak uncolored. Transparent—faintly subtranslucent. Fracture subconchoidal. Brittle.

Var.—1. *Ordinary.* In crystals, white to gray, grayish-green, brownish, and rarely, from impurity, nearly black. Kokscharof gives for the angles those of meionite, namely, $1 \wedge 1$, pyr., $= 136^\circ\ 11'$, bas., $= 63^\circ\ 42'$, $1\text{-}i \wedge 1\text{-}i$, pyr., $= 146^\circ\ 57\frac{1}{2}'$, bas., $= 47^\circ\ 26'$, $i\text{-}i \wedge 1\text{-}i = 113^\circ\ 43'$, $I \wedge 1 = 121^\circ\ 51'$ (Min. Russl., ii. 82). The prisms are sometimes several inches thick.

Nuttalite (named after T. Nuttal) is white to smoky brown scapolite from Bolton, Mass. Chemists have found wide variations in composition, and have shown that it is sometimes much altered. The crystals and massive variety of Chelmsford, Mass., of gray, greenish, and reddish shades of color, has been called *Chelmsfordite.*

2. *Massive.* *Glaucolite* is of pale violet-blue, bluish, indigo-blue, to greenish-gray colors, sometimes resembling cancrinite, but having the cleavage of scapolite. It is from near R. Slüdianka, beyond L. Baikal, Siberia, where it occurs in veins in granite. The pink scapolite of Bolton is similar. Named from γλαυκος, *greenish-gray* or *sea-green.*

Comp.—O. ratio for $\dot{R}$, $\overline{\text{R}}$, $\ddot{\text{Si}} = 1 : 2 : 4$; or for bases and silica $1 : 1\frac{1}{4}$. Formula $(\frac{1}{3}(\dot{\text{C}}\text{a}, \dot{\text{N}}\text{a})^3 + \frac{2}{3}\overline{\text{Al}})^2\ddot{\text{Si}}^3 + \ddot{\text{Si}}$; or else with half the excess of silica ($\ddot{\text{Si}}$) basic; =, if $\dot{\text{C}}\text{a} : \dot{\text{N}}\text{a} = 4 : 1$, Silica 48·4, alumina 28·5, lime 18·1, soda 5·0 = 100.

The above is the mean ratio; but the analyses show variations from it, as seen below, due, in part at least, to impurities, alteration, or incorrect determinations.

Analyses: 1, 2, G. v. Rath (Pogg., xc. 82, 288); 3, Thomson (Min., i. 273); 4, Wolff (Inaug. Diss. Berlin, 1843, Ramm. Min. Ch., 719); 5, Wurtz (Am. J. Sci., II. x. 325); 6–8, G. v. Rath (l. c.); 9, Berg (Jahresb., xxv. 356); 10, v. Rath (l. c.); 11, Wolff (l. c.):

	$\ddot{\text{Si}}$	$\overline{\text{Al}}$	$\overline{\text{Fe}}$	$\dot{\text{Mg}}$	$\dot{\text{Ca}}$	$\dot{\text{Na}}$	$\dot{\text{K}}$	$\dot{\text{H}}$
1. Bolton, *bkh.-gn.*	44·40	25·52	3·79	1·01	20·18	2·09	0·51	1·24=98·74 Rath.
2. " "	45·57	23·65	3·38	1·23	20·81	2·46	0·63	0·78=98·51 Rath.
3. "	46·30	26·48	—	—	18·62	8·64	—	5·04=100·08 Thom.
4. " *rdh.*, *mass.*	48·79	28·16	0·32	1·29	15·02	4·52	0·54	0·74=99·86 Wolff.
5. " *bluish*, "	47·67	25·75	2·26	—	17·31	7·76	—	—=100·77 Wurtz.
6. Arendal, *ywh.-gn.* "	45·05	25·31	2·02	0·30	17·30	6·45	1·55	1·24=99·22 Rath.
7. Arendal, *ywh.*, *cryst.*	46·82	26·12	1·39	0·26	17·28	6·88	0·97	0·38=100 Rath.
8. Malsjö, *bluish*, *mass.*	47·24	24·69	—	2·18	16·84	3·55	0·85	1·75=97·06 Rath.
9. Drothems, *violet*, "	46·82	26·60	0·32	0·55	17·17	4·76	0·32	1·60=98·14 Berg.
10. L. Baikal, *Glaucolite*	47·49	27·57	1·54	0·47	17·16	4·71	0·58	0·48=100 Rath.
11. Laurinkari, Finl.	48·15	25·38	1·48	0·84	16·63	4·91	0·12	0·35=98·45 Wolff.

Anal. 1, G.=2·788, blackish-green crystals, the interior in part opaque; 2, 2·748, and like the preceding in color; 3, 2·709; 4, G.=2·718; 5, G.=2·704; 6, G.=2·751; 7, G.=2·697; 8, G.=2·763; 9, G.=2·34?, from the parish of Drothems in E. Gothland; 10, G.=2·666; 11, G.=2·733, color blackish-green and greenish-gray.

The oxygen ratios for Ṙ, R̶, S̈i, corresponding to the analyses are:

1. 1 : 2 : 3·6
2. 1·2 : 2 : 4·1
3. 1 : 2 : 4
4. 1 : 2·2 : 4·3
5. 1 : 1·8 : 3·7
6. 1 : 1·7 : 3·4
7. 1 : 1·8 : 3·6
8. 1 : 1·7 : 4·0
9. 1·1 : 2·0 : 4·0
10. 1 : 2·1 : 4·0
11. 1·1 : 2 : 4·0

The first two analyses by v. Rath of specimens named *nuttallite*, and attributed to Bolton, are evidently of altered crystals, as the presence of over 3 p. c. of oxyd of iron indicates. The color stated, "blackish-green," is further evidence on this point. Moreover it is a very unusual color at the locality, as nuttallite is ordinarily white, grayish-white, and pale smoky brown, the darker color occurring sometimes in crystals that are partly whitish. V. Rath states that the mineral was very difficultly fusible. Thomson's analysis (No. 3) was also made on an altered specimen, as it gave 5 p. c. of water.

Muir, in an analysis of nuttallite published by Thomson (Min., 383) obtained S̈i 37·81, Ä̶l 25·10, F̶e 7·59, Ċa 18·34, K̇ 7·30, Ḣ 1·50=97·94. The potash and the low silica, as well as the iron, indicate an altered specimen, if the analysis may be so far trusted as to draw a conclusion from it. The color of the mineral (white, to yellowish, bluish, or greenish) and the associated minerals on the specimen (sphene and green pyroxene) show that Muir probably had true nuttallite for investigation.

Wurtz's analysis of the pink scapolite of Bolton gives more soda than the rest. In a recent trial (priv. contrib.) B. S. Burton found about 3 p. c. of alkalies, sustaining Wolff's results.

The bluish-gray massive variety from Malsjö has been analyzed also by Suckow (Verwitt. Min., [illegible]), but as he found no alkalies, his results are questionable, either on the ground of the specimen or the analysis. He obtained S̈i 48·17, Ä̶l 28·27, F̶e 2·38, Ċa 19·04, Ḣ 2·00=99·86. Suckow analyzed also a kaolin from Malsjö, a result of alteration of the scapolite (see p. 323).

Pyr., etc.—B.B. fuses easily with intumescence to a white blebby glass. Imperfectly decomposed by muriatic acid.

Obs.—Occurs in metamorphic rocks, and most abundantly in granular limestone near its junction with the associated granitic or allied rock; sometimes in beds of magnetite accompanying limestone. It is often associated with light-colored pyroxene, amphibole, garnet, and also with apatite, sphene, zircon; amphibole is a less common associate than pyroxene. The scapolite of Pargas, Finland, is in limestone; that of Arendal in Norway, and Malsjö in Wermland, occurs with magnetite in limestone.

Some foreign localities of the mineral are above indicated. In the following those of wernerite and ekebergite are not yet distinguished. In *Vermont*, at Marlboro', massive. In *Mass.*, at Bolton and Boxborough, in crystals, sometimes large; at Chelmsford; Littleton; Chester; Carlisle; Westfield, massive; at Parsonsfield and Raymond, near Dr. Swett's house, crystals, with yellow garnet. In *Conn.*, at Monroe, white and nearly fibrous; a stone quarry at Paugatuck, Stonington, massive. In *N. York*, at Two Ponds in Orange Co., reddish-white crystals with pyroxene, sphene, and zircon, one crystal 10 in. long and 5 in diameter; at Fall Hill, Monroe, of white and bluish colors, massive, with lamellar pyroxene; in Warwick of the same county, near Amity, milk-white crystals with pyroxene, sphene, and graphite; 5 m. S. of Warwick, and 2 m. N. of Ellenville, near Greenwood Furnace (planes 1, *I*, *i*-2, *i*-*i*), are other good localities; in Essex Co., perfect crystals and massive nearly fibrous, white and greenish-white, abundant near Kirby's graphite mine, 4 m. N. E. of Alexandria, in Ticonderoga, associated with pyroxene; at Crown Point; in Lewis Co., in fine crystals, white, bluish, and dark gray, presenting the play of light not unusual with this variety; edges of the crystals often rounded. In *N. Jersey*, at Franklin and Newton, and 3 m. W. of Attleboro', crystallized, in limestone. In *Canada*, at G. Calumet Id., massive lilac-colored; at Hunterstown, in large crystals, with sphene; at Grenville, with pyroxene.

Pisani has analyzed a scapolite from Brakke, Norway, which gives a composition between that of paranthite and wernerite. He obtained (C. R., lv. 450):

S̈i 48·78 Ä̶l 32·65 F̶e 0·87 Ṁg 1·15 Ċa 13·32 Ṅa 2·59 K̇ 0·63 Ḣ 1·30=101·29.

It had been called Esmarkite.

One of the minerals called *saussurite* by Boulanger, stated to come from Mt. Genèvre, gave him G.=2·65, and the composition S̈i 44·6, Ä̶l 30·4, Ṁg 2·5, Ċa 15·5, Ṅa 7·5 (Ann. d. M., III. viii. 159). It is stated to be greenish-white and compact, and to occur associated with a greenish-brown smaragdite. In low specific gravity it is near scapolite. But we may suspect that there is some mistake about the specific gravity, in which case it may be zoisite (see p. 290) like other saussurite of the Alps. It agrees rather nearly with the latter in composition.

Canaanite, a grayish-white or bluish white rock occurring with dolomite in Canaan, Conn., and referred to massive scapolite by some authors, is massive whitish pyroxene, a mineral common in crystals in the dolomite of the region.

A so-called *glaucolite* from the L. Baikal region, analyzed by Bergemann (Pogg., ix. 267) and Givartovski (Bull. Soc. Nat. Moscow, 1848, 548) differs from the true glaucolite in being difficultly fusible (as much so as orthoclase), and also in composition, these analysts obtaining:

	$\ddot{\mathrm{Si}}$	$\bar{\mathrm{Al}}$	$\bar{\mathrm{Fe}}$	$\dot{\mathrm{Mn}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Na}}$	$\dot{\mathrm{K}}$	$\dot{\mathrm{H}}$
1.	50·58	27·60	0·10	0·85	3·73	10·26	2·96	1·26	1·73=99·07 Bergemann.
2.	50·49	28·12	0·44	0·59	2·68	11·31	8·10	1·00	1·78=99·51 Givartovski.

It was massive, of a greenish-blue color, with G.=2·721, Berg.; 2·65, Giv. It has been supposed to be a feldspar.

Alt.—As the altered scapolites that have been derived from ekebergite or paranthite have not been distinguished from those derived from wernerite, the following observations are made to include all:

In the alteration of the scapolites, one or more of the following changes occur, as illustrated in the following analyses of different kinds:

1. The hydration of the mineral.
2. The loss of part or all of the protoxyd bases, often effected largely through the action of carbonated waters carrying off the lime as carbonate.
3. The substitution of potash for the soda or lime, due to the action of the carbonates in solution in percolating waters.
4. The increase in the amount of soda, probably by the action of carbonate of soda or chlorid of sodium in solution.
5. The introduction of oxyd of iron, through salts of lime (organic, bicarbonate, etc.) in solution.
6. The substitution of magnesia for other protoxyd bases.
7. The loss of silica as well as protoxyd bases.

By the substitution of potash, the mineral passes either to the state of *pinite* (anal. 8 to 15), or to that of a *potash mica* (anal. 15, 16). By the acquisition of iron (anal. 17, 18) it passes in some cases to *epidote* (anal. 19). By the introduction of magnesia, it may pass to *steatite*; or of magnesia and potash, to a *magnesia mica* (anal. 20). By a loss of bases, the proportion of silica left increases (anal. 4, 5, 6, 21, 22, 23); and by a loss of silica also (which may become opal in its separation), the mineral passes to a *kaolin*-like compound, a common result of its alteration (anal. 24). Moreover, silica may remain, and the altered crystal become by additions a siliceous pseudomorph, as occurs at Pargas.

Analyses: I. *Hydrous.* 1, Weibye and Berlin (Pogg., lxxix. 302).

II. *Containing carbonate of lime.* 2–6, Hermann (J. pr. Ch., xxxiv. 177); 7, Brewer (This Min. 1850, 680); 7*a*, same, with the $\ddot{\mathrm{C}}$ removed.

III. *Potassic and often also carbonated.* 8, v. Rath (Pogg., xc. 288); 8*a*, same, with the $\ddot{\mathrm{C}}$ removed; 9, T. S. Hunt (Rep. G. Can., 1852–53, 168, 1863, 474); 10, Stadtmüller (Am. J. Sci., II. viii. 394); 11, T. S. Hunt (ib., 103); 12, Crossley (This Min., 1850, 680); 13, J. D. Whitney (Am. J. Sci., II. xvi. 207); 14, T. S. Hunt (Rep. G. Can., 1853, 1863); 15, Bischof (Ch. Geol., ii. 1433); 16–19, v. Rath (l. c.); 20, Bischof (l. c.); 21, John (Beud. Min., ii. 94, 1832); 22, Berzelius (Afh. i. Fys., ii. 202); 23, Hartwall & Hedberg (Jahresb., iv. 155); 24, Suckow (Verwitt. Min., 138 1848):

			$\ddot{\mathrm{Si}}$	$\bar{\mathrm{Al}}$	$\bar{\mathrm{Fe}}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Mn}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Na}}$	$\dot{\mathrm{K}}$	$\dot{\mathrm{H}}$
I.	1.	Arendal, *Ather.*	38·00	24·10	——	4·82	0·78	2·80	22·64	——	——	6·95=100·09 B.
II.	2.	S'dianka, *Strog.*	43·35	30·52	0·95	——	——	——	21·59	3·74	——	——=100·15 H.
	3.	Diana, *gray*	47·94	30·02	2·60	——	0·26	——	14·41	2·20	0·78	0·31=98·47 H.
	4.	Bolton, *white cr.*	56·04	23·92	1·14	——	0·14	0·20	9·28	8·66	1·27	——=100·65 H.
	5.	" *rdh. mass.*	51·68	29·30	1·16	——	0·15	0·78	13·51	1·46	0·94	0·82=99·80 H.
	6.	Gulsjö, *w. mass.*	53·75	28·06	0·34	——	0·26	——	9·24	7·00	0·55	0·67=99·87 H.
	7.	Franklin, *gnh.* (½)	47·35	28·77	——	1·72	——	2·02	12·00	——	*tr.*	1·80, $\ddot{\mathrm{C}}$ 4·72=98·38 B.
	7*a*.	"	49·71	30·21	——	1·81	——	2·12	12·20	——	——	1·89=98·34 B.
III.	8.	Bolton, *yellow*	49·99	23·00	1·64	——	——	1·73	3·35	0·35	7·09	4·23, $\dot{\mathrm{Ca}}\ddot{\mathrm{C}}$ 7·80=99·19 R.
	8*a*.	"	52·20	24·03	1·71	——	——	1·80	8·06	0·37	7·40	4·43=100·99 R.

			$\ddot{\mathrm{Si}}$	$\bar{\mathrm{Al}}$	$\bar{\mathrm{Fe}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Na}}$	$\dot{\mathrm{K}}$	$\dot{\mathrm{H}}$
	9.	Perth	46·30	26·20	—	3·63	12·88	2·88	4·30	2·80=98·99 Hunt.
	10.	Diana	45·79	30·11	1·86	—	17·40	—	3·48	1·63=100·27 Stadtm.
	11.	*Algerite*	49·82	24·91	1·85	1·15	—	*tr.*	10·21	7·57, $\dot{\mathrm{Ca}}\ddot{\mathrm{C}}$ 3·94=99·45 H.
	12.	"	49·96	24·41	1·48	5·18	—	—	9·97	5·06, $\dot{\mathrm{Ca}}\ddot{\mathrm{C}}$ 4·21=100·27 C.
	13.	"	52·09	18·63[a]	—	*und.*	—	*und.*	*und.*	6·68, $\dot{\mathrm{Ca}}\ddot{\mathrm{C}}$ 4·41, $\dot{\mathrm{Ca}}^3\ddot{\ddot{\mathrm{P}}}$ 8·22 W
	14.	*Wilsonite* (½)	47·60	31·20	—	4·19	1·45	0·88	9·30	5·43=99·55 Hunt.
	15.	Arendal, *Mica*	[65·82][b]	27·37[a]	—	0·42	—	0·42	5·77	0·20=100 Bisch.
IV	16.	" "	44·49	24·91	4·84	0·36	2·14	1·11	6·71	3·44, $\dot{\mathrm{Ca}}\ddot{\mathrm{C}}$ 11·11=99·11 R.
	17.	" *brick-red*	59·74	16·20	7·90	4·02	2·15	4·31	4·42	1·83=100·57 Rath.
	18.	" *black*	29·52	15·77	19·14	8·50	9·02	0·58	0·37	10·89, $\dot{\mathrm{Ca}}\ddot{\mathrm{C}}$ 4·62=98·45 R.
	19.	" *Epidote*	37·92	19·21	15·55	0·25	22·68	0·39	0·23	2·51=98·74 Rath.
V.	20.	Pargas, *Mica*	46·75	26·15	—	15·78	—	0·82	5·64	0·63=95·77 Bischof.
	21.	*Gabbronite*	54·00	24·00	—	1·50	—	17·25	—	2·00=100 John.
VI.	22.	Sjösa, *brick-red*	61·50	25·35	1·50	0·75	3·00		5·00	$\dot{\mathrm{Mn}}$ 1·50=99 Berz.
	23.	Petteby, Parg.	51·34	32·27	1·91	—	9·33	5·12	—	1·00=100·97 H. & H.
VII.	24.	Mälsjo, *Kaolin*	53·32	44·65	—	—	1·17	—	—	—=99·11 Suckow.

[a] With a little $\mathrm{Fe}^2\mathrm{O}^3$. [b] Probably too high.

The following are the characters of different altered scapolites, including those of which analyses are above given :

ATHERIASTITE *Weibye* (Pogg., lxxix. 302, 1850). Anal. 1. Like scapolite in form; color greenish; opaque. From Arendal, with black garnet and keilhauite.

STROGANOVITE *Herm.* (J. pr. Ch., xxxiv. 178, 1845) (Anal. 2). Has the form of scapolite (Koksch. Min. Russl., iii. 95). Color yellowish to light oil-green; lustre greasy; translucent; H.=5·5, G.=2·79. B.B. fuses easily with intumescence. From the Slüdianka in Dauria. The analysis afforded 6·4 p. c. of carbonic acid, which is above removed; this corresponds to 11·4 p. c. of $\dot{\mathrm{Ca}}\ddot{\mathrm{C}}$.

Anal. 3. Large gray crystals, containing 9·23 p. c. of $\dot{\mathrm{Ca}}\ddot{\mathrm{C}}$; G.=2·74. In the anal. as above given 4·06 of $\ddot{\mathrm{C}}$ is removed. Occurs at Diana, N. Y., with sphene in calcite.

Anal. 4. White crystals with calcite, from Bolton; G.=2·66. In the anal. as above given, 2·5 p. c. of $\ddot{\mathrm{C}}$ is removed. Anal. 5, reddish massive, from Bolton; G.=2·70. Anal. 8, massive, yellowish; H.=4·5; G.=2·787. Contains 7·80 p. c. of $\dot{\mathrm{Ca}}\ddot{\mathrm{C}}$. From Bolton.

Anal. 6. Whitish massive, from Gulsjö; contains 3·41 $\dot{\mathrm{Ca}}\ddot{\mathrm{C}}$; G.=2·69. In the anal. above, 1·5 p. c. of $\ddot{\mathrm{C}}$ removed.

Anal. 7. Greenish or yellowish-green, cleavable, and partly in crystals, from Franklin, N. J., having H.=3·5, G.=2·78, with subresinous lustre; B.B. very fusible. Contains 10·72 p. c. of $\dot{\mathrm{Ca}}\ddot{\mathrm{C}}$.

Anal. 9. Greenish-gray, waxy in lustre to pearly, subtranslucent, with H.=5·5, G.=2·640--[illegible]; from Perth in Canada. Contains considerable magnesia as well as potash.

Anal. 10. In grayish crystals, from Diana, associated with sphene. (Not from Bolton, as announced: the specimen shows by its character and the associated minerals that it is unquestionably from Diana.)

ALGERITE *Hunt* (Am. J. Sci.. II. viii. 103, 1849) (anal. 11—13) occurs in slender square prisms, sometimes 2 or 3 in. long, imbedded in calcite. Yellowish to gray and usually dull. Brittle. H. =3—3·5; some crystals more altered, 2·5. G.=2·697—2·712, Hunt; 2·78, Crossley. From Franklin, Sussex Co., N. J. The varying results of analyses, and the presence of carbonate of lime, of magnesia, and the relations to known examples of altered scapolite, confirm the view derived from the form and appearances, that algerite is an altered scapolite, and related to pinite.

WILSONITE *Hunt* (Logan's Rep. Can., 1853 and 1863, Am. J. Sci, II. xix. 428) (anal. 14) is a massive mineral from Bathurst, Canada, affording square prisms by cleavage, and having H. =[illegible], G.=2·765—2·776, lustre vitreous, a little pearly on cleavage surfaces; color reddish-white, rose-red, and peach-blossom red. According to Chapman (Am. J. Sci., II. xx. 269), its crystallization and other characters are essentially those of scapolite. It is associated with apatite, calcite, and pyroxene. The oblique basal cleavage, mentioned by Hunt, is, as stated in the last edition of this work, p. 503, only a fracture. Hunt in Rep. G. Can. 1863 makes it a variety of gieseckite. Occurs also in northern N. York. See further under **PINITE**, p. 479.

Terenite of Emmons (Rep. G. N. Y., 1837, 152) has the form of scapolite, with H.=2; G.=2·53; lustre a little pearly; color yellowish-white or greenish; and is from a small vein in limestone at Antwerp, N. Y. It has not been analyzed, but is probably near algerite or wilsonite. The *Pinitartigen* (pinite-like) *Scapolit* of Schumacher (Verz., 98, 1801), from Arendal, is probably simi lar to the algerite and other *pinite* pseudomorphs. It is described as occurring in crystals a massive, of a white, greenish, and other shades, and as B.B. fusing easily. His *Talkartiger S·a lit*, from Arendal, appears to have been a *steatitic* pseudomorph, it being B.B. infusible.

Mica from Arendal, Norway (*Micarelle* of Abildgaard). Anal. 15, 16. The mica occurs i bedded in quartz, and has, according to v. Rath (l. c.), the form of 8-sided crystals of scapoli 6 in. long. The crystals are covered with mica externally, and within consist throughout of aggregation of the same mica. The mica is greenish-white, translucent. H.=2—3. G.=2·8 Oxygen ratio (from v. Rath) 1 : 5·6 : 10·5; perhaps 1 : 6 : 10½, giving 1 : 1½ for the oxygen the bases and silica. The change from scapolite has consisted in the removal of lime, addition $\overline{\dddot{\mathrm{F}}}\mathrm{e}$, and substitution of potash for soda.

Mica from Pargas, anal. 20, is a magnesia mica.

The *red* scapolite of Arendal (anal. 17) has H.=5; G.=2·852. Brownish or brick-red. I ficultly fusible. Oxygen ratio 1 : 2·4 : 7·5. In the change, $\overline{\dddot{\mathrm{F}}}\mathrm{e}$, magnesia, and potash have be introduced.

The *black* scapolite of Arendal (anal. 18) is altered by a large addition of magnesia and ir Color grayish-black; streak grayish-white. Rather soft. G.=2·837. No cleavage. B.B. edg rounded with difficulty. O. ratio 1 : 2·1 : 2·5 : 1·3, unless part of the iron is sesquioxyd.

The *epidote pseudomorph* of the same locality (anal. 19) gives the oxygen ratio of epid 1 : 2 : 3. The crystals occur imbedded in uralite. Forchhammer has described other epid pseudomorphs after scapolite from Arendal, which are albite externally and epidote within.

GABBRONITE of Schumacher (Verzeichn., 1801) is referred here by Sæmann, who observes th there are, in the Ecole des Mines at Paris, crystals of it of the form of scapolite (This Min., 5 1854). Schumacher describes it as bluish-gray, inclining to leek-green; also grayish mounta green; lustre feeble; fracture smooth like that of flint; G.=2·947; having some resemblance gabbro. The bluish-gray variety from the Kenlig mine near Arendal, with black hornble and calcite, and the other from Fredericksvärn, Norway, in syenite.

The *kaolin* from Malsjö, anal. 24, is a reddish-yellow clay-like mass, retaining something of crystalline form of scapolite; G.=2·1. The composition corresponds to 1 of alumina to 2 of sili For another kaolin see under EKEBERGITE (Passauite).

Steatitic pseudomorphs occur at Newton, N. J., and Arendal in Norway. A *siliceous* scapol of Pargas, of a gray color, in limestone, contains 92·71 p. c. of silica. *Albite* is announced Tschermak as occurring pseudomorphous after scapolite.

Pseudo-Scapolite of N. Nordenskiöld (Bidrag Finl. Min., 66, 1820) is wernerite altered to pyr ene. The crystals are large and contain crystals of pyroxene, which are most abundant tow the exterior; from Simonsby, near Pargas.

300. EKEBERGITE. Scapolite (fr. Arendal) pt. Wernerite (fr. Arendal) pt. [Syn. un WERNERITE.] Sodait (fr. Hesselkulla) *Ekeberg*, Afh., ii. 153, 1807. Natrolite of Hesselk *Wollaston*. Ekebergite *Berz.*, Arsb., 1824, 168. Ekebergit, Porzellanspath (fr. Passau) *J. Fuchs*, Denkschr. Ak. Munchen, vii. 65, 1818, Tasch. Min., xvii. 94, 1823. Porzellanit *v. K* Taf., 52, 1853. Passauit *Naumann*, Min., 305, 1855.

Tetragonal. Like wernerite in form and cleavage. Also compact, finely columnar massive.

H.=5·5—6. G.=2·74. Lustre vitreous, somewhat pearly or grea Color white, gray, greenish-white, bluish, reddish. Transparent to s translucent.

Comp.—O. ratio for $\dot{\mathrm{R}}$, $\overline{\dddot{\mathrm{R}}}$, $\dddot{\mathrm{Si}}$=1 : 2 : 4·5; formula $(\frac{1}{3}(\dot{\mathrm{Ca}}, \dot{\mathrm{Na}})+\frac{2}{3}\overline{\dddot{\mathrm{A}}}\mathrm{l})^{2}\dddot{\mathrm{Si}}^{3}+3\dddot{\mathrm{Si}}$; or else w half the excess of silica (or 1½ $\dddot{\mathrm{Si}}$) basic; =, if $\dot{\mathrm{Ca}}$: $\dot{\mathrm{Na}}$=3 : 1, Silica 51·7, alumina 26·3, lime 1 soda 5·9=100; if $\dot{\mathrm{Ca}}$: $\dot{\mathrm{Na}}$=2 : 1, Silica 51·7, alumina 26·3, lime 14·2, soda 7·9=100.

Analyses: 1, Hermann (J. pr. Ch., xxxiv. 177); 2, Wolff (Inaug. Diss., Berlin, 1843, Ran Min. Ch., 719); 3, Hartwall (Berz. Jahresb., iv. 155); 4, Wolff (l. c.); 5, v. Rath (Pogg., xc 288); 6, Wolff (l. c.); 7, Damour (L'Institut., 1862, 21); 8, v. Rath (l. c.); 9, Fuchs (l. c.); 10 Kobell (J. pr. Ch., i. 89); 11, Schafhäutl (Ann. Ch. Pharm., xlvi. 340):

	$\dddot{\mathrm{Si}}$	$\overline{\dddot{\mathrm{A}}}\mathrm{l}$	$\overline{\dddot{\mathrm{F}}}\mathrm{e}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Na}}$	$\dot{\mathrm{K}}$	$\dot{\mathrm{H}}$
1. Hessellkulla	51·02	26·86	2·73	0·37	13·29	4·64	0·82	——, $\dot{\mathrm{Mn}}$ 0·26=100 H
2. " *gyh.-gn.*	49·26	26·40	0·54	——	14·44	6·14	0·65	0·69=98·12 Wolff.

	S̈i	Äl	F̶e	Ṁg	Ċa	Ṅa	K̇	Ḣ
3. Pargas	49·42	25·41	1·40	0·68	15·59	6·05	—	1·45=100 Hartwall.
4. Malsjö, *pink, mass.*	49·88	27·02	0·21	0·85	12·71	7·59	0·87	0·77=99·90[a] Wolff.
5. " *white*	50·04	25·68	—	1·06	12·64	5·89	1·54	2·50=99·35 Rath.
6. Arendal, *ywh.-w.*	50·91	25·81	0·75	0·58	13·34	7·09	0·85	0·41=99·74 Wolff.
7. "	50·30	25·08	—	—	14·08	5·98	1·01	3·25=99·70 Damour.
8. Gouverneur	52·25	23·97	—	0·78	9·86	8·70	1·73	1·20=98·49 Rath.
9. Passau, *Passauite*	49·30	27·90	—	—	14·42	5·46	—	0·90=97·98 Fuchs.
10. " "	50·29	27·37	—	—	13·53	5·92	0·17	—=97·30 Kobell.
11. " "	49·20	27·30	—	—	15·48	4·53	1·23	1·20, Cl 0·92=99·65 S.

[a] 1·85 p. c. of carbonate of lime removed.

Anal. 1, G.=2·80; 2, G.=2·735; 4, G.=2·623; 5, G.=2·658; 6, G.=2·712; 8, G.=2·633; 9, G. =2·64.

The *passauite* (Porcellanspath) has the O. ratio, in anal. 1, 1 : 2·4 : 4·8; in 2, 1 : 2·4 : 4·9; in 3, 1 : 2·2 : 4·6. But a slight change in the bases would make the last 1 : 2 : 4·5; and it is probable that the mineral is an altered ekebergite. Fuchs made the prisms probably about 92°, and so also did Schafhäutl. But Descloizeaux has found that it has but one optical axis—a negative one—and this decides it to be tetragonal in crystallization. Its colors are white to yellowish, bluish, and grayish-white. The crystals are coarse, and irregularly grouped or single.

Pyr., etc.—In the closed tube yield a small amount of water. B.B. whitens and fuses with intumescence to a blebby glass. Imperfectly decomposed by muriatic acid.

Obs.—From Hessellkulla and Malsjö in Sweden; Arendal in Norway; Pargas in Finland, in limestone; Gouverneur, St. Lawrence Co., N. Y., in limestone, with apatite and sphene, in short thick crystals sometimes several inches in diameter.

The passauite is from Appenzell, near Passau, in Bavaria.

Alt.—The passauite is the source, by its alteration, of a large bed of porcelain earth or kaolin. Part of the kaolin has the prismatic form of the passauite. Fuchs found in one of his analyses S̈i 45·06, Äl 32·00, F̶e 0·90, Ċa 0·74, Ḣ 18·00, undecomposed mineral 2·96=99·66; in another S̈i 43·65, Äl 35·95, F̶e 1·00, Ċa 0·83, Ḣ 18·50=99·91. Opal occurs in the kaolin as one result of the alteration.

PARALOGITE *N. Nordensk.* (Bull. Soc. Nat. Moscow, xxx. 221, 1857). Has the form and angles of scapolite (Koksch. Min. Russl., iii. 187), and is probably altered ekebergite. Colors white, bluish, reddish-blue; G.=2·665. The crystals, after action of acids, are full of worm-like holes, owing to the separation of the carbonate of lime present. Analysis afforded S̈i 44·95, Äl 26·89 Ṁn *tr.*, Ṁg 1·01, Ċa 14·44 [Ṅa 10·86], ign. 1·85=100. No potash was found. B.B. easily fusible. The O. ratio for Ṙ, R̶, S̈i is 1 : 3 : 6; but supposing a loss of part of the bases, it may have been originally a true ekebergite. From the lazulite locality near Bucharei in Siberia, in the L. Baikal region.

301. MIZZONITE. *Scacchi*, Pogg., Ergänz., iii. 478, 1852.

Tetragonal. Closely resembles meionite in its crystals. Observed planes: *O*, *I*, *i-i*, *i*-2, 1. *O* ∧ 1-*i*=156° 6′; *a*=0·4430; 1 ∧ 1=135° 56′ and 64° 8′, Scacchi; 135° 58′, Kokscharof. Cleavage as in meionite. Crystals quite small. Unknown massive.

H.=5·5—6. G.=2·623, v. Rath. Lustre vitreous. Colorless to white. Transparent to translucent.

Comp.—O. ratio for Ṙ, R̶, S̈i=1 : 2 : 5¼; or, for bases and silica,=1 : 1¾; formula, (⅓(Ċa, Ṅa)³ + ⅔ Äl)² S̈i³ + 2¼ S̈i; or else with half the excess of silica basic; =, if Ċa : Ṅa=1 : 1, Silica 55·2, alumina 24·0, lime 9·9, soda 10·9=100. The analyses agree about as well with the O. ratio 1 : 2 : 5⅓.

Analysis: v. Rath (Pogg., cix. 254):

S̈i 54·70 Äl 23·80 Ṁg 0·22 Ċa 8·77 Ṅa 9·83 K̇ 2·14, ign. 0·13=99 59.

Pyr., etc.—B.B. fuses easily, but with less intumescence than meionite. Not acted upon by muriatic acid.

Obs.—Occurs on Somma, like the meionite but is associated with feldspar instead of calcite Named from μείζων, *greater*, the axis of the prism being a little longer than in meionite.

302. DIPYRE. Schorl blanchâtre de Mauléon (Pyrenees) (discov'd by Gillet-Laumont in 1786) Leucolite, *Delameth.*, Sciagr., i. 289, ii. 401, 1792. Dipyre *H.*, Tr., iii. 1801. Schmelzstein *Wern.* Steff. Orykt., i. 411, 1811. Couseranite *Charpentier*, Ann. Ch. Phys., xxxix. 280, 1828. Couzeranite. Prehnitoid *Blomstrand*, Œfv. Ak. Stockh., 1854, 297.

Tetragonal. Form and cleavage same as for wernerite and meionite Crystals small or large, single or grouped. Sometimes columnar.

H.=5—5·5. G.=2·646. Lustre vitreous to somewhat pearly. Colorless, whitish, yellowish, greenish, and sometimes reddish; opaque white Transparent to subtranslucent.

Dipyre occurs in rather coarse crystals, often large or stout, and rarely columnar, in metamorphic rocks, while *marialite* is found only in very small colorless or white crystals, in igneous rocks and contains more alkali. Prehnitoid is similar to dipyre.

Comp.—O. ratio for $\dot{\text{R}}$, $\overset{\dots}{\text{R}}$, $\ddot{\text{Si}}$=1 : 2 : 6; formula $(\frac{1}{3}(\frac{1}{2}\dot{\text{Ca}}+\frac{1}{2}\dot{\text{Na}})^3+\frac{2}{3}\overset{\dots}{\text{Al}})^2\ddot{\text{Si}}^3+6\ddot{\text{Si}}$=, if $\dot{\text{Ca}}$: $\dot{\text{N}}$ =1 : 1, Silica 58·3, alumina 22·6, lime 9·1, soda 10·0.

Analyses: 1, Vauquelin (Haüy's Tr., iii. 1801); 2, Delesse (C. R., xviii. 994, 1844); 3, Damou (L'Institut, 16, 1862); 4, Pisani (Descl. Min., i. 227); 5, Blomstraud (Œfv. Ak. Stockh., 1854):

		$\ddot{\text{Si}}$	$\overset{\dots}{\text{Al}}$	$\dot{\text{Mn}}$	$\dot{\text{Mg}}$	$\dot{\text{Ca}}$	$\dot{\text{Na}}$	$\dot{\text{K}}$	$\dot{\text{H}}$
1. *Dipyre*		60	24	——	——	10	4		2=100 Vauq.
2. "	Libarens	55·5	24·8	——	——	9·0	9·4	0·7	——=99·4 Delesse.
3. "	Pouzac	56·22	23·05	——	——	9·44	7·68	0·90	2·41=99·70 Damour.
4. "	Libarens	56·69	22·68	0·39	0·49	6·85	8·65	0·78	4·55=101·08 Pisani.
5. *Prehnitoid*		56·00	22·45	0·18	0·36	7·79	10·07	0·46	1·04, $\overset{\dots}{\text{Fe}}$ 1·01=99·36 Bl.

Pyr., etc.—B.B. fuses with intumescence to a white blebby glass. Some specimens are phosphorescent when heated. Imperfectly decomposed by acids.

Obs.—From the region of the Hautes-Pyrenees, in granular limestone; at Pouzac, near Bagnères-de-Bigorre, with a white uniaxial mica; near Libarens, about a mile and a half from Mauléon with mica or talc; at the baths of Aulus in the Dept. of Ariége; in a black schist on the righ bank of the Lés, near Luzenac, Ariége; in the vicinity of Loutrin, near Angoumer, in blocks o granular limestone, with pyrite, sphene. The *prehnitoid* is from a locality between Kongsber and Solberg in Sweden, with coarsely crystallized hornblende; its hardness is stated by Blomstrand to be 7, and G.=2·50.

The name *dipyre*, from δίς, *twice*, and πῦρ, *fire*, alludes to the two effects of heat, *fusion* and *pho phorescence*. *Prehnitoid* refers to a resemblance to *prehnite*.

Alt.—Dipyre undergoes very easy alteration, much easier than wernerite, and this it probabl owes to the large percentage of soda. At all the localities the mineral occurs to a large extent i a crumbling state. Some of it appears to be changed to a kind of greenish leuchtenbergite.

Couseranite appears to be the same mineral in an altered form. It occurs in the same region and the dipyre may be seen passing into couseranite. Its square prisms are usually rough o rounded exteriorly, and bluish-black or grayish-black to deep black in color, but sometimes whitish and blackish on the same specimen. It is often soft and fragile. Charpentier's mineral cam from the department of Ariége (formerly Couserans). Analyses: 1, Dufrénoy (Ann. d. M., II iv. 327); 2, Pisani (Descl. Min., i. 234):

	$\ddot{\text{Si}}$	$\overset{\dots}{\text{Al}}$	$\overset{\dots}{\text{Fe}}$	$\dot{\text{Mg}}$	$\dot{\text{Ca}}$	$\dot{\text{Na}}$	$\dot{\text{K}}$	$\dot{\text{H}}$
1.	52·37	24·02	——	1·40	11·85	3·96	5·52	——=98·55 Dufr.
2.	58·33	20·20	1·90	7·20	0·99	0·76	8·82	2·35=100·55 Pisani.

Pisani's analysis was made on large square prisms from Pouzac. It has the composition o agalmatolite. Both of the analyses indicate the alteration by the amount of potash present.

Other localities are near Bagnères-de-Bigorre; at Sentenac near Seix, Ariége, in hard limestone. An orthoclase of the region has sometimes been mistaken for couseranite.

303. MARIALITE. *v. Rath*, ZS. G., xviii. 635, 1866. [Not Marialite of Ryllo.]

Tetragonal. Closely resembles meionite in its crystals. Form like f

288, except that O is present, and 3-3 are wanting. $1 \wedge 1 = 136° 0'$, nearly.

H.=5·5–6. G.=2·626; but, allowing for impurity, 2·530. Lustre vitreous. Colorless, or white. Transparent to translucent.

Comp.—O. ratio for $\dot{\text{R}}$, $\dddot{\text{R}}$, $\ddot{\text{Si}}$=1 : 2 : 6, like dipyre; but having the alkalies and lime in the ratio 2 : 1 instead of 1 : 1. Formula $(\frac{1}{3}(\frac{1}{3}\dot{\text{Si}}+\frac{2}{3}\dot{\text{Na}})^3+\frac{2}{3}\dddot{\text{Al}})^2\ddot{\text{Si}}^3+3\ddot{\text{Si}}$=Silica 58·3, alumina 22·3, lime 6·0, soda 13·4=100. Or perhaps ratio 1 : 2 : 6½, which gives silica 62·1, alumina 20·2, lime 5·5, soda 12·2, agreeing better with the analysis. Analysis: v. Rath (l. c.); 1*a* is the analysis with $\dddot{\text{Fe}}$ removed as mixed magnetite:

	$\ddot{\text{Si}}$	$\dddot{\text{Al}}$	$\dddot{\text{Fe}}$	$\dot{\text{Mg}}$	$\dot{\text{Ca}}$	$\dot{\text{Na}}$	$\dot{\text{K}}$
1.	59·50	20·70	4·45	0·29	4·39	8·90	1·09=99·32.
1*a*.	62·72	21·82	——	0·31	4·63	9·37	1·15=100.

Pyr., etc.—Like those of mizzonite.

Obs.—From a volcanic rock called piperno, occurring at Pianura, near Naples.

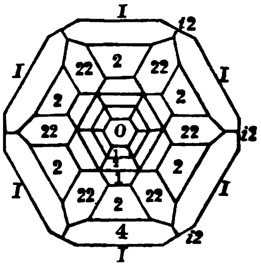
---

304. NEPHELITE. Sechsseitige weisse durchsichtige Schörlsäuler mit oder ohne Pyramide an der Spitze, etc. (fr. Vesuvius (Somma)), *J. J. Ferber*, Briefe aus Wälschland, 166, 1773;=Basaltes crystallisatus albus crystallis prismaticis *v. Born*, Lithoph., ii. 73, 1775;=Sommite *Delameth.*, T. T., ii. 271, 1797;=Nepheline *H.*, Tr., iii. 1801. Pseudo-sommite, Pseudo-nepheline (fr. C. di Bove), *Fl. Bellevue*, J. de Phys., li. 458, 1800; id., var. of Sommite, *Delameth.*, l. c. Nefelina, Cavolinite, Davina, *Mont. & Covelli*, Min. Vesuv., 1825.

Fettstein *Wern.*, 1808, Klapr. Beitr., v. 176, 1810, Steffen's Orykt., i. 472, 1811. Elæolith (fr. Norway) *Klapr.*, Mag. Ges. Fr. Berl., iii. 43, 1809, Beitr., v. 176, 1810. Pierre grasse *H.*, Tabl., 65, 228, 1809. Phonite (fr. Norway) Descl. Min., i. 289, 1863.

Hexagonal. $O \wedge 1 = 135° 55'$; $a=0·839$. Observed planes: O; prisms, I, i-2, i-$\frac{3}{2}$; pyramids, $\frac{2}{5}$, $\frac{1}{2}$, $\frac{2}{3}$, 1, 2, 4, 6; 2-2, 4-2. Usual forms six-sided and twelve-sided prisms with plane or modified summits. Fig. 292, summit planes of a crystal.

292



Vesuvius.

$O \wedge 2 = 117° 18'$
$O \wedge \frac{2}{3} = 147 \; 9$
$O \wedge \frac{1}{2} = 154° 9'$
$O \wedge 4 = 104 \; 28$
$I \wedge 1 = 134 \; 5$
$I \wedge 2 = 152 \; 42$
$1 \wedge 1$, pyr.,$=139 \; 17$
$1 \wedge 1$, bas.,$=88 \; 11$
$I \wedge i\text{-}2 = 150$

Cleavage: I distinct, O imperfect. Also massive, compact; also thin columnar.

H.=5·5–6. G.=2·5–2·65. Lustre vitreous—greasy; a little opalescent in some varieties. Colorless, white, or yellowish; also when massive, dark green, greenish or bluish-gray, brownish and brick-red. Transparent—opaque. Fracture subconchoidal. Double refraction feeble; axis negative.

Var.—1. *Glassy*, or Sommite. Usually in small crystals or grains, with vitreous lustre, first found on Mt. Somma, in the region of Vesuvius; G.=2·58, fr. Vesuvius, Scheerer; 2·637, ib., Breith. *Davyne* is nephelite from Vesuvius, with feeble lustre, containing, according to Rammelsberg, 12–14 p. c. of carbonate of lime, which he attributes to partial alteration; and *Cavolinite* is of the same locality; it has a silky lustre owing to longitudinal rifts within.

Kokscharof found the angle 1 ∧ 1=139° 17′; whence *I* ∧ 1=134° 5′ 22″, and *a*=0·838926 (Min. Russl., ii. 160). Breithaupt made *I* ∧ 1=134° 5′; Haidinger 134° 3′; Scacchi 133° 57½.

2. *Elæolite.* In large coarse crystals, or massive, with a greasy lustre. G.=2·597, fr. Miask, Breith.; 2·65, fr. Arkansas, Smith & Brush.

Comp.—O. ratio for $\dot{\text{R}}$, $\bar{\text{R}}$, $\ddot{\text{Si}}$=1 : 3 : 4½. Formula perhaps $(\dot{\text{N}}\text{a}^3, \dot{\text{K}}^3)^2\ddot{\text{Si}}^3+3\ddot{\bar{\text{A}}}\text{l}^2\ddot{\text{Si}}^3+3\ddot{\text{Si}}=(\frac{1}{4}\dot{\text{R}}^3+\frac{3}{4}\ddot{\bar{\text{A}}}\text{l})^2\ddot{\text{Si}}^3+\frac{3}{4}\ddot{\text{Si}}$. Possibly $7(\frac{1}{4}\dot{\text{R}}^3+\frac{3}{4}\ddot{\bar{\text{A}}}\text{l})^2\ddot{\text{Si}}^3+2(\frac{1}{4}\dot{\text{R}}^3+\frac{3}{4}\ddot{\bar{\text{A}}}\text{l})\ddot{\text{Si}}^3$, making it a combination of a unisilicate and a bisilicate. The percentage corresponding to either, is, if $\dot{\text{N}}\text{a} : \dot{\text{K}}=5:1$, silica 44·2, alumina 33·7, soda 16·9, potash 5·2=100.

Analyses: 1, Arfvedson (Jahresb., ii. 97); 2, 3, 4, Scheerer (Pogg., xlvi. 291, xlix. 359); 5, Gmelin (Neph. im Dolerit, etc., Heidelberg, 1822); 6, Heidepriem (J. pr. Ch., l. 500); 7, Monticelli & Covelli (Prod. Min. Vesuv., 375, and Pogg., xi. 470); 8, 9, Rammelsberg (Pogg., cix. 579, and Min. Ch., 652); 10, 11, 12, Scheerer (Pogg., xlvi. 291, xlix. 359); 13, 14, Bromeis (Pogg., xlviii. 577); 15, P. v. Pusirevsky (Koksch. Min. Russl., iii. 78); Smith & Brush (Am. J. Sci., II. xvi 371); 17, J. P. Kimball (Am. J. Sci., II. xxix. 65); 18, D. M. Balch (Proc. Essex Inst., iv. 5).

I. Nephelite.	$\ddot{\text{Si}}$	$\ddot{\bar{\text{A}}}\text{l}$	$\ddot{\bar{\text{F}}}\text{e}$	$\dot{\text{C}}\text{a}$	$\dot{\text{N}}\text{a}$	$\dot{\text{K}}$	$\dot{\text{H}}$
1. Vesuvius	44·11	33·73	——	——	20·46	——	0·62=98·92 Arfved.
2. "	44·03	33·28	0·65*	1·77	15·44	4·94	0·21=100·32 Scheerer.
3. "	44·29	33·04	0·39*	1·82	14·93	4·72	0·21=99·40 Scheerer.
4. Odenwald	43·70	32·31	1·07	0·84	15·83	5·60	1·39=100·74 Scheerer.
5. "	43·36	33·49	1·50	0·90	13·36	7·13	1·39=101·13 Gmelin.
6. Löbau	43·50	32·33	1·42	3·55	14·13	5·03	0·32, $\dot{\text{M}}\text{g}$ 0·11=100·39 Heid.
7. *Davyne*	42·91	33·28	1 25	2·02	——	7·43	——=96·89 M. & C.
8. "	38·76	28·10	——	9·32	15·72	1·10	1·96, Cl *tr.*, $\ddot{\text{C}}$ 5·63=99·59 Ramm
9. "	36·81	28·66	——	10·33	15·85	1·21	1·96, Cl *tr.*, $\ddot{\text{C}}$ 6·01=100·83 R.
II. Elæolite.							
10. Fredericksv'n, *gn.*	45·31	32·63	0·45	0·33	15·95	5·45	0·60=100·72 Scheerer.
11. Brevig, *bn.*	44·59	32·14	0·86	0·28	15·67	5·10	2·05=100·69 Scheerer.
12. Miask, *white*	44·30	33·25	0·82	0·32	16·02	5·82	——, $\dot{\text{M}}\text{g}$ 0·07=100·60 Scheerer
13. " "	42·51	33·73	——	0·20	14·01	6·91	——, $\dot{\text{M}}\text{g}$ 0·77=98·13 Brown.
14. " "	42·33	34·39	——	0·47	16·26	5·95	0·92, $\dot{\text{M}}\text{g}$ 0·45=100·77 Brown.
15. Marienskaja	44·94	30·29	0·72	1·15	21·80	1·48	——, $\dot{\text{M}}\text{g}$ 0·15=100·53 Pusir.
16. Magnet Cove, Ark.	44·48	30·97	2·09	0·66	15·61	5·91	0·95=100·65 S. & B.
17. Salem, Mass.	44·31	32·80	*tr.*	0·40	16·43	5·50	1·47=100·91 Kimball.
18. " "	44·32	32·69	——	0·59	17·02	5·09	——=99·71 Balch.

* With Mn^2O^3.

In the last analysis, the mineral, previous to analysis, had been dried at 150° C.; when dried at 100 C., it afforded 1·31 p. c. of water. Traces of muriatic acid, and also of sulphuric, were detected by Scheerer and Bromeis; and in one nepheline from Mt. Somma they found 0·22 of the former and 0·10 of the latter. Other analyses: of E. fr. Norway, Scheerer, Pogg., cxix., 145; N. fr. Meiches in the Vogelsgeb., A. Knop, Jahrb. Min., 1865, 686.

Pyr., etc.—B.B. fuses quietly at 3·5 to a colorless glass. Gelatinizes with acids.

Obs.—Nephelite occurs both in ancient and modern volcanic rocks, and also metamorphic rocks allied to granite and gneiss, the former mostly in glassy crystals or grains (sommite), the latter massive or in stout crystals (elæolite). A doleryte containing much disseminated nepheline, such as occurs at Katzenbuckel, near Heidelberg, has been called *nephelinophyre* and *nephelindoleryte.* A granite-like rock found near Miask, in which elæolite replaces quartz, has been named *miascyte*, from its locality. A rock composed of orthoclase, elæolite, and sodalite, from Ditro in Transylvania, is the *ditröyte* of Tschermak. The zircon-syenite of Norway contains much elæolite.

Nephelite occurs in crystals in the older lavas of Somma, with mica, idocrase, etc.; at Capo di Bove, near Rome (the locality of the *pseudo-nepheline*); in the clinkstone of Katzenbuckel, near Heidelberg; at Hamberg in Hessia; Aussig in Bohemia; Löbau in Saxony. Elæolite is found at Brevig, Stavern, and Fredericksvärn, Norway, imbedded in zircon-syenite; in the Ilmen Mts., Urals, along with white feldspar, brown hexagonal mica, zircon, pyrochlore, etc.; at Marienskaja in the Tunkinsk Mts., Siberia, with graphite, cancrinite, zircon. The crystal measured by Scacchi was of the variety *sommite*, or *davyne*, occurring at Somma in a geode in limestone with sodalite (Pogg. Erganz., iii. 478, 1858)

Elæolite occurs massive and crystallized at Litchfield, Me., with cancrinite; in the Ozark Mts., Arkansas, with brookite and schorlomite; in a boulder, with sodalite, at Salem, Mass.

Named *nepheline* by Haüy (1801), from νεφελή, *a cloud*, in allusion to its becoming cloudy when immersed in strong acid; *elæolite* (by Klaproth), from ἔλαιον, *oil*, in allusion to its greasy lustre, the variety having been made a distinct species earlier by Werner (1808), under the German name of *Fettstein.* The name *sommite*, derived from the Vesuvian locality, given in 1797 by Delametherie, has the priority. But Werner early adopted Haüy's name, and later authors have all taken the same course.

A mineral from Norway, of a yellowish-brown color, called *phonite*, is very much like elæolite, according to Descloizeaux.

Alt.—Nephelite or elæolite is liable to ready alteration, and usually produces a zeolite, as *thomsonite*. The *Ozarkite* of Shepard, according to Smith and Brush, is *thomsonite* (q. v.), and its situation in cavities in elæolite shows that it is a product of alteration. The large amount of soda in nephelite compared with the silica fits it especially for generating zeolites. Blum attributes bergmannite to the alteration of elæolite (Pogg., lxxxvii. 315, and cv. 133).

Giesseckite is shown by Blum to be a pseudomorph after this species. It differs mainly in containing several per cent. of water. It occurs in six-sided greenish-gray prisms of greasy lustre, in Greenland, having $O \wedge 1 = 135°$ nearly; and also at Diana, in Lewis Co., N. Y., with the same angles, for the most part, although the results of measurement vary between 131° and 139°. The crystals of Diana are hexagonal in cleavage; yet the planes of cleavage are often separated by layers of a waxy appearance, without lustre or cleavage. According to Descloizeaux, the material of the crystals acts on polarized light like a gum or colloid, and is evidently a result of alteration. *Liebenerite*, from the valley of Fleims, in the Tyrol, is considered by Blum a similar pseudomorph, and Descloizeaux sustains this conclusion. See further PINITE, under HYDROUS SILICATES.

Elæolite has been observed altered also to mica and opal. *Davyne* is regarded as altered nephelite, due to the introduction of carbonic acid, as stated above; and *cancrinite* is supposed to have had the same origin.

304A. CANCRINITE. *G. Rose*, Pogg., xlvii. 779, 1839.

Hexagonal, and in six and twelve-sided prisms, sometimes with basal edges replaced; $O \wedge \frac{1}{2} = 154° 7'$, $I \wedge \frac{1}{2} = 115° 53'$, $\frac{1}{2} \wedge \frac{1}{2} = 154° 47'$; also thin columnar and massive. H.=5–6. G.=2·42–2·5. Color white, gray, yellow, green, blue, reddish; streak uncolored. Lustre subvitreous, or a little pearly or greasy. Transparent to translucent.

COMP.—Formula the same as for nepheline, with some Ṙ C̈ and *n* Ḣ, Ṙ of the silicate to that of the carbonate being mostly as 3 : 1. Rose found no water. Analyses: 1, 2, G. Rose (Pogg., xlvii. 779); 3, Pusirevsky (Koksch. Min. Russl., iii. 76); 4, 5, J. D. Whitney (Pogg., lxx. 431); 6, v. Struve (Pogg., xc. 615); 7, Pusirevsky (l. c.); 8, G. Tschermak (Ber. Ak. Wien, xliv. 134); 9, Pisani (Ann. Ch. Phys., III. lxvii.):

		S̈i	A̶l	Ċa	Ṅa	K̇	C̈	Ḣ
1. Ilmen Mts.		40·59	28·29	7·06	17·38	0·57	6·38	——=100·27 G Rose.
2. "		40·26	28·34	6·34	17·66	0·82	6·38	——=99·70 G. Rose.
3. "	(?)	35·96	29·57	5·68	18·53	——	5·55	3·70, F̶e, Ṁn 0·19, S̈ 0·32= 99·50 P.
4. Litchfield,	*yellow*	37·42	27·70	3·91	20·98	0·67	5·95	2·82, M̶n, F̶e 0·86=100·31 Wh.
5. "	*greenish*	37·20	27·59	5·26	20·46	5·50	5·92	3·28, M̶n, F̶e 0·27 Whitney.
6. Tunkinsk Mts.		38·33	28·55	4·24	20·37	——	(C̈ & Ḣ) 8·51=100 Struve.	
7. "		37·72	27·75	3·11	21·60	——	5·61	4·07=99·86 Pusirevsky.
8. Ditro		37·2	30·3	5·1	17·4	——	5·2	4·0=99·2 Tschermak.
9. Barkevig		41·32	28·09	4·11	17·15	——	3·60	6·60=101·07 Pisani.

G.=2·448, yellow, fr. Litchfield, Me., Whitney; 2·461, green, ib.; 2·489, rose-red (anal. 3), fr. Ilmen Mts., Pusirevsky; 2·454, yellow (anal. 7), fr. Tunkinsk Mts., id.; 2·42, fr. Ditro (anal. 8), Tschermak; 2·404, fr. Barkevig, Pisani (anal. 9).

Cancrinite is closely like nephelite in crystalline form, and it is probably identical with it in atomic ratio, excepting the carbonate and water, which may be due, as stated, to alteration. Davyne is intermediate in composition, and differs only in that it has the carbonic acid combined with lime alone.

Whitney found a trace of chlorine in his analyses. The red color of the Miask cancrinite is due to disseminated grains of hematite, according to Kenngott, who also found calcite in microscopic grains, and suggests that this may be the source of the carbonic acid of cancrinite.

PYR., ETC.—In the closed tube gives water. B.B. loses color, and fuses (F.=2) with intumescence to a white blebby glass, the very easy fusibility distinguishing it readily from nephelite. Effervesces with muriatic acid, and forms a jelly on heating, but not before.

OBS.—Found at Miask in the Urals; of citron-yellow color at the Marienskoy graphite mine in the Tunkinsk Mts., 400 versts west of Irkutsk, in a coarse granite, with zircon, calcite, and magnetite; at Barkevig, in the Langesund-fiord, Norway, whitish and pale yellowish, with blue sodalite and "bergmannite;" at Ditro in Transylvania, pale flesh-red, in the rock called *ditroyte*, consisting of orthoclase, elæolite, and sodalite (anal. 8). In crystals and massive, with blue sodalite, at Litchfield, Me.

Alt.—Occurs altered to natrolite (*bergmannite*); the cancrinite, as Sæmann and Pisani observe, first losing its translucence and then passing to the fibrous condition and nature of the zeolite.

---

305. SODALITE. Sodalite (fr. Greenland) *Thomson*, R. Soc. Ed. Tr., v. 387, read Nov. 1810. Phil. Mag., xxxvi. 303, 1810.

Isometric. In dodecahedrons, f. 3; also 4, 5, 10, 11, 14. Cleavage: dodecahedral, more or less distinct. Twins: hexagonal prisms, terminating in 12 planes forming 6 prominent triangular ridges of 120°, radiating from the centre, and arising from a combination of dodecahedrons. Also massive.

H.=5·5—6. G.=2·136—2·26, Vesuvius; 2·401, fr. Scarrupata, v. Rath; 2·289, Ural; 2·37, Greenland; 2·294—2·314, Salem, Kimball. Lustre vitreous, sometimes inclining to greasy. Color gray, greenish, yellowish, white; sometimes blue, lavender-blue, light red. Subtransparent—translucent. Streak uncolored. Fracture conchoidal—uneven.

Comp.—$(\frac{1}{4}\dot{\mathrm{N}}\mathrm{a}^3+\frac{3}{4}\dddot{\mathrm{A}}\mathrm{l})^2\ddot{\mathrm{S}}\mathrm{i}^3+\frac{1}{3}\mathrm{Na\,Cl}=(\dot{\mathrm{N}}\mathrm{a}^3)^2\ddot{\mathrm{S}}\mathrm{i}^3+3\dddot{\mathrm{A}}\mathrm{l}^2\ddot{\mathrm{S}}\mathrm{i}^3+2\mathrm{Na\,Cl}$=Silica 37·1, alumina 31·7, soda 19·2, sodium 4·7, chlorine 7·3=100. The name alludes to the *soda*. J. D. Whitney suggests that the blue color may be owing to ferric acid present.

Analyses: 1, Ekeberg (Thomson's Ann. Phil., i. 104); 2, Thomson (l. c.); 3, Arfvedson (Jahresb., ii. 97); 4, 5, Rammelsberg (Min. Ch., 702); 6, v. Rath (ZS. G., xviii. 621); 7, Hofmann (Pogg., xlvii. 377); 8, v. Borc (Pogg., lxxviii. 413); 9, 10, Whitney (Pogg., lxx. 431); 11, J. P. Kimball (Am. J. Sci., II. xxix. 67); 12, D. M. Balch (Proc. Essex Inst., Salem, iv. 4):

	$\ddot{\mathrm{S}}\mathrm{i}$	$\dddot{\mathrm{A}}\mathrm{l}$	$\dddot{\mathrm{F}}\mathrm{e}$	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\mathrm{N}}\mathrm{a}$	Cl
1. Greenland	36·00	32·00	0·15	—	25·00	6·75=99·90 Ekeberg.
2. "	38·52	27·48	1·00	2·7	28·50	3·00, ign. 2·1=98·30 T.
3. Vesuvius	35·99	32·59	—	—	56·55[a]	5·30=100·43 Arfvedson.
4. "	38·12	31·68	—	—	24·37	6·69=100·86 Ramm., G.=2·136.
5. " *gn.*	38·76	84·62	—	—	23·43	2·55=99·36 Ramm.
6. Scarrupata	37·30	27·07	4·03	0·43	16·43	6·96, $\dot{\mathrm{M}}\mathrm{g}$ 0·73, $\dot{\mathrm{K}}$ 1·19, Na 4·51, ign. 3·12=101·77 Rath.
7. Ilmen Mts.	38·40	32·04	—	0·32	24·47[a]	7·10=102·33 Hofmann.
8. Lamo, Norway	38·86	30·82	—	1·21	22·03	*und.*[b], $\dot{\mathrm{K}}$ 0·51, $\dot{\mathrm{M}}\mathrm{g}$ 0·44=93·87 Borc.
9. Litchfield, Me.	37·30	32·88[c]	—	—	23·86	6·97, $\dot{\mathrm{K}}$ 0·59=101·60 Whitney.
10. " "	37·63	30·93	1·08	—	25·48	—, rest *undet.*, Whitney.
11. Salem, Mass.	37·33	32·70	*tr.*	—	24·31	6·99=101·33 Kimball.
12. " "	37·54	32·15	—	0·35	18·94	6·45, Na 4·18=99·61 Balch, G.=2·30.

[a] With some potash. [b] Traces of Sn, Mn, W, and Mo. [c] With some Fe^2O^3.

Pyr., etc.—In the closed tube the blue varieties become white and opaque. B.B. fuses with intumescence, at 3·5—4, to a colorless glass. Decomposed by muriatic and nitric acids, with separation of gelatinous silica.

Obs.—Occurs in mica slate, granite, syenite, trap, basalt, and volcanic rocks, and is often associated with nephelite (or elæolite) and eudialyte. With sanidine it forms a *sodalite-trachyte* at Scarrupata in Ischia, in which also occur augite, titanite, and magnetite in crystals. Found in West Greenland in mica slate, along with feldspar, arfvedsonite, and eudialyte; at Vesuvius, on Monte Somma, in white, translucent, dodecahedral crystals, with pyroxene, mica, and rarely in green dodecahedrons, with cubic planes, in limestone along with idocrase and nepheline; massive and of a gray color imbedded in trap at the Kaiserstuhl in Brisgau; also near Lake Laach; in Sicily, Val di Noto, with nephelite and analcite; at Miask, in the Ural, blue in the granite-like rock called *miascyte*, with elæolite and feldspar; Sedlowatoi, in the White Sea, with eudialyte; in nodular masses at Lamöe near Brevig, Norway, of a lavender-blue color, with elæolite, wöhlerite, and rarely eudialyte.

A blue variety occurs at Litchfield, Me., massive, with distinct cleavage, associated with elæolite, zircon, and cancrinite; a lavender-blue, in a vein in syenite, at Salem, Mass., violet to azure-blue, with elæolite, orthoclase, biotite, and zircon.

Bergemann obtained for a greenish mineral having G.=2·502, occurring with elæolite at Brevig in Norway (Pogg., lxxxiv. 492), $\ddot{\mathrm{Si}}$ 46·03, $\dddot{\bar{\mathrm{Al}}}$ 23·97, $\dot{\mathrm{Na}}$ 21·48, Cl 7·43, $\bar{\mathrm{P}}$ 0·86, $\dot{\mathrm{Ca}}$, $\bar{\mathrm{Fe}}$ *tr.*=99·77: it gives the formula of anorthite (oxygen ratio 1 : 3 : 6) with an addition of some chlorid of sodium; but it may be only an impure sodalite.

Named in allusion to its containing soda.

Alt.—Sodalite occurs altered to kaolin, like the feldspars, and also in conditions of partial change.

An altered sodalite from Greenland afforded Rammelsberg $\ddot{\mathrm{Si}}$ 43·20, $\dddot{\bar{\mathrm{Al}}}$ 32·54, $\dot{\mathrm{Ca}}$ 3·00, $\dot{\mathrm{Na}}$ 11·42, Cl *tr.*, $\dot{\mathrm{H}}$ (by loss) 9·84, giving for $\dot{\mathrm{R}}$, $\dddot{\bar{\mathrm{Al}}}$, $\ddot{\mathrm{Si}}$, $\dot{\mathrm{H}}$, the oxygen ratio 1 : 4 : 6 : 2; but it is not regarded by this chemist as a distinct chemical compound.

Trolle-Wachtmeister found a Vesuvian sodalite to contain (Pogg., ii. 14) $\ddot{\mathrm{Si}}$ 50·98, $\dddot{\bar{\mathrm{Al}}}$ 27·64, $\dot{\mathrm{Na}}$ 20·96, Cl 1·26=100·84, which must have been either very impure or altered.

306. LAPIS-LAZULI. Σάπφειρος *Theophr.* Sapphiros *Plin.*, xxxvii. 39. Sapphirus *Agric.*, Foss., 288, 1546. Cyaneus, Lapis Lazuli (Lapis Azul *Arab.*, unde nomen Asuri, aut Lazuli), *B. de Boot*, Lap., 273, 1636. Lapis-Lazuli, Lazur-Sten, Jaspis colore cœruleo cuprifer, *Wall.*, Min., 97, 1747. Lapis-Lazuli, ou Pierre d'Azur, *Fr. Trl.* Wall., i. 186, 1753. Zeolites Bloa (=Blue Zeolite], Lapis Lazuli, *Cronst.*, 100, 1758. Zeolithus cæruleus *v. Born.*, Lithoph., i. 46, 1772. Lasurstein *Germ.* Native Ultramarine. Outremer *Fr.*

Isometric. In dodecahedrons, f. 3, 4. Cleavage: dodecahedral, imperfect. Commonly massive, compact.

H.=5–5·5. G.=2·38–2·45. Lustre vitreous. Color rich Berlin or azure-blue, violet-blue, red, green; also colorless. Translucent—opaque. Fracture uneven.

Comp.—A silicate of soda, lime, and alumina, with a sulphid probably of iron and sodium. Analyses: 1, Klaproth (Beitr., i. 189); 2, Gmelin (Schw. J., xiv. 329); 3, Köhler (Ramm. Min. Ch., 710); 4, Schultz (ib.); 5, Varrentrapp (Pogg., xlix. 515); 6, v. Hauer (Verh. G. Reichs., 1860, 86); 7, F. Field (Q. J. Ch. Soc., iv. 331); 8, Schultz (l. c.):

	$\ddot{\mathrm{Si}}$	$\dddot{\bar{\mathrm{Al}}}$	$\bar{\mathrm{Fe}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Na}}$	$\dot{\mathrm{H}}$	$\dddot{\mathrm{S}}$
1. Orient	46·0	14·5	3·0	17·5	——	2·0	4·0, $\ddot{\mathrm{C}}$ 10·0=97·0 Klaproth.
2. "	49	11	4	16	8	*tr.*	2, $\dot{\mathrm{Mg}}$ 2=92 Gmelin.
3. "	45·33	12·33	2·12	23·56	11·45	0·35	3·22, Cl 0·42, S?=98·78 Köhler.
4. "	43·26	20·22	4·20	14·73	8·76	——	5·76, S 3·16=100 Schultz.
5. Bucharei	45·50	31·76	*tr.*	3·52	9·09	0·12	5·89, Fe 0·86, Cl 0·42, S 0·95=98·11 Varrentr.
6. Ditro	40·54	43·00	0·86	1·14	[12·54]	1·92	——=100 Hauer.
7. Andes	66·9	20·0	0·1	——	10·1	——	——, S 2·9 Field.
8. "	45·70	25·34	1·30	7·48	10·55	——	4·32, S 3·96, $\dot{\mathrm{K}}$ 1·35=100 Schultz.

Pyr., etc.—Heated in the closed tube gives off some moisture; the variety from Chili glows with a beetle-green light, but the color of the mineral remains blue on cooling. Fuses easily (3) with intumescence to a white glass. Decomposed by muriatic acid, with separation of gelatinous silica and evolution of sulphuretted hydrogen.

Obs.—It is usually found in syenite or crystalline limestones, associated often with pyrite and mica in scales.

Occurs of a deep blue color in Siberia, at Bucharei, in limestone, with pyrite, apatite, and glaucolite; near the river Talaja, and also the Bystraja, in the Lake Baikal region, in a crystalline limestone containing mica, in syenite; also on the Slüdianka in the same region; at Ditro in Transylvania, in a hornblendic vein in syenite; in Persia; China; Thibet; at Bardakschan in Tartary; in the Andes of Ovalle, near the sources of the Cazadero and Vias, tributaries of the Rio Grande, in a granitic rock. On the banks of the Indus it is disseminated in grayish limestone.

The richly colored varieties of lapis lazuli are highly esteemed for costly vases and ornamental furniture; also employed in the manufacture of mosaics; and when powdered constitutes the rich and durable paint called *ultramarine*. B. de Boot gives, in his work above referred to, the method employed for making artificial ultramarine. An ultramarine, chemically prepared, equal to that from native lapis lazuli in color and permanency, and now extensively used in the arts, contains, according to Varrentrapp,

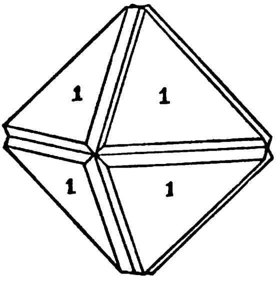
$\ddot{\mathrm{Si}}$ 45·604, $\dddot{\mathrm{S}}$ 3·830, $\dddot{\bar{\mathrm{Al}}}$ 23·304, $\dot{\mathrm{Ca}}$ 0·021, $\dot{\mathrm{Na}}$ 21·476, $\dot{\mathrm{K}}$ 1·752, S 1·685, Fe 1·063, Cl *tr.*=98·785.

307. HAÜYNITE. Latialite (fr. the Campagna, ancient Latium) *Gismondi*, in Mem. read ı 1803, before the Acad. de Lincei at Rome, but unpublished. Haüyne *Bruun-Neergard*, Schw. J., iv. 417, 1807, J. d. M., xxi. 365, 1807. Auina *Ital.* Berzeline *L. A. Necker*, Bibl. Univ., xlvi 52, 1831, Regne Min. Paris, 1835; *v. Rath.* ZS. G., xviii. 546, 1866=Marialite *Rylo*=Gismondina ottaedrica *Med. Spada.*

Isometric. In dodecahedrons, octahedrons, etc., f. 3—7; also witl planes 3, 3-3. Cleavage: dodecahedral distinct. Twins: composition face octahedral, as in f. 293 parallel to all the planes 1; anc f. 294, parallel to one plane with faces of the dodecahe dron. Commonly in rounde grains often looking like crys tals with a fused surface.

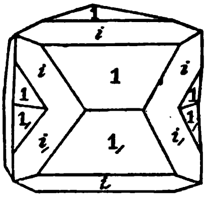
H.=5·5–6. G.=2·4—2·5 Lustre vitreous, to somewha greasy. Color bright blue, sky blue, greenish-blue; aspara gus-green. Streak slightl bluish to colorless. Subtrans parent to translucent. Fracture flat conchoidal to uneven.

293



Albano.

294



Albano.

Var.—For the mineral fr. Marino, G.=2·833, Gmelin; fr. Vesuvius, G.=2·464, Ramm.; f Melfi, G.=2·466, Scacchi; fr. L. Laach, 2·481, v. Rath. The white variety from near Albano *Berzeline* of Necker, according to v. Rath (l. c.), from whom figs. 293, 294, representing twins of i are taken. Vom Rath remarks that the mineral analyzed by Gmelin (Obs. de Hauyna, etc which has been referred to berzeline, was a mixture

Comp.—$(\frac{1}{4}\dot{\text{Na}}^3+\frac{3}{4}\dddot{\text{Al}})^3\ddot{\text{Si}}^3+\dot{\text{Ca}}\,\text{S}=(\dot{\text{Na}}^3)^2\ddot{\text{Si}}^3+3\dddot{\text{Al}}^2\ddot{\text{Si}}^3+4\dot{\text{Ca}}\,\dddot{\text{S}}$=Silica 32·0, alumina 27·4, lin 9·9, soda 16·5, sulphuric acid 14·2=100. Analyses: 1, Gmelin (Obs. de H., Heidlb., 1814, Schı J., xiv. 325, xv. 1); 2, Varrentrapp (Pogg., xlix. 515); 3–5, J. D. Whitney (Pogg., lxx. 431 6, Rammelsberg (Pogg., cix. 577); 7, id. (ZS. G., xii. 273); 8, v. Rath (ib., xvi. 84); 9, v. Rath (il xviii. 547):

	$\ddot{\text{Si}}$	$\dddot{\text{Al}}$	$\dddot{\text{Fe}}$	$\dot{\text{Mg}}$	$\dot{\text{Ca}}$	$\dot{\text{Na}}$	$\dot{\text{K}}$	$\dot{\text{H}}$	$\dddot{\text{S}}$
1. Marino	35·48	28·87	1·16	——	12·00	——	15·55	[3·45][a]	12·39 Gmelin.
2. Niederm'g	35·01	27·41	——	——	12·55	9·12	——	6·2	12·60, Fe 0·17, Cl 0·58 S 0·24=98·34
3. "	33·90	28·07	——	——	7·50	19·28	——	——	12·01=100·73 Whitne
4. "	34·83	28·51	0·31	——	7·23	18·57	——	——	12·13=101·58 Whitne
5. Mt. Albano	32·44	27·75	——	——	9·96	14·24	2·40	——	12·98=99·77 Whitne
6. Vesuvius (⅔)	34·06	27·64	*tr.*	——	10·60	11·79	4·96	——	11·25=100·30 Ramm.
7. Melfi	34·88	29·34	——	0·70	5·54	14·47	3·76	——	11·08, Cl *tr.*=99·77 R
8. L. Laach (⅔)	33·11	27·35	1·05	0·22	11·70	15·39	1·12	0·20	12·54, Cl 0·33=103·01
9. *Berzeline*	32·70	28·17	——	——	10·85	11·13	4·64	0·48	12·15, Cl 0·66, Na 0·4 =101·21

[a] $\dot{\text{H}}$, S, and loss.

The haüynite from Niedermendig, according to Whitney, corresponds in composition to 2 ha nite+1 nosite.

Pyr., etc.—In the closed tube retains its color. B.B. in the forceps fuses at 4·5 to a wl glass. Fused with soda on charcoal affords a sulphid, which blackens silver. Decomposed muriatic acid with separation of gelatinous silica.

Obs.—Occurs in the Vesuvian lavas, on Somma; at Melfi, on Mt. Vultur, Napies, in a kind lava called *Haüynophyr*, a black to brown rock containing the haüynite disseminated through of black, green, blue, red, and brown colors, and also white, and sometimes red inside and l outside; in the lavas of the Campagna, Rome, and also in the peperino of Marino and Lari near Albano, of sky-blue, bluish-green, and sometimes opaline, also white (*berzeline*); in basal Niedermendig and Mayen, L. Laach, in a trachytic rock; at Mt. Dor in Puy de Dome: at Michael's, Azores.

Named after the crystallographer and mineralogist Haüy.

Alt.—The variations in the analyses as to water present show a tendency to hydration and to other changes in the mineral.

ITTNERITE *Gmelin* (Schw. J., xxxvi. 74, 1822); SKOLOPSITE *v. Kobell* (Gel. Anzeig., xxviii. 638, 1849). Rammelsberg has shown (Ber. Ak. Berlin, 1862, 1864) that ittnerite and skolopsite are probably altered haüynite or nosite. Ittnerite contains 10 to 12 p. c. of water, and scolopsite varies in the water from none to 10 p. c. Ittnerite occurs in translucent dodecahedrons or granular massive, with H.=5·5; G.=2·37—2·40; color dark bluish or ash-gray to smoky gray; lustre resinous, and comes from Kaiserstuhl near Freiberg, in Brisgau, Sasbach, and Endingen.

Scolopsite occurs granular massive; H.=5; G.=2·53, color grayish-white, to pale reddish-gray, and is from Kaiserstuhl, and occurs in the same rock with ittnerite (Fischer, Ber. Ges. Freiburg, 1862).

Analyses: 1, Gmelin (l. c.); 2, J. D. Whitney (Pogg., lxx. 442); 3, Rammelsberg (Ber. Ak. Berlin, 1864, 171); 4, v. Kobell (l. c.); 5, Rammelsberg (l. c., ii. 1862, 245); 6, id. (ib., 1864, 172):

	$\ddot{\mathrm{Si}}$	$\dddot{\mathrm{Al}}$	$\dddot{\mathrm{Fe}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Na}}$	$\dot{\mathrm{K}}$	$\dot{\mathrm{H}}$	$\dddot{\mathrm{S}}$	Cl
1. *Ittnerite*	34·02	28·40	0·62	—	7·27	12·15	1·56	10·76[a]	2·86	0·73=98·36 Gmelin.
2. "	35·69	29·14	—	—	5·64	12·57	1·20	[9·83]	4·62	1·25=100 Whitney.
3. "	37·97	30·50[b]	—	0·76	3·42	7·89	1·72	12·04	4·01	0·62=98·93 Ramm.
4. *Scolopsite*	44·06	17·86	2·49	2·23	16·34	12·04	1·30	—	4·09	0·56=100·97 Kobell.
5. "	34·79	21·00	2·70	2·67	15·10	11·95	2·80	8·29	4·39	1·36=100·05 Ramm.
6. "	38·60	19·29		1·80	12·21	10·84	2·18	[10·25]	3·56	1·27=100 Ramm.

[a] With H S. [b] With a little $\mathrm{Fe^2O^3}$.

Scolopsite was named from σκολοψ, *a splinter*, from its splintery fracture.

308. NOSITE. In ripis (L. Laach) lapillos elegantiores et sapphiros reperire est, *Freherus*, Orig. Palatinarum, ii. 36, 1612. Spinellan *Nose*, Nöggerath's Min. Stud. Geb. Niedderrhein, 109, J. de Phys., lxix. 160, 1809. Spinellan, Nosian, *Klapr.*, Breitr., vi. 371, 1815. Häuyne pt. Nosean, Nosin, *some authors*.

Isometric, like haüynite. In dodecahedrons. Often granular massive. H.=5·5. G.=2·25—2·4. Color grayish, bluish, brownish; sometimes black. Translucent to nearly opaque.

Comp.—$(\frac{1}{4}\,\dot{\mathrm{Na}}^3+\frac{3}{4}\,\dddot{\mathrm{Al}})^2\,\ddot{\mathrm{Si}}^3+\frac{1}{2}\,\dot{\mathrm{Na}}\,\dddot{\mathrm{S}}=(\dot{\mathrm{Na}}^3)^2\,\ddot{\mathrm{Si}}^3+3\,\dddot{\mathrm{Al}}^2\,\ddot{\mathrm{Si}}^3+2\,\dot{\mathrm{Na}}\,\dddot{\mathrm{S}}$=Silica 36·1, sulphuric acid 8·0, alumina 31·0, soda 24·9=100. A little chlorid of sodium is also present; ratio of chlorid to sulphate about 1 : 10.

Analyses: 1. 2. Bergmann (Bull. Sci., 1823, iii. 406); 3, Varrentrapp (Pogg., xlix. 515); 4, 5, J. D. Whitney (Pogg., lxx. 431); 6–9, v. Rath (ZS. G., xvi. 86):

		$\ddot{\mathrm{Si}}$	$\dddot{\mathrm{Al}}$	$\dddot{\mathrm{Fe}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Na}}$	$\dot{\mathrm{K}}$	Cl	$\dddot{\mathrm{S}}$
1. L. Laach		38·50	29·25	1·67	1·14	16·56	—	—	8·16, $\dddot{\mathrm{Mn}}$ 1·00=99·11 Bergm.
2. "		37·00	27·50	1·28	8·14	12·24	—	—	11·56, $\dddot{\mathrm{Mn}}$ 0·50=99·59 Bergm.
3. "		35·99	32·57	0·06	1·12	17·84	1·85	0·65	9·17=99·22 Varrentrapp.
4. "		36·52	29·54	0·44	1·09	23·12	1·37	0·61	7·66=100·34 Whitney.
5. "		36·53	29·42		1·62	22·97			7·13=100·99 Whitney
6. "	*dk. bn.*	36·72	29·08	0·75	1·20	23·33	0·83	0·71	7·52, $\dot{\mathrm{K}}$ 0·34=100·18 Rath, G.=2·281.
7. "	*bh.-gy.*	36·69	28·45	0·47	0·63	23·90	2·15	1·05	7·30=100·64 Rath, G.=2·299
8. "	*gnh.*	36·46	29·61	0·91	2·37	20·60	2·02	0·70	7·34=100 Rath, G.=2·336.
9. "	*clear*	36·87	26·60	0·28	4·05	20·75	0·37	1·08	10·00=100 Rath, G.=2·399.

Klaproth, in his analysis (Beitr., vi. 375), obtained $\ddot{\mathrm{Si}}$ 43·0, $\dddot{\mathrm{Al}}$ 29·5, $\dddot{\mathrm{Fe}}$ 2·0, $\dot{\mathrm{Ca}}$ 1·5, $\dot{\mathrm{Na}}$ 19·0, $\dddot{\mathrm{S}}$ 1·0, $\dot{\mathrm{H}}$ 2·5=93·5.

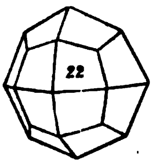
Pyr., etc.—B.B. like haüynite. Gelatinizes in acids, yielding no sulphuretted hydrogen.

Obs.—From near Andernach on the Rhine, at Lake Laach, in loose blocks consisting largely of a glassy feldspar, with mica, magnetite, and occasionally zircon, occupying cavities in the feldspar, in small grains or crystals; also found at Rieden and Volkersfeld in a leucite rock.

Named after K. W. Nose of Brunswick.

309. LEUCITE. Weisse Granaten, Weisse granat-förmige Schörl-Crystallen (fr. Vesuvius), *J. J. Ferber*, Briefe aus Wälschland, 165, 176, etc., 1773. Basaltes albus polyedrus granatiformis, etc., *v. Born*, Lithoph., ii. 78, 1775. Schorl blanc *Fr. Trl.* of Ferber. Grenats blancs calcinés (fr. Vesuvius, where called Occhio di Pernice, Rome, etc.) *de Saussure*, J. de Phys., vii. 21, 1776. Œil de Perdrix, Grenats blancs, altérés par une vapeur acide qui ayant dissout le fer a laissé les grénats dans un état de blancheur, *Sage*, Min., i. 317, 1777; *de Lisle*, ii. 330, 1783. Weisse Granaten *Hoffm.*, Bergm. J., 454, 474, 1789. White Garnet. Leucit *Wern.*, Bergm. J., i. 489, 1791, Höpfner's Mag. N. Helvet., iv. 241. Leucite *H.*, J. d. M., v. 260, 1799. Amphigène *H.*, Tr., ii. 1801.

295



Isometric. Usual form the trapezohedron (f. 295). Cleavage: dodecahedral, very imperfect. Surfaces of crystals even, but seldom shining. Often disseminated in grains; rarely massive granular.

H.=5·5–6. G.=2·44–2·56. Lustre vitreous. Color white, ash-gray or smoke-gray. Streak uncolored. Translucent—opaque. Fracture conchoidal. Brittle.

Comp.—O. ratio 1 : 3 : 8; $\dot{\mathrm{K}}\,\ddot{\mathrm{Si}}+\dddot{\mathrm{Al}}\,\ddot{\mathrm{Si}}^3$=Silica 55·0, alumina 23·5, potash 21·5=100. Analyses 1–4, Klaproth (Beitr., ii. 39); 5, Arfvedson (Afhandl. i Fys., vi. 139); 6, Avdejef (Pogg., iv 107); 7–9, Rammelsberg (Pogg., xcviii. 142); 10, 11, Bischof (Lehrb., ii.); 12, Rammelsberg (Min. Ch., 999); 13–15, Bischof (l. c.); 16, Rammelsberg (Pogg., xcviii. 150); 17–20, Bischof (l. c.); 21, A. Knop (Jahrb. Min., 1865, 685):

			$\ddot{\mathrm{Si}}$	$\dddot{\mathrm{Al}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Na}}$	$\dot{\mathrm{K}}$	$\dot{\mathrm{H}}$
1.	Vesuvius		53·750	24·625	—	—	21·350	—=99·725 Klaproth.
2	"		53·50	24·25	—	—	20·09	—=97·84 Klaproth.
3.	Pompeii		54·50	23·50	—	—	19·50	—=97·50 Klaproth.
4.	Albano		54·	23·	—	—	22·	—=99 Klaproth.
5.	Vesuvius		56·10	23·10	—	—	21·15	—, $\bar{\mathrm{F}}\mathrm{e}$ 0·95=101·30 Arfvedson.
6.	"		56·05	23·03	*tr.*	1·02	20·40	—=100·50 Avdejef.
7.	"		56·10	23·22	—	0·57	20·59	—=100·48 Rammelsberg.
8.	"		56·25	23·26	0·32	0·43	20·04	—=100·40 Rammelsberg.
9.	"	($\frac{3}{3}$)	56·48	23·14	—	0·50	19·78	0·52=100·42 Rammelsberg.
10.	"		57·84	22·85	0·20	6·04	12·45	0·59, $\bar{\mathrm{F}}\mathrm{e}$ 0·14=100·11 Bischof.
11.	"		56·49	22·99	0·04	3·77	15·21	1·48=99·98 Bischof.
12.	"		57·24	22·96	0·91	0·93	18·61	—=100·65 Rammelsberg.
13.	"		55·81	24·23	—	8·83	10·40	—=99·27 Bischof. G.=2·519.
14.	L. Laach		54·36	24·23	—	3·90	16·52	0·64=99·65 Bischof.
15.	"		56·22	23·07	0·28	6·40	13·26	—=99·66 Bischof.
16.	Rocca Monfina	($\frac{3}{2}$)	56·36	23·15	0·25	0·25	19·31	0·74, Cl 0·03=100·09 Ramm. G.=2·444
17.	"		57·28	22·44	—	1·75	17·12	1·41=100 Bischof.
18.	"		58·10	22·76	—	1·78	17·36	Bischof.
19.	"		56·45	24·35	—	1·98	17·43	Bischof.
20.	"		56·32	23·99	—	2·15	17·54	Bischof.
21.	Vogelsberg	($\frac{2}{1}$)	56·61	22·92	1·68	2·95	13·65, $\dot{\mathrm{F}}\mathrm{e}$ 2·33=100·14 Knop.	

Potash, regarded long as an alkali exclusively of the vegetable kingdom, was first found among minerals in this species by Klaproth, whose earliest analysis was made in 1796.

Rammelsberg does not find the large proportion of soda announced for some kinds by Bischof. According to Deville, the leucite of the modern Vesuvian lavas contain more soda than that of the ancient of Somma, the ratio of soda to potash in that of the lava of 1855 being 1 : 2·09; in the 1847, 1 : 1·67; and in the Somma, 1 : 8·21. Specimen for anal. 7 is from lava of 1811, colorless, transparent, G.=2·480; for 8, id., in grains; for 9, 10, pure crystals from the Vesuvian eruption of Ap. 22, 1845; for 11, id. of Feb. 10, 1847; for 12, id. of January, 1857; for 13, date of eruption not stated; for 14, 15, small crystals, externally somewhat altered; 16, large, fragile, yellow crystals, of feeble lustre and little hardness; 17, the same; 18–20, of different parts of same crystals. 18 the exterior, 20 the interior, and 19 an intermediate portion.

By spectral examination, Richter has detected lithia in the Vesuvian leucite.

Pyr., etc.—B.B. infusible; with cobalt solution gives a blue color (alumina). Decomposed by muriatic acid without gelatinization.

Obs.—Leucite is confined to volcanic rocks, and to those of certain parts of Europe. At Vesuvius and some other parts of Italy it is thickly disseminated through the lava in grains, and the name *leucitophyr* and also *amphigenyte* has been given to such lavas. It is a constituent in the nephelin-dolerяte of Merches in the Vogelsberg (anal. 21); abundant in trachyte between Lake Laach and Andernach, on the Rhine. Vesuvius presents the finest and largest crystallizations. Near Rome, at Borghetta to the north, and Albano and Frascati to the south, some of the older lavas appear to be almost entirely composed of it.

The leucitic lava of the neighborhood of Rome has been used for the last two thousand years, at least, in the formation of mill-stones. Mill-stones of this rock have been discovered in the excavations at Pompeii.

Named by Werner from λευκός, *white*, in allusion to its color.

Haüy's name, *Amphigene*, is of later date, and is from αμφι, *both*, and γενναω, *to make*, in allusion to the existence of cleavage in two directions (which is not a fact), and to his inference therefrom of two "primitive forms" (which is only a notion of his); and it has therefore the best of claims for rejection.

Alt.—Feldspar, nephelite, and kaolin occur with the form of leucite, as a result of its alteration. The glassy feldspar pseudomorphs were first announced by Scacchi, and since by Blum. The following are analyses of altered leucite: 1, 2, Rammelsberg (Min. Ch., 647); 3, C. Stamm (Ann. Ch. Pharm., xcix. 287); 4, 5, Rammelsberg (Min. Ch., 647); 6, Bergemann (J. pr. Ch xxx. 418):

	$\ddot{Si}$	$\dddot{Al}$	$\dot{Ca}$	$\dot{Na}$	$\dot{K}$	ign.
1. Rocca Monfina	53·32	26·25	0·66	8·76	1·98	9·03=100 Rammelsberg.
2. "	53·39	25·07	0·28	11·94	0·64	9·26=100·58 Rammelsberg.
3. Kaiserstuhl	54·02	22·54	2·90	10·13	0·71	8·93, $\dot{Mg}$ 0·57, $\dot{Fe}$ 1·35=101·15 Stamm.
4. Vesuvius (?)	57·37	24·25	1·28	5·72	11·09, $\dot{Mg}$ 0·27=99·98 Rammelsberg.	
4A. " *decom.*	18·39	12·11	0·56	5·50	4·10, $\dot{Mg}$ 0·17=40·83	=99·97 Rammelsberg.
4B. " *undec.*	39·91	11·69	0·40	0·30	6·84=59·14	
5. "	57·62	24·72	0·55	6·32	10·93=100·14 Rammelsberg.	
5A. " *decom.*	24·00	12·47	0·71	5·25	2·86=45·29	=100·29 Rammelsberg.
5B. " *undec.*	34·78	11·58	—	*tr.*	8·64=55·00	
6. Oberwiesenthal	60·46	22·11	—	0·52	13·53, $\dot{Mg}$ 1·22, $\dot{Fe}$ 1·98=99·82 Bergemann.	

The mineral of 1 and 2 is white and kaolin-like; 3, occurs in trachyte; 4, 5, are Somma crystals, and A, under each, part of same decomporable by muriatic acid; B, part undecomporable; 6, crystal, having H.=5·5, G.=2·5616.

No. 3 has nearly the composition of analcite, and was published as of that species. But Rose (Pogg., ciii. 521) and others make it an altered leucite, with the composition of analcite. 1 and 2 are nearly the same in constitution with 3, as Rammelsberg states. 4, 5, correspond, according to Rammelsberg, to a mixture of nephelite (A part) with glassy feldspar (B part); and yet has the composition of a *potash-soda-leucite*. 6 has the composition and reactions nearly of *oligoclase* (oxygen ratio, 1 : 3·1 : 9·4); it lost by ignition 1·22 p. c.; 5·97 p. c. were soluble in muriatic acid, and consisted of $\ddot{Si}$ 3·50, $\dddot{Al}$ 1·60, $\dot{Fe}$ 0·05, $\dot{Mg}$ 0·04, $\dot{Na}$ *tr*, $\dot{K}$ 0·47, $\dot{Ca}$, Mn *tr*.

FELDSPAR GROUP.

The feldspars are characterized by specific gravity below 2·85; hardness 6 to 7; fusibility 3 to 5; oblique or clinohedral crystallization; prismatic angle near 120°; two easy cleavages, one basal, the other brachydiagonal, inclined together either 90°, or very near 90°; cleavage a prominent feature of many massive kinds, and distinct in the grains of granular varieties, giving them angular forms; close isomorphism, and a general resemblance in the systems of occurring crystalline forms; twinning parallel to the clinodiagonal section and *O*, and sometimes 2-*ĭ* (or the corresponding triclinic planes); transition from granular varieties to compact, hornstone-like kinds, called felsites, which sometimes occur as rocks; often opalescent, or having a play of colors as seen in a direction a little oblique to *i-ĭ*; often aventurine, from the dissemination of microscopic crystals of foreign substances parallel for the most part to the planes *O* and *I*.

The protoxyd bases are lime, soda, potash, and in one species baryta; the sesquioxyd only alumina; the oxygen ratio of the protoxyds and sesquioxyds is constant, 1 : 3; while that of the silica and bases varies from 1 : 1 to 3 : 1, the amount of silica increasing with the increase of alkali, and becoming greatest when alkalies are the only protoxyds.

The included species are as follows:

		Crystallization.	O. ratio Ṙ, R̶, S̈i.
ANORTHITE	Lime feldspar	Triclinic	1 : 3 : 4
LABRADORITE	Lime-soda feldspar	"	1 : 3 : 6
HYALOPHANE	Baryta-potash feldspar	Monoclinic	1 : 3 : 8
ANDESITE	Soda-lime feldspar	Triclinic	1 : 3 : 8
OLIGOCLASE	" " "	"	1 : 3 : 9
ALBITE	Soda feldspar	"	1 : 3 : 12
ORTHOCLASE	Potash feldspar	Monoclinic	1 : 3 : 12

The species appear in the analyses beyond to shade into one another by gradual transitions; but whether this is the actual fact, or whether the seeming transitions (when not from bad analyses) are due to mixtures of different kinds through contemporaneous crystallization, is not positively ascertained. The latter is the most reasonable view. It has been shown by Breithaupt and others that orthoclase and albite (or the *potash* and *soda* feldspars) occur together in infinitesimal interlaminations of the two species, and that the soda-potash variety called *perthite* (p. 356) is one of those thus constituted. This structure is apparent under a magnifying power, and also when specimens are examined by means of polarized light. Moreover, these and other feldspars very commonly occur side by side or intercrystallized when not interlaminated; as oligoclase and orthoclase in the granite of Orange Summit, N. Hampshire, and Danbury, Conn.; in obsidian in Mexico; in trachytes of other regions. Such facts show that the idea of indefinite shadings between the species is probably a false one, since the two keep themselves distinct, and in the perthite and similar cases, even to microscopic perfection. They also make manifest that contemporaneous crystallization is a true cause in many cases.

Intermediate varieties may also come through alteration under the agency of infiltrating waters. Water filtrated through powdered feldspar of any kind soon becomes alkaline by taking up part of the bases. Moreover there is a strong tendency to alteration, and the final production of kaolin, a change involving the loss of all the protoxyd bases, and also much of the silica, the oxygen ratio of the silica and alumina being thus reduced to 1 : 1, from 3 : 1 in orthoclase or albite, and from 2 : 1 in labradorite.

The species andesite is still a doubtful one.

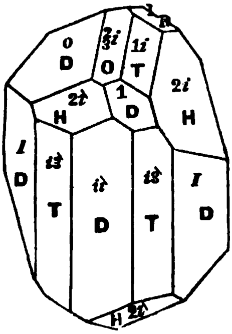
The play of colors, especially remarkable in much labradorite, and occurring also in some adularia, albite, and oligoclase, indicates, according to Reusch (Pogg., cxvi. 392, cxviii. 256, cxx. 95), the existence of a cleavage structure of extreme delicacy transverse to the median or brachydiagonal section. In adularia the plane of this cleavage is perpendicular to this section (or that of the clinodiagonal); in labradorite it is in general more or less inclined, and differently in different specimens. The play of color, Reusch observes, appears therefore to be that of thin plates; yet the linings of what he regards as a cleavage system appear to be of indistinguishable minuteness; and although the existence of thin plates can hardly be established by means of the microscope, it is proved by their effects in the play of colors, nebulous images within, and the phenomena of inflexion or diffraction which result from their regular grouping. There appears to be no connection between the inclination of the plane in labradorite and the colors observed. The play of colors is best seen on a plate polished parallel to the brachydiagonal section (*i-ĭ*), when, as Descloizeaux states, it is turned to the right or left on an axis slightly oblique to the face which extends toward the obtuse angle between the edges *O*/*i-ĭ* and *I'*/*i-ĭ*, and makes an angle of about 70° with the edge *O*/*i-ĭ*; and the maximum effect is produced in two positions situated 45° to 50° from one another, which are unequally inclined to the face *i-ĭ*.

The play of colors is independent of the disseminated microscopic crystals of foreign substances which occasion the aventurine effect.

The feldspars are intimately related to the isometric species of the Leucite group. Leucite has the oxygen ratio 1 : 3 : 8, one of the feldspar ratios; so that isometric leucite, monoclinic hyalophane, and triclinic andesite (if this species is sustained), form a trimorphous group. Bu while the form of leucite appears at first sight to be very unlike that of the true feldspars, there is actually approximate isomorphism. For the monoclinic and triclinic forms are strictly oblique or clinohedrized dodecahedrons.*

If a dodecahedron be so placed that an octahedral axis, that is, the line between the apices of two of the trihedral solid angles, is vertical, it is then a six-sided prism with trihedral summits. If now this axis be inclined 8° 6′ in one of the diametral planes of the six-sided prism, it will have the inclination of the axis of orthoclase; and this 8° 6′ is the greatest amount of divergence from the dodecahedral angles that occurs in the species. The planes *I*, *i-ì* incline to one another at angles near 120°, and correspond to the 6 vertical planes of the dodecahedron (as above placed). The basal plane *O* is also dodecahedric, for $O \wedge I = 122°\ 16'$, and $O \wedge$ *i-ì* (dodecahedric) $= 90°$. The four planes 1 are also dodecahedric, as shown by their position and inclinations. Thus all the *twelve* faces of the dodecahedron occur in the above figure; they are lettered **D**.

296



Again, the planes *i-3̀* and 1-*ì*, which replace the edges between the dodecahedric planes *I*, *i-ì* and 1, 1, with angles near 150°, correspond to planes of the trapezohedron 2-2 (that truncating the dodecahedron, f. 14), and consequently the figure contains *six* trapezohedric planes; they are lettered **T**.

Again, the planes 2-ì are cubic; for they make with the dodecahedric plane *O* the angle 135° 3′, varying but 3′ from the isometric angle. 2-*i* is another cubic face; it is inclined to *I*, a dodecahedric plane, 134° 19′. There are present, therefore, all *six* faces of the cube; they are lettered **H**.

Finally the plane ⅔-*i*, at the top of the figure (and the only remaining one), lettered **O**, is octahedric, as shown by its intersections with the cubic, dodecahedric, and trapezohedric faces; and also by its inclination to the cubic face 2-*i* = 124° 51′, and to the dodecahedric face *I* = 145° 47′, these angles in isometric forms being 125° 16′ and 144° 44′.

It follows then that the above figure contains the *dodecahedric* planes *I*, *I*, *i-ì*, *O*, 1, 1, with their opposites, or the whole *twelve*; the *trapezohedric* *i-3̀*, *i-3̀*, 1-*ì*, with their opposites, or *six*; the *octahedric*, ⅔-*i*, with its opposite, or *two*; and the cubic 2-ì, 2-ì 2-*i*, or all *six*; and no others. The angles of the *oblique cube* are 2-ì ∧ 2-ì, over *O*, = 90° 6′, 2-ì ∧ 2-*i* = 96° 48′. Moreover, the normal apex of the clinohedrized dodecahedron is that part of the crystal occupied by the octahedric plane ⅔-*i*; in other words, ⅔-*i* is normally the *basal* plane, and not *O*; and the true inclination of the vertical axis is 8° 6′ (the angle ⅔-*i* ∧ *i-ì* being 98° 6′).

Accordingly the two cleavages in orthoclase, parallel to *O* and *i-ì*, are both dodecahedric. Moreover, the directions of twinning are either dodecahedric (parallel to *i-ì*, which is the most common, and *O*), or cubic (parallel to 2-ì).

These relations hold true also for the triclinic feldspars, the only peculiarity in which is that the principal section has slight lateral obliquity, so that the two cleavage planes (dodecahedric) incline to one another 93° 15′ to 94° 15′ instead of 90°. G. Rose, in an article on albite (Pogg., cxxv. 457), alludes to the remarkable fact that the planes 2-ì (see p. 349), either side of *O*, make with one another in this species very nearly a right angle (90° 35′, Neumann, and 90° 4′, Descloizeaux). The fact is not so surprising when it is observed that the planes 2-ì are *cubic* faces. They correspond to 2-*i* in orthoclase.

310. ANORTHITE. INDIANITE. Matrix of Corundum (fr. the Carnatic, India) *Bourn.*, Phil. Trans., 1802. Indianite *Bourn.*, Cat., 60, 1817; *Phillips*, Min., 44, 1823. Anorthit (fr. Vesuv.) *G. Rose*, Gilb. Ann., lxxiii. 197, 1823. Cristianite (Christianite), Biotina (fr. Vesuv.), *Mont. & Cov.*, Min. Vesuv., 1825. Tankit (fr. Norway) *Breith.*, Schweigg. J., lv. 246, 1829. Thiorsauit (fr. Iceland) *Genth*, Ann. Ch. Pharm., lxvi. 18, 1848; Thiorsanit *bad orthogr.*

Latrobite (fr. Labrador) *Brooke*, Ann. Phil., v. 383, 1823; *Children*, ib., viii. 38, 1824 = Diploit *Breith.*, C. G. Gmelin's Chem. Unters. Dipl., Tübingen, 1825. Amphodelit (fr. Finland) *N. Nordensk.*, Pogg., xxvi. 488, 1832; = Lepolit *v. Jossa*, Breith. Handb., 531, 1847.

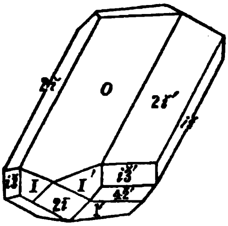
Triclinic. $a : b$ (brach.) : c (macrod.) $= 0{\cdot}86663 : 1 : 1{\cdot}57548$.

---

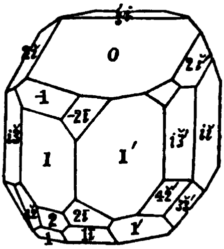
* See a paper by the author, Am. J. Sci., II. xliv. 406. The following comparisons will be better appreciated if the reader has before him a dodecahedral crystal (as of garnet), or a model of the form, so placed that a trihedral solid angle shall be at top, and one of the faces of the trihedral summit shall be inclined to the left. The vertical edge to the left will then correspond to the left vertical line of the figure of orthoclase, that is, to the edge *I*/*I*.

I ∧ *I'*=120° 31'
O ∧ *i*-ĭ, ov. 2-ĭ',=85 50
O ∧ *i*-ĭ, ov. 2-ĭ,=94 10
O ∧ *I'*=114 6½
O ∧ *I*=110 40
O ∧ 2-ĭ'=133 14
O ∧ 2-ĭ=137° 22'
O ∧ 2-ī, ov. 1-ī,=98 46
O ∧ 1=122 8
O ∧ 1'=125 43
O ∧ *i*-ī, ov. 1-ī,=87 6
i-ĭ ∧ *I*=121 56
i-ĭ ∧ *I'*=117° 33½'
i-ĭ ∧ *i*-ī=116 3
I' ∧ *i*-3̆'=148 32
α=88 48⅓
β=64 4½
γ=86 46⅔

297



298



					O					
⅓-ĭ										⅓-ĭ'
⅔-ĭ										⅔-ĭ'
			-1				-1'			
2-ĭ					-2-ī					2-ĭ'
								4-2̆'		
6-ĭ										6-ĭ'
i-ĭ		*i*-3̆	*I*		*i*-ī		*I'*		*i*-3̆'	*i*-ĭ
6-ĭ'										6-ĭ
4-ĭ'				4-2̆		4-2̆'		4-2̆		
		3-3̆							3-3̆	
2-ĭ'			2		2-ī		2'			2-ĭ
				⁴⁄₃-2̆		⁴⁄₃-2̆'				
			1		1-ī		1'			
⅔-ĭ'					⅔-ī					⅔-ĭ
⅓-ĭ'										⅓-ĭ

Observed Planes.

Cleavage: *O*, *i*-ĭ perfect, the latter least so. Twins similar to those of albite. Also massive. Structure granular, or coarse lamellar.

H.=6—7. G.=2·66—2·78; 2·70—2·75, Iceland, Urals, Corsica; 2·762, massive, Rose; 2·763, amphodelite; 2·668, indianite, Silliman. Lustre of cleavage planes inclining to pearly; of other faces vitreous. Color white, grayish, reddish. Streak uncolored. Transparent—translucent. Fracture conchoidal. Brittle. Optic-axial angle large; one bisectrix positive and nearly normal to *i*-ī, the other negative and sensibly oblique to *i*-ĭ.

Var.—1. *Anorthite* was described from the glassy crystals of Somma; and *christianite* and *biotine* are the same mineral. *Thiorsauite* is the same from Iceland.

2. *Indianite* is a white, grayish, or reddish granular anorthite from India, first described in 1802 by Count Bournon.

3. *Amphodelite* is a reddish-gray or dingy peach-blossom-red variety, partly in rather large crystals, from Finland and Sweden; the angle between the two cleavage surfaces (or *O* ∧ *i*-ĭ) is 94° 20'. and *O* on edge *I*/*I'*=116°. *Lepolite* of Breithaupt (or, as he says, of von Jossa, who sent it to him) comes from the same region, and is the same variety; some of the crystals are 2 inches long

Latrobite, from Labrador, is pale rose-red, and closely resembles amphodelite. It has three cleavages, affording, according to Brooke, the mutual inclinations 98° 30′, 93° 30′, and 91°, or, according to Miller, 101° 45′, 93° 30′ ($=O \wedge i\text{-}\bar{i}$), and 109° ($=O \wedge I'$). Named after Rev. C. J. Latrobe.

Walmstedt's "Scapolite from Tunaberg" is anorthite, according to G. Rose (Kryst. Ch. Min., 83).

Comp.—O. ratio 1 : 3 : 4; $(\frac{1}{4}\dot{R}^3+\frac{3}{4}\overset{\cdots}{\mathrm{Al}})^2\ddot{\mathrm{Si}}^3$=Silica 43·1, alumina 36·9, lime 20·0=100.

Analyses: 1, Chenevix (Phil. Trans., 1802, 333); 2, G. Rose (Gilb. Ann., lxxiii. 173); 3, 4 Abich (Pogg., li. 519); 5, Reinwardt (Pogg., l. 351); 6, Forchhammer (Jahresb., xx. xxiii. 284); 7. Damour (Bull. G. Fr., II. vii. 83); 8, Waltershausen (Vulk. Gest., 22); 9, Erdmann (Œfv. Ak. Stockh., 67, 1848); 10, Nordenskiöld (Jahresb., xii. 174); 11, Svanberg (Jahresb., xx. 238); 12, 13, Laugier (Mem. Mus. d'Hist. Nat., vii. 341); 14, G. J. Brush (Am. J. Sci., II. viii. 391, with corrections priv. contrib.); 15, 16, Hermann (J. pr. Ch., xlvi 387); 17, 18, C. Gmelin (Pogg., iii. 68); 19–21, A. Streng (Jahrb. Min., 1864, 259, B. H. Ztg., xxiii. 54); 22, Deville (Ann. Ch. Phys., III. xl. 286); 23, R. H. Scott (Phil. Mag., IV. xv. 518); 24, Potyka (Pogg., cviii. 110); 25, Haughton (Phil. Mag., IV. xix. 13): 26, A. Streng (Jahrb. Min. 1867, 536); 27, Rammelsberg (Min. Ch., 590):

	$\ddot{\mathrm{Si}}$	$\overset{\cdots}{\mathrm{Al}}$	$\overset{\cdots}{\mathrm{Fe}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Na}}$	$\dot{\mathrm{K}}$	$\dot{\mathrm{H}}$
1. Carnatic	42·5	37·5	3·0	—	15·0	—	—	—=98·0 Chenevix.
2. Mt. Somma	44·49	34·46	0·74	5·26	15·68	—	—	—=100·63 G. Rose.
3. "	44·12	35·12	0·70	0·56	19·02	0·27	0·25	—=100·04 Abich.
4. "	43·79	35·49	0·57	0·34	18·93	0·68	0·54	—=100·34 Abich.
5. Java	46·0	37·0	—	—	14·5	0·6	—	—=98·1 Reinwardt.
6. Iceland, Thiorsà.	47·63	32·52	2·01	1·30	17·05	1·09	0·29	—=101·89 Forchh. G.=2·70.
7. " "	45·97	33·28	1·12	—	17·21	1·85	—	—, augite 0·69 D. G.=2·75.
8. Hecla	45·14	32·10	2·03	—	18·32	1·06	0·22	0·31, $\overset{\cdots}{\mathrm{Mn}}$ 0·78[a]=99·96 Waltersh.
9. *Anorthite*	43·34	35·37	—	0·35	17·41	0·89	0·52	0·39; $\dot{\mathrm{Fe}}$ 1·35, undec. 0·57=100·19 Erdmann
10. *Amphod.*, Finl.	45·80	35·45	—	5·05	10·15	—	—	1·85, $\dot{\mathrm{Fe}}$ 1·70 Nordenskiöld.
11. " Tunaberg	44·55	35·91	0·07	4·08	15·02	—	—	0·60=100·28 Svanberg.
12. *Indianite, red*	42·00	34·00	3·20	—	15·00	3·35	—	1·00=98·55 Laugier.
13. " *white*	43·0	34·5	1·0	—	15·6	2·6	—	1·0=97·7 Laugier.
14. " "	42·09	38·89		—	15·78	4·08		—=100·84 Brush.
15. Lojo, *Lepol.*	42·80	35·12	1·50	2·27	14·94	—	1·50	1·56=99·69 Hermann.
16. Orrijärvi "	42·50	33·11	4·00	5·87	10·87	—	1·69	1·50=99·54 Hermann.
17. *Latrobite*	44·65	36·81	—	0·63	8·28	—	6·58	2·04, $\overset{\cdots}{\mathrm{Mn}}$ 3·16=102·16 Gmelin.
18. "	41·78	32·83	—	5·77[b]	9·79	—	6·58	2·04=98·78 Gmelin.
19. Neurode	45·05	30·00	1·97	1·29	16·71	1·86	0·48	3·13=100·49 Streng. G.=2·76.
20. Harzburg, *cryst.*	45·37	34·81	0·59	0·83	16·52	1·45	0·40	0·87=100·84 Streng.
21. " *massive*	42·01	28·63	2·23	*tr.*	19·11	0·76	1·12	5·03=98·89 Streng.
22. St. Eustache	45·8	35·0	—	0·9	17·7	1·0	—	—=100·4 Deville.
23. Bogoslovsk, Ural	46·79	33·17	3·04	*tr*	15·97	1·28	0·55	—=100·31 Scott. G.=2·72.
24. Konchekovskoi, "	45·31	34·53	0·71	0·11	16·85	2·59	0·91	—=101·01 Potyka. G.=2·73.
25. Carlingford, Irel.	45·87	34·73	—	1·55	17·10	—	—	—=99·25 Haughton.
26. Hyffhäuser Mts.	44·67	34·22	0·88	0·29	11·92	1·57	2·33	4·13=100·01 Streng.
27. *Meteoric*	44·38	33·73	3·29	0·36	18·07	1·03	0·33	—=101·19 Rammelsberg.

[a] With Ca O and Ni O. [b] With Mn^2O^3.

Anal. 23, granular, in dioryte; 24, with hornblende forming a rock; 26, in dioryte, G.=2·77; 27, from meteorite of Juvenas.

Genth obtained in an analysis of his *Thiorsauite*, which is regarded as the same mineral as that of anal. 6, $\ddot{\mathrm{Si}}$ 48·36, $\overset{\cdots}{\mathrm{Al}}$ 30·59, $\overset{\cdots}{\mathrm{Fe}}$ 1·37, $\dot{\mathrm{Mn}}$ *tr.*, $\dot{\mathrm{Mg}}$ 0·97, $\dot{\mathrm{Ca}}$ 17·16, $\dot{\mathrm{Na}}$ 1·13, $\dot{\mathrm{K}}$ 0·62=100·20. The Neurode feldspar (anal. 19), from a serpentine rock, gives the O. ratio 1 : 2½ : 4, and is hydrous, and had probably lost part of its alumina. For an analysis of the same by v. Rath, see Pogg., xcv. 553.

Pyr., etc.—B.B. fuses at 5 to a colorless glass. Anorthite from Mt. Somma, and indianite from the Carnatic, are decomposed by muriatic acid, with separation of gelatinous silica.

Obs.—Occurs in some granites; occasionally in connection with gabbro and serpentine rocks; in some cases along with corundum; in many volcanic rocks.

Anorthite (*christianite* and *biotine*) occurs at Mount Vesuvius in isolated blocks among the old lavas in the ravines of Monte Somma, associated with sanidin, augite, mica, and idocrase; on the island of Procida near the entrance to the bay of Naples; in the Faroe islands, and on Java; on Iceland, on the plain of Thiorsà, Hecla, and elsewhere (G.=2·69—2·75); near Bogoslovsk in the

Ural (G.=2·72—2·73, anal. 23, 24); at Carlingford in Ireland; in the meteoric stone of Juvenas (anal. 27).

Amphodelite occurs in Lojo, Finland, in a limestone quarry, and at Tunaberg, Sweden; *lepolite*, at Lojo and Orrijärfvi; *linseite* is probably the same partly altered (Breith., J. pr. Ch., xlvii. 236), containing a few p. c. of water. *Latrobite* is from Amitok island, on the coast of Labrador. *Indianite* is the gangue of corundum in the Carnatic, with garnet, cyanite, and hornblende; the specimen analyzed by G. J. Brush was originally from the hands of Count Bournon, and came from the Indian locality.

Anorthite was named in 1823 by Rose from ἀνορθός, *oblique*, the crystallization being triclinic. Bournon's name, *Indianite*, derived from the locality in India, was first published in his Catalogue of the Royal Mineralogical Collection, in the year 1817. The species had been described by him as early as 1802 (l. c.), and his description is remarkably complete for the time, it including, besides physical characters, a chemical analysis by Chenevix (anal. 1 above) agreeing nearly in essential points with the later by Rose, and quite as well as his, with the true or normal composition of the mineral. Bournon supposed that the grains might be rhombohedral in crystallization; but Brooke, in Phillips' Mineralogy (3d ed.), published in 1823, the year of Rose's publication, announced that there were two cleavages, inclined to one another 84° 45′ and 95° 15′, differing not widely from the same angle ($O \wedge i\text{-}\bar{i}$) as ascertained by Rose. Justice seems to require that Bournon's name should be restored to the species. Beudant, in the first edition of his mineralogy, published in 1824, describes indianite in full and called it lime-feldspar, mentioning anorthite only in his index.

Christianite was named by Monticelli and Covelli after the prince Christian Friedrick of Denmark, who explored Vesuvius with them; *Amphodelite* from ἀμφί, *double*, and ὀβελός, *spear*, the crystals being often twinned parallel to $i\text{-}\bar{i}$; *Latrobite*, after C. F. Latrobe, the discoverer of the variety.

For recent observations on cryst., see Descl. Min., i. 294; Hessenb. Min. Not., No. i. 6; Websky, ZS. G., xvi. 530; Kokscharof, Bull. Ac. St. Pet., vii. 326. The angles given are from Kokscharof, whose measurements agree closely with those of Marignac.

Alt.—*Linseite* N. Nordenskiöld, Komonen, Verh. Min. Ges. St Pet., 1843, 112. Considered altered lepolite, which is from the same mine in Orrijärvi, Finland. Occurs in large crystals, H.=3·5; G.=2·796 —2·83; color black externally. The name is sometimes written *lindsayite*.

Sundvikite A. E. Nordenskiöld, Beskrifn. Finl. Min., 113, 1855, and Jahrb. Min., 1858. Feldspar-like in form; G.=2·70; from Nordsundvik, Finland. It is regarded as altered anorthite.

Rosite and *polyargite* are pinite-like pseudomorphs; see PINITE.

The following are analyses of these minerals: 1, Komonen (l. c.); 2, Hermann (J. pr. Ch., xlvi 393, xlviii. 254); 3, Bonsdorff & Ursin (Ramm. Min. Ch., 593):

	$\ddot{\mathrm{Si}}$	$\dddot{\mathrm{Al}}$	$\dddot{\overline{\mathrm{Fe}}}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Na}}$	$\dot{\mathrm{K}}$	$\dot{\mathrm{H}}$
1. *Linseite*	47·50	35·29	—	7·03	3·56	—	—	—	6·62=100 Komonen.
2. "	42·22	27·55	6·98	2·00	8·85	—	2·53	3·00	7·00=100·13 Hermann.
3. *Sundvikite*	44·82	30·70	—	3·69	1·48	6·81	6·78	—	3·38, Mn 1·21=99 21 B. & U

The presence of little lime and of much water is a peculiarity of each of these minerals.

310A. CYCLOPITE *von Waltershausen*, Vulk. Gest., 292, 1853. Cyclopite occurs in white transparent glassy crystals, with H.=6. According to v. Waltershausen, in crystallization it is triclinic, like anorthite and labradorite. Analysis afforded him (l. c.) $\ddot{\mathrm{Si}}$ 41·45, $\dddot{\mathrm{Al}}$ 29·83, $\dddot{\overline{\mathrm{Fe}}}$ 2·20, $\dot{\mathrm{Ca}}$ 20·83, $\dot{\mathrm{Mg}}$ 0·66, $\dot{\mathrm{Na}}$ 2·32, $\dot{\mathrm{K}}$ 1·72, $\dot{\mathrm{H}}$ 1·91=100·92. It coats geodes in the doleryte of the Cyclopean islands near Catania.

310B. BARSOWITE *G. Rose*, Pogg., xlviii. 567, 1839. Massive, of a granular texture, with a nearly perfect cleavage in one direction.

H.=5·5—6. G.=2·74—2·752. Lustre more or less pearly. Color snow-white, subtranslucent. Fracture granular or splintery. Optically biaxial (Descl.).

Mean of three analyses by Varrentrapp (Pogg., xlviii. 568): $\ddot{\mathrm{Si}}$ 48·71, $\dddot{\mathrm{Al}}$ 33·90, $\dot{\mathrm{Mg}}$ 1·54, $\dot{\mathrm{Ca}}$ 15·29=99·44. The analysis corresponds to the oxygen ratio 1 : 3·18 : 5·24. B.B. alone, fuses only on the edges to a vesicular glass. Gelatinizes easily on heating with muriatic acid. The mineral is probably identical with anorthite. Optical characters separate it from scapolite. Occurs in boulders in the auriferous sand of Barsovskoi, as the gangue of the blue corundum, as indianite is the gangue of the corundum of the Carnatic.

310C. BYTOWNITE *Thomson*, Min., i. 372, 1836. Bytownite is a greenish-white, feldspar-like mineral, occurring in boulders at Bytown, Canada, having G.=2·801, Thomson, 2·733, Hunt. It has been referred to anorthite, although the analyses give the oxygen ratio nearly 1 : 3 : 5, as in barsowite. The following are analyses with others of related substances: 1, Thomson (l. c.); 2, T. S. Hunt (Am. J. Sci., II. xii. 213, Phil. Mag., IV. i. 322); 3, Tennant (Rec. Gen. Sci., iii 339); 4, 5, T. S. Hunt (Logan's Rep., 1863, 479); 6, T. Thomson (Min., i. 384, 1836):

		$\ddot{\rm Si}$	$\bar{\ddot{\rm Al}}$	$\bar{\ddot{\rm Fe}}$	$\dot{\rm Mg}$	$\dot{\rm Ca}$	$\dot{\rm Na}$	$\dot{\rm H}$
1. *Bytownite*	(⅔)	47·57	29·65	3·57	0·40	9·06	7·60	1·98=99·83 Thomson.
2. "		47·40	30·45	$\dot{\rm Fe}$ 0·80	0·87	14·24	2·82	2·00, $\dot{\rm K}$ 0·38=98·90 Hunt.
3. Bytown		45·80	26·15	$\dot{\rm Fe}$ 4·70	2·95	16·25	——	2·00=97·85 Tennant.
4. Yamaska		46 90	31·10	1·85	0·65	16·07	1·77	1·00, $\dot{\rm K}$ 0·58=99·42 Hunt.
5. Hunterstown		49 10	26·80	0·80	*tr.*	14·67	*und.*	1·20=98·96 Hunt.
6. *Huronite*		45·80	33·92	$\dot{\rm Fe}$ 4·32	1·72	8·04	——	4·16=97·96 Thomson.

The specimen for anal. 2 was a greenish-white feldspathic rock from a boulder near Ottawa, having G.=2·73—"a portion of the specimen upon which Dr. Thomson based the species *bytownite*." That of 3 was from the same region, but is not called bytownite by Tennant. That of 4 was a feldspar from the intrusive dioryte of Yamaska mountain, having the cleavage surface finely striated; and associated with hornblende and a little sphene; G.=2·756—2·763. That of 5 is a pale sea-green feldspar from a boulder; G.=2·695—2·703.

Thomson's *huronite*, anal. 6 (l. c.), is an impure anorthite-like feldspar, related to the above, according to T. S. Hunt (priv. contrib.); excluding the 4·16 p. c. of water, the $\ddot{\rm Si}$ would be 47 p. c. of the remainder. Thomson states that it is infusible. He also says that his bytownite is infusible, which Prof. Brush finds is not a fact.

311. **LABRADORITE.** Labradorstein (under Feldspat) *Wern.*, Ueb. Cronst., 149, 1780, Bergm. J., 375, 1789. Pierre de Labrador *Forst.*, Cat., 82, 1780; *de Lisle*, Crist., ii. 497, 1783. Labrador Feldspar. Labrador *G. Rose*, Gilb. Ann., lxxiii. 173, 1823; *Breith.*, Char., 1823. Lime Feldspar.

Mornite *Thom.*, Ed. N. Phil. J., xiii. 1832. Silicite *Thom.*, Phil. Mag., III. xxii. 190, 1843. Saussurite pt. Radauit *Breith.*, B. H. Ztg., xxv. 87.

Triclinic. Observed planes: *O*; *i-ĭ*; 1, *I*; 2-*ĭ*; 1′, *I′*.

I ∧ *I′*=121° 37′	*O* ∧ *I′*=113° 34′	*i-ĭ* ∧ *I*=117° 30′
O ∧ *i-ĭ*, ov. 2-*ĭ′*,=93 20	*O* ∧ 2-*ĭ*=98 58	*i-ĭ* ∧ *I′*=120 53
O ∧ *i-ĭ*, ov. 2-*ĭ*,=86 40	*O* ∧ 1=125 28	*i-ĭ*, left, ∧ 2-*ĭ*=90 20
O ∧ *I*=110 50	*O* ∧ 1′=122 42	*I* ∧ *I*, in twin,=125

Angles from Marignac. Rensch gives, as a mean of many measurements, *O* ∧ *i-ĭ*=86° 20′, *O* ∧ *I′*=114° 4′, *i-ĭ* ∧ *I′*=120° 43′. Twins: (1) composition-face *i-ĭ*; often lamellar from repeated composition of this kind; (2) *O*, with the orthodiagonal as the axis of revolution. Cleavage: *O* easy; *i-ĭ* less so; *I* traces. Also massive granular, and grains cleavable; sometimes cryptocrystalline or hornstone-like.

H.=6. G.=2·67—2·76. Lustre of *O* pearly, passing into vitreous; elsewhere vitreous or subresinous. Color gray, brown, or greenish; sometimes colorless and glassy; rarely porcelain-white; usually a change of colors in cleavable varieties. Streak uncolored. Translucent—subtranslucent.

Comp., Var.—O. ratio 1 : 3 : 6; $\dot{\rm R}\ddot{\rm Si}+\bar{\ddot{\rm Al}}\ddot{\rm Si}^2$; or $(\frac{1}{4}\dot{\rm R}^3+\frac{3}{4}\bar{\ddot{\rm Al}})^2\ddot{\rm Si}^3+\frac{3}{2}\ddot{\rm Si}$;=, if 1 $\dot{\rm R}=\frac{3}{4}\dot{\rm Ca}+\frac{1}{4}\dot{\rm Na}$, Silica 52·9, alumina 30·3, lime 12·3, soda 4·5=100.

Var. 1. *Cleavable.* (*a*) Well crystallized to (*b*) massive.

Play of colors either wanting, as in some colorless crystals; or pale; or deep; blue and green are the predominant colors; but yellow, fire-red, and pearl-gray also occur. By cutting very thin slices parallel to *i-ĭ* from the original labradorite, they are seen under the microscope to contain, besides striæ, great numbers of minute scales, like the aventurine oligoclase, which are probably göthite or hematite. The chatoyant colors may be heightened in their effect by these scales, but are not due to them (p. 336).

2 *Compact massive*, or *cryptocrystalline; Labradorite-Felsite.* The color sometimes gray to brownish-red; but sometimes porcelain-white. Some of the so-called *saussurite* is here included.

A variety from the gabbro of Baste in the Radau valley, Harz, is called *Radauite* by Breithaupt. Breithaupt refers to anal. 20; H.=5; G.=2·766—2·849; color white to gray; intercleavage angle 93¼°. He also refers here, with a query, a feldspar from Rizzoni in the Tyrol; G. of a specimen not fresh 2·811.

Analyses: 1, Klaproth (Beitr., vi. 250, 1815); 2, S. v. Waltershausen (Vulk. Gest., 24, 1853); 3, 4, Lehunt (Ed. N. Phil. J., 1832, July, 86); 5, Haughton (Q. J. Sci. Dublin, v. 94); 6, Thomson (Phil. Mag., III. 1843, 190); 7, Svanberg (Jahresb., xxiii 285); 8, Forchhammer (J. pr. Ch., xxx. 385); 9, Damour (Bull. G. Soc., vii. 88); 10, 11, Kersten (Pogg., lxiii. 123); 12, Waage (Forh. Vid. Christiania, 1861, 177); 13, Blomstrand (Œfv. Ak. Stockholm, 296, 1854, J. pr. Ch., lxvi. 158); 14, 15, G. v. Rath (Pogg., xcv. 538); 16, Streng (Jahrb. Min. 1864, 267); 17, v. Rath (Pogg., xcv 555); 18, C. F. Chandler (Inaug. Diss., Gött., 1856); 19, Delesse (Ann. d. M., IV. xii. 251, 258) 20, Rammelsberg (ZS. G., xi. 101, Min. Ch., 597); 21–23, Streng (B. H. Ztg., xx. 265, xxiii. 53) 24, Segeth (J. pr. Ch., xx. 253); 25, Delesse (l. c.); 26, Abich (Ann. Ch. Phys., lx. 332); 27, 28 Waltershausen (l. c.); 29–33, T. S. Hunt (Phil. Mag., IV. i. 322, ix. 354, and Rep. G. Can., 1851, and 1863, 479); 34, Deville (Et. Geol., 1848); 35, A. Schlieper (Am. J. Sci., II. xi. 121); 36–40, v. Hauer (Verh. G. Reichs., 1867, 12, 14, 58, 59, 60):

	$\ddot{\mathrm{Si}}$	$\dddot{\bar{\mathrm{Al}}}$	$\dddot{\bar{\mathrm{Fe}}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Na}}$	$\dot{\mathrm{K}}$	$\dot{\mathrm{H}}$
1. Labrador	55·75	26·50	1·25	——	11·00	4·00	——	0·5=99·00 Klaproth.
2. "	53·75	27·06	0·99	0·47	9·58	1·25	7·53	0·62=101·25 Waltersh.
3. Campsie	54·67	27·89	0·31	0·18	10·60	5·05	0·49	——=99·19 Lehunt.
4. Glasgow	52·34	29·97	0·87	– –	12·10	3·97	0·30	——=99·95 Lehunt.
5. Scavig, Irel.	53·60	29·88	$\dot{\mathrm{F}}$e0·20	0·07	11·02	4·92	0·80	0·48=100·97 Haughton.
6. Antrim, *Silicite*	54·80	28·40	——	——	12·40	——	——	0·60, $\dot{\mathrm{F}}$e 4·0=100·20 Th.
7. Dalarne	52·15	26·82	1·29	1·02	9·14	4·64	1·79	1·75=98·60 Svanberg.
8. Faroe	52·52	30·03	1·72	0·19	12·58	4·51	——	——=101·55 Forchh.
9. Berufiord, Icel.	52·17	29·22	1·90	——	13·11	3·40	——	——=99·80 Damour.
10. Egersund, Norw.	52·30	29·00	1·95	0·15	11·69	4·01	0·50	——=99·60 Kersten.
11. " "	52·45	29·85	1·00	0·16	11·70	3·90	0·60	——=99·66 Kersten.
12. Hitteröe	51·39	29·42	2·90	0·37	9·44	5·63	1·10	0·71=100·96 Waage.
13. Sweden	53·82	26·96	1·48	0·20	11·20	5·00	1·34	——=99·95 Blomstrand.
14. Neurode, Sil.	52·55	28·32	2·44	0·48	11·61	4·52	0·64	0·62=101·18 Rath.
15. "	50·31	27·31	1·71	0·78	10·57	4·81	1·55	2·20=99·24 Rath.
16. "	48·54	29·74	0·94	0·68	15·14	2·95	1·37	1·02=100·38 Streng.
17. " *Sauss.*	50·84	26·00	2·73	0·22	14·95	4·68	0·61	1·21=101·24 Rath.
18. Zobten, "	51·76	26·82	1·77	0·35	12·96	4·61	0·62	0·68=99·57 Chandler.
19. Tyrol	52·23	27·73	1·50	0·93	8·28	7·38		0·95=100 Delesse.
20. Baste, Harz, *Rad.*	51·00	29·51	*tr.*	0·28	11·29	3·14	2·09	2·48=99·79 Ramm.
21. Ilfeld "	53·11	27·27	$\dot{\mathrm{F}}$e2·53	0·91	7·47	5·09	1·08	2·38=99·84 Streng.
22. Harzburg, *cryst.*	50·60	29·62	2·13	0·53	13·86	2·65	1·21	1·22=101·82 Streng.
23. " *Radauite*	50·65	27·55	0·15	0·30	13·06	2·53	2·19	2·97=99·40 Streng.
24. Kiew, Russia	55·49	26·83	1·60	0·15	10·93	3·96	0·36	0·51=99·83 Segeth.
25. Greece	53·20	27·31	1·03	1·01	8·02	3·52	3·40	2·51=100·63 Delesse.
26. Etna	53·48	26·46	1·60	1·74	9·49	4·10	0·22	0·42, $\dot{\mathrm{M}}$n 0·89=98·40 A.
27. " *cryst.*	53·56	25·82	3·41	0·52	11·69	4·00	0·54	0·95=100·48 Waltersh.
28. " "	55·83	25·31	3·64	0·74	10·49	3·52	0·83	——=100·35 Waltersh.
29. Drummond, Can.	54·70	29·80	0·36	*tr.*	11·42	2·44	0·23	0·40=99·35 Hunt.
30. Morin, "	54·20	29·10	1·10	0·15	11·25	*undet.*		0·40=96·20 Hunt.
31. Rawdon, "	54·45	28·05	0·45	——	9·68	6·25	1·06	0·55=100·49 Hunt.
32. Château Richer, "	55·80	26·90	1·53	0·27	9·01	4·77	0·86	0·45=99·59 Hunt.
33. Montarville, "	53·10	26·80	1·35	0·72	11·48	4·24	0·71	0·60=99·00 Hunt.
34. Guadeloupe, W. I.	54·25	29·89	——	0·70	11·12	3·63	0·33	——=99·92 Deville.
35. Maui, Pacific	53·98	27·56	1·14	1·35	8·65	6·06	0·47	——=99·21 Schlieper.
36. Illowa	54·53	27·37	——	*tr.*	9·62	5·98	1·81	1·21=100·52 Hauer.
37. Reesk	55·63	26·74	——	*tr.*	9·78	5·08	1·61	1·07=99·91 Hauer.
38. Deva	53·74	28·72	——	*tr.*	10·69	4·95	1·02	1·36=100·48 Hauer.
39. Cziffar	51·72	25·72	4·51	*tr.*	9·66	3·95	1·02	2·26=98·84 Hauer.
40. Pereu, Vitz.	54·72	27·39	——	——	7·76	6·66	2·01	0·55=99·09 Hauer.

In anal. 2, G.=2·646; anal. 5, from doleryte, of meteoric origin; anal. 6, G.=2·666; 8, G.=2·68; 9, G.=2·709, trap, ywh.; 10, G.=2·71, brown, massive; 11, G.=2·72, with blue opalescence; 12, G.=2·72; 13, G.=2·68, between Lund and Christianstadt; 14, G.=2·715, hypersthene rock, bh.-gy.; 15, G.=2·707, gabbro, bh.-gy.; 16, O. ratio 1 : 2½ : 4½ or 1⅓ : 3⅓ : 6, gabbro. 17, G.=2·998, color porcelain-white; 18, snow-white, gnh.-w., little lustre, strp. with uralite; 19, in "melaphyre," between Botzen and Collman, pale gyh.-gn.; 20, G.=2·817, gabbro; 21, G.=2·6, in porphyryte, 22, from gabbro; 23, ib., massive; 25, G.=2·883, in "porphyry," Southern Morea; 27, G.=2·618; 28, G.=2·633; 29, G.=2·697, lavender-blue cleavable feldspar, from a boulder, 30, G.=2·684—2·695, bluish opalescent, cleavable; 31, G.=2·67, bh.-white, in trap rock; 32, G.=2·68, pale bh.- or gnh.-gy., lustre of cleavage surfaces vitreous, elsewhere waxy; 33, G.=2·73—2·74, from basalt; 34, in trachytic doleryte, central peak; 35, glassy colorless crystals; 36–40 fr. Hungary, in trachyte; 36, G.=2·636; 38, G.=2·598; 39, G.=2·678: 40, G.=2·637. Anal. 36–39 give the O. ratio 1 : 3 : 7, intermediate between labradorite and andesite.

Pyr., etc.—B.B. fuses at 3 to a colorless glass. Decomposed with difficulty by muriatic acid, generally leaving a portion of undecomposed mineral.

Obs.—Labradorite is a constituent of some rocks. (1) The cleavable mineral, along with hornblende, composes a granite-like variety of *diabase*, or a rock resembling dioryte, but having labradorite as the feldspar. (2) If the hornblendic constituent is a dark *lamellar* variety of either hornblende or pyroxene, or the species hypersthene, the rock is called *hyperyte* (or hypersthenyte). (3) If the hornblendic mineral is a light lamellar pyroxene (diallage), the rock is called gabbro. (4) If the hornblende and labradorite constitute a homogeneous fine-grained compact mass, the rock is called *amphibolyte* or *diabase;* and (5) if the diabase contains distinct crystals of porphyry, it is a *diabase porphyry*, the green porphyry or oriental verd-antique of Greece (anal. 25) being of this nature. (6) The crypto-crystalline, or felsite variety of labradorite, occurring occasionally in connection with some of these rocks, has been called incorrectly *saussurite* and *jade* or *nephrite*. The above are labradoric metamorphic rocks.

There are also the following *labradoric intrusive* rocks. (7) *Doleryte*, consisting of labradorite and pyroxene, with generally some magnetite—a rock which, on the one hand, may be light-colored crystalline or granitoid, and on the other, dark-colored compact massive, either porphyrite or not, sometimes crypto-crystalline, and also a cellular lava; it includes much of the so-called *trap*, *greenstone*, and *amygdaloid*. (8) *Basalt*, similar to doleryte in structure, colors, and varieties, but containing, in addition to labradorite and pyroxene, chrysolite in disseminated grains. Dolerytic and basaltic lavas are the most common of volcanic rocks. (9) Labradorite also occurs in other kinds of lava, and is sometimes found in them in glassy crystals, as in those of Etna and Vesuvius.

The labradoric metamorphic rocks are most common among the formations of the Azoic or pre-Silurian era. Such are part of those of British America, northern New York, Pennsylvania, Arkansas; those of Greenland, Norway, Finland, Sweden, and probably of the Vosges. Being a feldspar containing comparatively little silica, it occurs mainly in rocks which include little or no quartz (free silica).

Many foreign localities are mentioned above.

On the coast of Labrador, labradorite is associated with hornblende, hypersthene, and magnetite. It is met with in place at Mille Isles, Chateau Richer, Rawdon, Morin, Abercrombie, and elsewhere, in Canada East; and in boulders at Drummond and elsewhere, Canada West. It occurs abundantly at Essex Co, N. Y.; large boulders are met with in the towns of Moriah, Newcomb, M'Intyre, Westport, and Lewis, N. Y.; also occasionally in Orange, Lewis, St. Lawrence, Warren, Scoharie, and Green Cos. In Pennsylvania, at Mineral Hill, Chester Co., and opposite New Hope, Bucks Co.; in the Witchita Mts., Arkansas.

Silicite and *mornite* are from Antrim, Ireland.

Labradorite was first brought from the Isle of Paul, on the coast of Labrador, by Mr. Wolfe, a Moravian missionary, about the year 1770, and was called by the early mineralogists Labrador stone (*Labradorstein*), and also chatoyant, opaline, or Labrador feldspar. Klaproth's analysis above (No. 1) was the first one made (in 1815).

Labradorite receives a fine polish, and owing to the chatoyant reflections, the specimens are often highly beautiful. It is sometimes used in jewelry.

Alt.—Labradorite, like anorthite, appears to undergo alteration with considerable facility, it losing lime through infiltrating carbonated or alkaline waters, and receiving water. In some cases, also, it has received considerable iron. The following analyses appear to be of specimens of this altered labradorite. The results are remarkable for either the small proportion of *lime* or large proportion of *iron*, or the same of *potash* or of *water*, each of which may be regarded as an indication of alteration. Analyses: 1–4, Delesse (1, Ann. d. M., IV. xii. 200; 2, ib., xvi. 342; 3, Ann. Ch. Phys., III. xl. 271; 4, Ann. d. M., IV. xvi. 324); 5, Metzger (Jahrb. Min., 1850, 683); 6, v. Rath (ZS. G., ix. 246); 7, Delesse (Ann. d. M., IV. 512); 8, T. S. Hunt (Rep. G. Can., 1863, 479):

	S̈i	A̶l	F̶e	Ṁg	Ċa	Ṅa	K̇	Ḣ
1. Belfahy, Vosges	52·89	27·39	1·24	—	5·89	5·29	4·58	2·28, Ṁn 0·30=99·86 Delesse.
2. P. Jean, "	53·05	28·66	1·00	1·51	6·37	4·12	2·80	2·40=99·91 Delesse.
3. *Vosgite* "	49·32	30·07	0·70	1·96	4·25	4·85	4·45	3·15, Ṁn 0·60=99·35 Delesse
4. Odern	55·23	24·24	1·11	1·48	6·86	4·83	3·03	3·05=99·83 Delesse.
5. Clausthal	54·44	25·50	5·33	—	8·05	2·11	0·12	3·65=99·20 Metzger.
6. Graubündten	53·92	21·51	4·16	1·26	9·41	5·57	1·59	2·76=100·18 Rath.
7. Oberstein	53·89	27·66	0·97	—	8·28	4·92	1·28	3·00=100 Delesse.
8. Mt. Royal, Can.	53·60	25·40	4·60	0·86	3·62	*undet.*		0·80 Hunt.

No. 1 is from a porphyritic rock, G.=2·719; 2, from dioryte; 3, the *vosgite*, from a porphyr G.=2·771, color whitish, sometimes slightly greenish or bluish, lustre greasy or pearly; 4, fro the euphotide of Odern in Elsace; 5, from an altered diabase-porphyry; 6, from a gabbro, an remarkable for its high specific gravity, G.=2·840; 7, from a porphyritic amygdaloid, a colorle and translucent variety, with G.=2·642; 8, from a basalt (or chrysolitic doleryte), "with a sma admixture of augite." Labradorite also occurs changed to calcite (Tschermak).

Artif.—Hausmann (Beitr. Eisenhochofenschlacken, 31) has referred to labradorite crystals di tributed through the mass of the slug of a furnace at Veckeshagen, which were an inch long, bu not well formed; had two cleavages at right angles to one another, with H.=6, G.=2·85; wa fusible B.B., but insoluble in muriatic acid; and afforded S̈i 66·2, A̶l 10·4, Ċa 21·0, Ḟe 1·9, M 0·1=99·6.

Globules of the Variolyte of Durance. These concretionary globules are often half an inch more in diameter, grayish-green in color, compact in texture, with G.=2·923. A specimen fro a locality south of Mt. Genèvre, near Briançon, afforded Delesse (Ann. d. M., IV. xvii. 116):

S̈i	A̶l	F̶e	C̶r	M̶n	Ṁg	Ċa	Ṅa	K̇	ign.
56·12	17·40	7·79	0·51	*tr.*	3·41	8·74	3·72	0·24	1·93=99·86

Carnatite. A feldspar, described by Beudant, occurring at the localities of corundum an indianite in the Carnatic, India, is pronounced by Breithaupt and von Kobell to be labradorite.

312. ANDESITE. Andesin *Abich*, Jahresb., xxi. 167, 1841. Pseudoalbit. Sacchar *Glocker*, J. pr. Ch., xxxiv. 494, 1845.

Triclinic. Approximate angles from Esterrel crystals (Descl.): $O \wedge i$-left, 87°–88°, $O \wedge I = 111°–112°$, $O \wedge I' = 115°$, $I \wedge i\text{-}\bar{i} = 119°–120°$, $I' \wedge i\text{-}\bar{i} =$ 120°, $O \wedge 2\text{-}\bar{i} = 101°–102°$. Twins: (1) composition-face $i\text{-}\breve{i}$; (2) doubl twins, made up of two twins of the kind in (1), one of them reversed, s that there are 4 planes I in front, and at each end there are the planes and $2\text{-}\bar{i}$; (3) double twins, like the last, but one of the parts turned aroun so that there are reëntering angles between two faces O and two $i\text{-}\breve{i}$, an four planes I in front. Cleavage more uneven than in albite. Also gra ular massive.

H.=5–6. G.=2·61—2·74; from the Andes, 2·61—2·74; of sacchari 2·66—2·69; from the Vosges, 2·65—2·68; 2·668, Canada, Hunt. Col white, gray, greenish, yellowish, flesh-red. Lustre subvitreous, incli ing to pearly.

Comp.—O. ratio 1:3:8, but varying to 1:3:7. Perhaps only a mixture of labradorite with soda-feldspar. Formula $(\frac{1}{4}(\dot{\mathrm{C}}\mathrm{a}, \dot{\mathrm{N}}\mathrm{a})^3+\frac{3}{4}\bar{\bar{\mathrm{A}}}\mathrm{l})^2\,\ddot{\mathrm{S}}\mathrm{i}^3+3\,\ddot{\mathrm{S}}\mathrm{i}$; or with half the excess of silica basic.

Analyses: 1, Abich (Pogg., li. 523); 2, 3, Rammelsberg (5th Suppl., 48); 4, Jacobson (Ram Min. Ch., 607); 5, Deville (Ann. Ch. Phys., III. xl. 283); 6–9, Delesse (Mem. Soc. d'Em. Doubs, Ann. d. M., V. iii. 374); 10, Varrentrapp (Pogg., lii. 473); 11, Schmidt (Pogg., lxi. 385); Waltershausen (Vulk. Gest., 24); 13, Laspeyres (ZS. G., xviii. 329); 14, 15, v. Rath (ZS. G., x 249); 16–19, T. S. Hunt (Rep. G. Can., 1863, 478); 20, Franke (Ramm. Min. Ch., 609); 21, T. S. Hunt (l. c.); 23, 24, v. Hauer (Verh. G. Reichs., 1867, 13, 81); 25, 26, Sommaruga (Jah G. Reichs, xvi. 397, 1866); 27, A. Streng (Jahrb. Min. 1867, 537):

	S̈i	A̶l	F̶e	Ṁg	Ċa	Ṅa	K̇	Ḣ	
1. **Marmato**	59·60	24·18	1·58	1·08	5·77	6·53	1·08	——	=99·92 Abich.
2. "	60·26	25·01	*tr.*	0·14	6·87	7·74	0·84	——	=100·86 Ramm.
3. "	58·32	26·52	*tr.*	0·11	8·18	5·27	2·36	0·60	=101·36 Ramm.
4. "	60·14	25·39	0·87	0·53	7·93	7·99	1·66	——	=104·51 Jacobson.
5. "	63·85	24·05	——	0·38	5·04	5·04	0·88	0·76	=100 Deville.
6. Vosges, *white*	58·92	25·05	——	0·41	5·64	7·20	2·06	1·27	=99·55 Delesse.
7. " *red*	58·91	24·59	0·99	0·39	4·01	7·59	2·54	0·98	=100 Delesse.
8. Chagey	59·95	24·13	1·05	0·74	5·65	5·39	0·81	2·28	=100 Delesse.
9. La Bresse	58·55	25·26	0·30	1·30	5·03	6·44	1·50	0·91	=99·29 Delesse.
0. Silesia	58·41	25·23	——	0·41	6·54	9·39	——	——	=99·98 Varrentrapp,
1. *Saccharite*	58·93	23·50	1·27	0·56	5·67	7·42	0·05	2·21, Ṅi 0·39	=100 Schmi

		$\ddot{\rm Si}$	$\ddot{\rm \bar{A}l}$	$\ddot{\rm \bar{F}e}$	$\dot{\rm Mg}$	$\dot{\rm Ca}$	$\dot{\rm Na}$	$\dot{\rm K}$	$\dot{\rm H}$
12.	Iceland, *cryst.*	60·29	23·75	3·21	0·64	6·29	5·70	0·87	——=100·75 Waltershausen
13.	Niedermendig	57·29	26·78	*tr.*	0·28	8·01	6·84	——	——=99·20 Laspeyres.
14.	St. Valentino	56·79	28·48	——	——	8·56	6·10	0·34	0·24=100·51 Rath.
15.	"	58·15[a]	26·55	——	0·06	8·66	[6·28]		0·30=100 Rath.
16.	Château Richer	59·80	25·39	0·60	0·11	7·78	5·14	1·00	——=99·82 Hunt.
17.	"	59·55	25·62	0·75	*tr.*	7·73	5·09	0·96	0·45=100·15 Hunt.
18.	"	57·20	26·40	0·40	——	8·34	5·83	0·84	0·20=99·66 Hunt.
19.	"	58·50	25·80	1·00	0·20	8·06	5·45	1·16	0·40=100·57 Hunt.
20.	"	58·38	23·86	1·18	0·10	7·83	6·05	1·68	1·03=100·11 Franke.
21.	St. Joachim	57·15	27·10		——	8·73	5·38	0·79	0·20=99·75 Hunt.
22.	Lachute	58·15	26·09	0·50	0·16	7·78	5·55	1·21	0·45=99·89 Hunt.
23.	Nagy-Sebes	57·20	25·12	——	*tr.*	6·96	7·28	1·87	1·68=100·11 Hauer.
24.	Czifar	60·10	17·62	7·03	1·85	2·24	4·01	3·82	2·11=98·78 Hauer.
25.	Kussahora, *bk.*	57·70	20·79	8·35	1·71	5·45	*tr.*	3·99	3·84=101·83 Sommaruga.
26.	" *bk.*	58·21	22·22	7·30	0·73	5·18	*tr.*	3·96	2·75=100·35 Sommaruga.
27.	Kyffhäuser Mts.	59·16	25·97	1·04	0·03	9·23	3·91	0·47	0·68, $\dot{\rm Ba}$, $\dot{\rm Sr}$ *tr.*=100·49 Str.

[a] Probably some mixed quartz.

In anal. 1, G.=2·733; 2, G.=2·674; 3, G.=2·68–2·688; 4, G.=2·679; 5, G.=2·61; 6, from Servance, G.=2·683; 7, fr. Coravillers, G.=3·651; 8, G.=2·736; 12, G.=2·65; 14, "tonalyte," fr. Tyrol, G.=2·695; 15, G.=2·676; 16, G.=2·688; 18, lavender-blue, subtransp., cleavable, curved surfaces; 19, gnh. base of preceding, granular; 21, in a boulder; 22, G.=2·687; 23, G.=2·585; 25, G.=2·853; 26, G.=2·607; 27, in dioryte, G.=2·69. Other analyses: v. Rath, ZS. G., ix. 259.

Of these analyses all but No. 5, by Deville, afford rather closely the oxygen ratio 1 : 3 : 8. No. 5 gives 0·80 : 3 : 8·91. Nos. 24 to 26 have part of the alumina replaced by iron, and probably in consequence of alteration, as the black color, little soda, and much potash would indicate.

Pyr., etc.—Andesite fuses in thin splinters before the blowpipe. Saccharite melts only on thin edges; with borax forms a clear glass. Imperfectly soluble in acids.

Obs.—Occurs in the Andes, at Marmato, as an ingredient of the syenite-like rock called *andesyte*; in the porphyry of l'Esterel, Dept. of Var, France; in the syenite of Alsace in the Vosges; white at Servance, red at Coravillers; in the porphyry near Chagey, Haute Saône; at Vapnefiord, Iceland, in honey-yellow transparent crystals (anal. 12); at Baumgarten in Silesia (anal. 10); in the Tyrol, south of Tonale, in Mt. Adamello, in a granite-like rock called *tonalyte*, consisting of this feldspar, according to v. Rath, with much quartz, some orthoclase, biotite, and hornblende.

Saccharite is granular massive, with traces of cleavage in one direction, occurring in veins in serpentine at the chrysoprase mines near Frankenstein, in Silesia.

In North America, found at (Château Richer, Canada (anal. 16–20), forming with hypersthene and ilmenite a wide-spread rock; color flesh-red.

Alt.—The following are analyses of altered andesite in addition to 24 to 26 above: 1, Rammelsberg (Min. Ch., 608); 2–4, Deville (Bull. Geol. Fr., II. vi. 410); 5, Francis (Pogg., lii. 471). No. 2 is of the mass of a crystal, 2A of the interior, 2B of the exterior portion:

		$\ddot{\rm Si}$	$\ddot{\rm \bar{A}l}$	$\ddot{\rm \bar{F}e}$	$\dot{\rm Mg}$	$\dot{\rm Ca}$	$\dot{\rm Na}$	$\dot{\rm K}$	$\dot{\rm H}$
1.	Esterrel Mts.	58·32	26·52	——	0·11	8·18	5·27	2·36	0·60=101·36 Ramm.
2.	"	59·07	26·67	——	0·58	7·96	4·95	*tr.*	0·77=100 Deville.
2A.	"	57·01	28·05	——	0·39	7·53	5·47	0·12	1·43=100 Deville.
2B.	"	52·42	24·78	——	0·51	15·02	5·10	0·14	2·05=100 Deville
3.	Hungary	53·92	26·69	1·20	1·68	6·98	4·02	1·20	1·40, $\ddot{\rm C}$ 2·93=100·02 Deville.
4.	Marmato	58·11	28·16	——	1·52	5·35	5·17	0·44	1·25=100 Deville, G.=2·62.
5.	Popayan	56·72	26·52	0·70	——	9·38	6·19	0·80	——=101·31, Francis; G.=2·64.

The oxygen ratio for 1 is 1 : 3 : 7·5; 2, 0·9 : 3 : 7·5; 2A, 0·84 : 3 : 7·0; 2B, 1·5 : 3 : 7·3; 3, 0·9 : 3 : 6·9; 4, 0·8 : 3 : 7·2; 5, 1 : 3 : 7·2. The mineral of the Esterrel Mts., near Fréjus in southern France, occurs in a rock called porphyry. Deville's analyses leave no doubt as to the alteration. The analysis by v. Rath (No. 14, above) also gives nearly the ratio 1 : 3 : 7; and the next, 1 : 3 : 7½. No. 4, from Marmato, contains 1·4 p. c. of carbonate of lime.

Deville takes the ground, as a result of his analyses, that all andesite is altered *oligoclase*, the oxygen ratio of which is 1 : 3 : 9; and the same result was earlier suggested by G. Rose and Bischof. Deville's analyses of the Marmato andesite gave him nearly the oligoclase ratio.

Andesite changes also to *kaolin*. That of La Bresse, studied by Delesse, is in part in this condition, being soft and crumbling; and in part less changed and of a reddish color.

313. HYALOPHANE. Hyalophan *v. Waltershausen*, Pogg., xciv. 134, 1855, c. 548.

Monoclinic, like orthoclase, and angles nearly the same. Observed planes: *O*; vertical planes, *I*, *i*-ì, *i*-3̀; hemidomes, 1-*i*, ⅔-*i*; clinodome, 2-ì. *C* (by calc.)=64° 16′ *I* ∧ *I*=118° 41′, *I* ∧ *i*-ì=120° 36′, *O* ∧ 1-*i*=130° 55½′ *I* ∧ 1-*i*=111° 55′. Cleavage: *O* perfect, *i*-ì somewhat less so. In small crystals, single, or in groups of two or three.

H.=6—6·5. G.=2·80, transparent; 2·905, translucent. Lustre vitreous, or like that of adularia. Color white, or colorless; also flesh-red. Transparent to translucent.

Comp.—O. ratio for $\dot{R}$, $\ddot{\ddot{R}}$, $\ddot{S}i$=1 : 3 : 8; formula $(\frac{1}{4}(\dot{B}a, \dot{K})^3+\frac{3}{4}\ddot{\ddot{A}}l)^2\ddot{S}i^3+3\ddot{S}i$, or like andesite and leucite, except that the protoxyds are mainly baryta and potash.

Analyses: 1, Uhrlaub (Pogg., c. 548); 2, same, the impurity, sulphuric acid and part of baryta as sulphate, being removed; 3, Stockar-Escher (Kenng. Uebers. 1856–57, 107); 4, Petersen (Jahrb. Min. 1867, 102); Igelström (Œfv. Ak. Stockh. 1867, J. pr. Ch., ci. 434):

	$\ddot{S}i$	$\ddot{\ddot{A}}l$	$\dot{M}g$	$\dot{C}a$	$\dot{B}a$	$\dot{N}a$	$\dot{K}$	$\dot{H}$	$\dddot{S}$	
1. Binnen	45·65	19·14	0·73	0·77	21·33	0·49	8·23	0·54	4·12	=101 Uhrlaub.
2. "	51·30	21·50	0·84	0·87	15·11	0·55	9·25	0·58	——	=100 Uhrlaub.
3. "	52·67	21·12	0·04	0·46	15·05	2·14	7·82	0·58	——	=99·88 St.-E.
4. "	51·84	22·08	0·10	0·65	14·82	10·03		0·48	——	=100 Petersen.
5. Jakobsberg, Swed.	51·14	22·86	3·10	4·28	9·56	[9·06]		——	——	=100 Igelström.

Anal. 2 gives the O. ratio 1 : 2·6 : 7, and 3, 1 : 2·8 : 7·8; and 4 agrees well with No. 3. No. 5 contains less baryta and more lime.

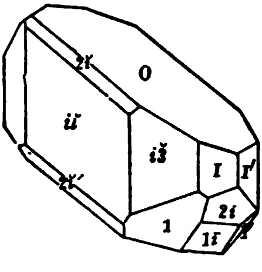
Pyr., etc.—B.B. fuses with difficulty to a blebby glass. Unacted upon by acids.

Obs.—Occurs in a granular dolomite, along with white barite, greenish tourmaline, mica, realgar, dufrenoysite, and sphalerite, near Imfeld, in the valley of Binnen in the Valais, in crystals 2 or three lines long, and rarely larger; also at the manganese mine of Jakobsberg in Sweden, in limestone with a manganiferous epidote (p. 283), looking much like common flesh-red ortho A massive variety accompanies it, containing according to Igelström (l. c.) $\ddot{S}i$ 50·90, $\ddot{\ddot{A}}l$ 21 C 13·30, $\dot{B}a$ 3·50, alkalies, Mg and Mn, 11·21 undetermined.

314. OLIGOCLASE. Natron-spodumen *Berz.*, Arsb., 160, 1824=Soda-spodumene. Oligokl *Breith.*, Pogg., viii. 79, 1826. Hafnefjordit, Kalkoligoklas, *Forchhammer*, Skand. Nat. sam i Stockholm, July, 1842. Aventurine Feldspar=Sunstone pt.

Triclinic. Observed planes (see, for position, the table under anorthite or albite): *O*; 2-ĭ, *i*-ĭ, 2-ĭ′; *i*-5̆; *i*-3̆; −2, *I*, 2, 1; 2-ī, ⁴⁄₃-ī, 1-ī; −2′, *I*′, 2′, 1′; *i*-3̆′; *i*-5̆′.

299



I ∧ *I*′=120° 42′ *O* ∧ 1=123° 51′
O ∧ *i*-ĭ, ov. 2-ĭ′,=93 50 *O* ∧ 1′=121 15
O ∧ *i*-ĭ, ov. 2-ĭ,=86 10 *O* ∧ 1-ī=127 6
O ∧ *I*=110 55 *O* ∧ 2-ī, ov. 1-ī,=97 22
O ∧ *I*′=114 40 *i*-ĭ ∧ *I*′=120 24
O ∧ 2-ĭ′=136 23 *i*-ĭ ∧ *I*=118 54
O ∧ 2-ĭ=132 40 *I*′ ∧ *i*-3̆′=150 30
I ∧ *i*-3̆=147 30

Cleavage: *O*, *i*-ĭ, perfect, the latter least so. Twins: similar to those of albite. Also massive.

H.=6—7. G.=2·56—2·72; mostly 2·65—2·69. Lustre vitreo-pearly or waxy, to vitreous. Color usually whitish, with a faint tinge of grayish-green, grayish-white, reddish-white, greenish, reddish;

metimes aventurine. Transparent, subtranslucent. Fracture conchoidal uneven.

Comp., Var.—O. ratio 1 : 3 : 9; $(\frac{1}{4}(\dot{N}a, \dot{C}a)^3+\frac{3}{4}\ddot{\bar{A}}l)^2\dddot{S}i^3+3\frac{1}{2}\dddot{S}i$; or else with half the excess silica basic; =, taking $\dot{R}$ as soda alone, Silica 62·1, alumina 23·7, soda 14·2=100. Part of the is replaced by lime.

Var. 1. *Cleavable*; in crystals or massive.

2. *Compact massive; oligoclase-felsite*; includes part, at least, of the so-called compact feldspar or these consisting of the feldspar in a compact, either fine granular or flint-like state, containing silica disseminated through the mass. In those here included, the feldspar is a soda-feldspar, it is often difficult to distinguish them from *albite-felsite*. See under **ALBITE** for analyses.

3. *Aventurine oligoclase, or sunstone.* Color grayish-white to reddish-gray, usually the latter, internal yellowish or reddish fire-like reflections proceeding from disseminated crystals of bably either hematite or göthite.

Much oligoclase has a faint greenish tinge and pearly lustre, in which it somewhat resembles dumene, whence the name *soda-spodumene*. Only the oligoclase of lavas or trachytic rocks G. below 2·6. *Hafnefiordite* (anal. 36) contains the protoxyds of an andesite or labradorite, may not belong here.

4. *Moonstone* pt. A whitish opalescence.

Analyses: 1, 2, Berzelius (Jahresb., iv. 147, xix. 302); 3, L. Svanberg (Œfv. Ak. Stockholm,); 4, R. Hagen (Pogg., xliv. 329); 5, Rosales (Pogg., lv. 109); 6, Francis (Pogg., lii. 470); Bodemann (Pogg., lv. 110); 8, Jevreinof (B. H. Ztg., 1853, No. 12); 9, Chodnef (Pogg., lxi. ; 10, Jevreinof (l. c.); 11, Scheerer (Pogg., lxiv. 153); 12, 13, Kersten (J. pr. Ch., xxxvii. Jahrb. Min. 1845, 653); 14, v. Hauer (Jahrb. G. Reichs., iv. 830); 15, Delesse (Ann d. M., xix. 149); 16. Kerndt (J. pr. Ch., xliii. 218); 17, Wolff (J. pr. Ch., xxxiv. 234); 18, Rammels- (Pogg., lvi. 617); 19, v. Rath (ZS. G., ix. 226); 20, Delesse (Ann. Ch. Phys., III. xxiv.); Seneca (G. Beschr. Baden, 1861–62); 22, Delesse (Bull. G. Soc., II. vii. 310); 23, Laurent Ch. Phys., lix. 108); 24, Damour (Ramm. 5th Suppl., 178); 25–27, Haughton (Rep. Br. soc., 1863, 56); 28–30, Smith & Brush (Am. J. Sci., II. xv. 211, xvi. 44); 31, C. T. Jackson J. Sci., II. xlii. 107); 32–35, Deville (C. R., xix. 46, Et. Geol. Teneriffe, 1848); 36, Forch- mer (Skand. Nat. S. Stockholm, 1842); 37, Fouqué (Ramm. Min. Ch., 614); v. Hauer (Verh. Reichs., 1867, 60); 39, 40, A. Streng (Jahrb. Min. 1867, 537):

	$\dddot{S}i$	$\ddot{\bar{A}}l$	$\ddot{\bar{F}}e$	$\dot{M}g$	$\dot{C}a$	$\dot{N}a$	$\dot{K}$	$\dot{H}$	
1 Danviks-Zoll	63·70	23·95	0·50	0·65	2·05	8·11	1·20	——	=100·16 Berzelius.
Ytterby, "	61·55	23·80	——	0·80	3·18	9·67	0·38	——	=99·38 Berzelius.
Sala, "	59·66	23·28	1·18	0·36	5·17	5·61	1·75	1·02	, und. 0·82=98·85 S.
Arendal, "	63·51	23·09	——	0·77	2·44	9·37	2·19	——	=101·37 Hagen.
" *ywh.*	62·70	23·80	$\dot{F}e$ 0·62	0·02	4·60	8·00	1·05	——	=100·79 Rosales.
Ajatzkaja, Ural	61·06	19·68	4·11	1·05	2·16	7·55	3·91	——	=99·52 Francis.
Schaitansk, "	64·25	22·24	0·54	1·14	2·57	7·98	1·06	——	=99·76 Bodemann.
Emerald mine, "	60·63	26·35	0·40	0·25	4·15	5·60	1·17	——	=98·55 Jevreinof.
Kimito, Finl., *red*	63·80	21·31	——	——	0·47	12·04	1·98	——	=99·60 Chodnef.
Pitkaranta "	60·97	25·40	——	0·39	6·36	6·38	0·66	——	=100·16 Jevreinof.
Tvedestr'd, *Sunst.*	61·30	23·77	0·36	——	4·78	8·50	1·29	——	=100 Scheerer.
Near Freiberg	62·97	23·48	0·51	0·24	2·83	7·24	2·42	——	=99·69 Karsten.
Marienbad, Boh.	63·20	23·50	0·31	0·25	2·42	7·42	2·22	——	=99·32 Kersten.
Zmin, "	63·16	23·16	——	——	3·00	9·72	0·17	0·79	=100·00 Hauer.
Visembach	63·88	22·27	0·51	*tr.*	3·45	6·66	1·21	1·70	=98·68 Delesse.
Boden	61·96	22·66	0·35	0·10	2·02	9·43	3·08	——	, $\dot{M}n$ 0·40=100 K.
Flensburg, Sil.	64·30	22·34	——	——	4·12	9·01	——	——	=97·77 Wolff.
Warmbrunn, "	[63·94]	23·71	*tr.*	*tr.*	2·52	7·66	2·17	——	=100 Ramm.
Albula, Grisons	62·01	21·16	2·54	0·78	3·53	5·94	4·33	——	=100·29 Rath.
Mer-de-Glace	63·25	23·92	*tr.*	0·32	3·23	6·88	2·31	——	, $\dot{M}n$ *tr.*=99·91 D.
Goggenau	63·63	22·52	——	0·44	3·85	8·39	2·29	——	=101·12 Seneca.
Quenast, Belg.	63·70	22·64	0·53	1·20	1·44	6·15	2·81	1·22	=99·69 Delesse.
Ariége	62·60	24·60	0·01	0·20	3·00	8·90	——	——	=99·40 Laurent.
Elba	62·30	22·00	0·44	——	4·86	8·20	0·94	——	=98·74 Damour.
Garvary Wood, I.	60·56	24·40	0·40	0·04	5·96	6·46	1·76	——	=99·58 Haughton.
? "	59·28	22·96	1·94	0·21	4·65	6·48	2·38	——	, $\dot{M}n$ 0·32=98·32 H
Knader, "	62·40	23·60	——	0·08	5·62	7·04	1·66	——	=100·40 Haughton.
Unionville, Pa. $(\frac{3}{2})$	64·27	21·21	*tr.*	0·58	0·81	10·94	1·36	1·08	=100·25 S. & B.
Danbury, Ct. $(\frac{1}{2})$	63·76	22·56	*tr.*	*tr.*	3·09	9·72	0·55	0·26	=99·94 S. & B.
Haddam, " $(\frac{1}{2})$	64·26	21·90	——	*tr.*	2·15	9·99	0·50	0·29	=99·09 S. & B.
Chester, Mass.	62·00	24·40	——	0·70	3·50	8·07	——	1·00	=99·67 Jackson.

	$\ddot{S}i$	$\ddot{\bar{A}}l$	$\dddot{\bar{F}}e$	$\dot{M}g$	$\dot{C}a$	$\dot{N}a$	$\dot{K}$	$\dot{H}$
32. Teneriffe	62·97	22·29	——	0·54	2·06	8·45	3·69	——=100 Deville.
33. "	63·81	21·98	——	0·66	1·10	9·46	2 99	——=100 Deville.
34. "	62·54	22·49	——	0·41	2·18	7·84	4·54	——=100 Deville.
35. "	61·55	22·03	——	0·47	2·81	7·74	3·44	——=98·04 Deville.
36. *Hafnefiordite*	61·22	23·32	2·40	0·36	8·82	2·56	*tr.*	——=98·68 Forchh.
37. L. Laach	63·5	22·1	——	1·8	0·3	8·9	3·4	——=100 Fouqué.
38. Schemnitz	59·49	23·88	——	——	6·20	4·36	4·09	0·99=99·01 Hauer.
39. Kyffhäuser Mts.	60·94	24·22	1·66	*tr.*	3·94	7·65	0·95	0·79, $\dot{S}r$ *tr.*=100·15 S
40. " "	60·01	21·66	1·54	0·68	5·15	7·08	1·37	2·59, $\dot{B}a$, $\dot{S}r$, $\dot{L}i$, *tr.*= 100·08 Str

A brownish feldspar from Borodin, Finland, afforded S. v. Waltershausen (Vulk. Gest., 2 63 20, $\ddot{\bar{A}}l$ 18·41, $\dddot{\bar{F}}e$ 0·20, $\dot{M}g$ 0 87, $\dot{C}a$ 0·11, $\dot{N}a$ 0·52, $\dot{K}$ 14·41, $\dot{H}$ 0·57=98·29. It may be an thoclase. G.=2·583. No. 9 may be mainly *albite*, judging from the amount of soda.

In anal. 3, G.=2·69; 8, G.=2·656; 9, G.=2·63; 11, G.=2·656; 12, G.=2·65; 13, G.=2· 16, G.=2·66—2·68, in mica schist; 17, G.=2·651; 19, G.=2·72, ign.=1·05; 24, G.=2·662; G.=2·61; 31, G.=2·586, H.=7·5, granular with emery; 33, G.=2·594; 34, G.=2·58—2·5 trachyte; 35, G.=2·592, in trachyte; 37, G.=2·56, in lava; 38, G.=2·635; 39, 40, in dior G.=2·63—2·64; Nos. 1 to 31, in metamorphic rocks, granite, gneiss, porphyry, syenite, and dior 32–37 in lavas or volcanic rocks.

Some of the analyses vary from the oxygen ratio 1 : 3 : 9 toward 1 : 3 : 12, and Scheerer in Handw. Chem. of Liebig, Poggendorf, etc., makes intermediate varieties, shading into both al and orthoclase, one called by him *oligoclase-albite*, the other *oligoclase-orthoclase*—see under *o clase* and *albite*. But as explained elsewhere, these probably arise from mixture.

Other analyses: from Ytterby, Haughton, Q. G. J., xviii. 412; from Dockweiler, in the E A. Streng, B. H. Ztg., xxiii. 53; from granite of the Ockerthal and of Meineckeburg, Fuchs, i

Pyr., etc.—B.B. fuses at 3·5 to a clear or enamel-like glass. Not materially acted upon by a

Obs.—Occurs in porphyry, granite, syenite, serpentine, and also in different eruptive ro It is sometimes associated with orthoclase in granite, or other granite-like rock. Among localities are Danviks-Zoll near Stockholm; Kimito in Finland, forming with quartz and mica granite containing columbite; Pargas in Finland; Ariége and Arendal, with calcite, epidote, crystals sometimes 2 or 3 in. long; Schaitansk, Ural, greenish, in a gangue of quartz and and yellowish-white feldspar; in gneiss of the Schwarzwald of Goggenau, north-east of Ba in syenite of the Vosges; in a micaceous dioryte (called *kersantyte*) at Visembach in the Vos in protogine of the Mer-de-Glace, in the Alps; in euphotide at Lavaldens, Department of Is at Albula in the Grisons; in a dark green porphyry at Quenast in Belgium; in mica schist at Emerald Mine of the Urals, and at Boden near Marienberg; in the amphibolyte of Marienbad, hemia; in a green porphyry (oligoclase-porphyry of Rose), near Elbingerode in the Harz; in base of the Harz; the Fichtelgebirge; Chalanches in Allemont and Bourg d'Oisans; as *sun* at Tvedestrand in the Christiana-fiord, Norway; at Hitteröe, Lake Baikal; at the North near Hammerfest; in Donigal, Ireland, in granite, with orthoclase, etc.; in Iceland, colorles Hafnefjord (*hafnefiordite*). The oligoclase-porphyry is called *oligophyre* by Coquand; nea Raphael in the Dept. of Var, in France, a rock of this kind has a beautiful turquois-blue colo very hard, and encloses crystals of oligoclase; G.=2·61. In lavas and trachyte (*oligoclas chyte*) at Teneriffe, and in the Euganean Mts. near Padua; in the domyte (trachyte) of Pu Dome; in doleryte at L. Laach; in pumice at Arequipa in Peru; in obsidian, with sanidi Zimapan in Mexico.

In the United States, at Unionville, Pa., with euphyllite and corundum, G.=2·61; also at bury, Ct., with orthoclase and danburite; Haddam, Ct., often transparent, with iolite and b tourmaline; Mineral Hill, Delaware Co., Pa., called moonstone; at Orange summit. N. Ha slightly greenish, and pearly; at the emery mine, Chester, Mass., granular, with H.= G.=2·586; at Dixon's quarry, Del.

Named in 1826 by Breithaupt from ὀλίγος, *little*, and κλάω, *to cleave*. Berzelius had previo (in 1824) recognized it as a new mineral from specimens from Danviks-Zoll; and he after named it natron-spodumene (soda-spodumene).

Alt.—Occurs altered to kaolin and natrolite. The change to kaolin takes place more easily in orthoclase, as shown by the longer resistance of the latter when both occur in the same (Laspeyres, ZS. G., xvi. 387).

315. ALBITE. Feltspat hvit pt. *Wall.*, 65, 1747. Feldspath pt., Schorl blanc pt., *de* Crist., ii. 409, Pl. v., f. 15, 16, 1783. Krummblätteriger Feldspath *Hedenberg*, Afh., i. 118, Albit *Gahn & Berz.*, Afh., iv. 180, 1815. Tetartin *Breith.*, Char., 1823. Soda Feldspar.

VAR. *introd. as species.* Cleavelandite (fr. Chesterfield) *Brooke*, Ann. Phil., II. v. 381, Periklin *Breith.*, Char., 1823; Pericline. Hyposklerit (fr. Arendal) *Breith.*, Schw. J., iii. 316, 1830. Peristerite (fr. Perth, Can.) *Thom.*, Phil. Mag., III. xxii. 189, 1843. Olafit *Breith.*, B. H Ztg., xxv. 88=Oligoklas-Albit *Scheerer*, Pogg., lxxxix. 17.

Felsite, Petrosilex, or Helleflinta pt., *Swed.* Adinole (fr. Sala) *Beud.*, Tr., ii. 126, 1832.

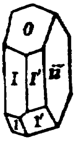
Triclinic.

I ∧ *I′*=120° 47′
O ∧ *i-ī*, ov. 2-ĭ′,=93 36
O ∧ *i-ī*, ov. 2-ī,=86 24
O ∧ *I′*=114 42
O ∧ *I*=110 50
O ∧ 2-ĭ′=136 50
O ∧ 2-ĭ=133 14

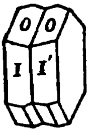
O ∧ 2-ī, ov. 1-ī,=97° 54′
O ∧ ½=150 3
i-ī ∧ 1′=113 41
i-ĭ ∧ 1=120 11
i-ĭ ∧ *I*=117 53
i-ĭ ∧ *I*=119 40

i-ĭ ∧ *i-3̆*=149° 35′
i-ĭ ∧ *i-3̆′*=149 38
I′ ∧ 1′=123 6
I ∧ 1=125 3
2-ĭ ∧ 2-ĭ′=90 4
I′ ∧ 2-ī=138 34

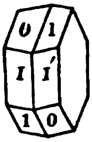
300



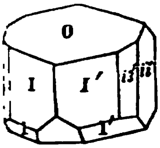
301



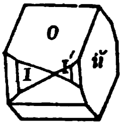
304



302



303

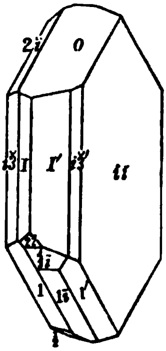


Pericline.

			O			
i-ī	*i-3̆*	*I*		*I′*	*i-3̆′*	*i-ĭ*
2-ĭ′			2-ī	2′		2-ĭ
			⁴⁄₃-ī	⁴⁄₃′		
				³⁄₂′		
		1	1-ī	1′		
		½		½′		

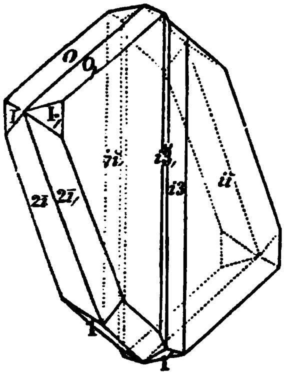
Observed Planes. Add ⅝′.

305



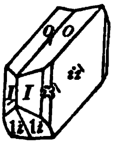
Middletown, Ct.

307

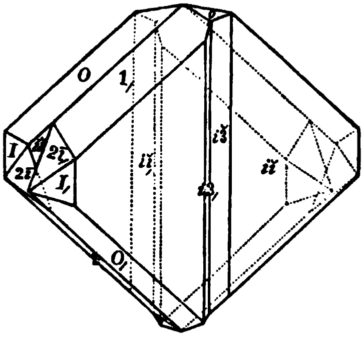


Roc-tourné, Savoy.

306



308

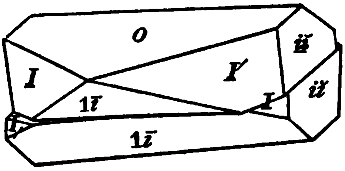


Roc-tourné, Savoy.

Cleavage: *O*, *i-ī* perfect, the first most so; 1-ī sometimes distinct. Twins: 1. Composition-face *i-ī*, axis of revolution normal to *i-ī*, the most common,

f. 301. 2. C.-face and revolution the same, but (f. 307) the two halves
mutual penetration crossing along a medial vertical line, so that the rig
quarter in front is continued in the left quarter behind, and the left
front in the right behind, the upper and under planes *O* meeting in a re
tering angle, and the 2-ī on either side in a salient angle—making an
tersecting twin, having the aspect of a double twin of four crystals in whi
the two diagonally opposite are alike in position. 3. C.-face the same, b
axis of revolution *parallel* to *i*-ī, and vertical, producing the form in f. 3
the planes *O* and 1 above (or below) being very nearly in the same zo
(the plane angle of *i*-ī, which the edges of *I* and *O* make, being 116° 2
and that which the edges of *I* and 1 make being 115° 55′, differing or
31′); also exemplified in the double twin, f. 308, the two halves of whi
are twins like f. 307; may be right or left-handed, according to which ha
is revolved; also in other similar double twins (fr. Middletown, Ct.),
which the two halves are like f. 305.
C.-face parallel to *O*, and revolution on
horizontal axis normal to the shorter diag
nal of *O*, as in f. 309; the twin right or le
handed, according as the part revolved is t
upper or lower. 5. The last kind (4), co
bined with the first (1), making double twi
Also massive, either lamellar or granula
the laminæ sometimes divergent; granu
varieties occasionally quite fine to impalpable.

309



Pericline.

H.=6—7. G.=2·59—2·65; 2·612, Finbo, Eggertz; 2·619, Broddb
Lustre pearly upon a cleavage face; vitreous in other directions. Col
white; also occasionally bluish, gray, reddish, greenish, and green; som
times having a bluish opalescence or play of colors on *O*. Streak uncolore
Transparent—subtranslucent. Fracture uneven. Brittle.

Comp., Var.—O. ratio 1 : 3 : 12; $(\frac{1}{4}\dot{N}a^3+\frac{3}{4}\dddot{A}l)^2\ddot{S}i^3+6\ddot{S}i$, or with half the excess of silica ba
=Silica 68·6, alumina 19·6, soda 11·8=100. A small part of the soda is replaced usually, if
always, by potash, and also by lime. But these differences are not externally apparent.

Var. 1. *Ordinary.* (*a*) In crystals or cleavable massive. The angles vary somewhat, especi
for plane *I′*; *I*∧*I′*=122° 15′, G. Rose; 121° 45′, Marignac and Descloizeaux, as mean of m
measurements of St. Gothard crystals; *O*∧*I′*=115° 5′, Rose; 114° 52′, M. and D. (*b*) *Aventuri*
similar to aventurine oligoclase and orthoclase. (*c*) *Moonstone;* similar to moonstone under oli
clase and orthoclase. *Peristerite* is a whitish adularia-like albite, slightly iridescent, having G
2·626; named from περιστερά, *pigeon*, the colors resembling somewhat those of the neck of a pige
(*d*) *Pericline* is in large, opaque, white crystals, short and broad, of the forms in fig. 303, 3
G.=2·641; *I*∧*I′*=120° 37′, Breith.; from the chloritic schists of the Alps.

(*e*) *Hyposclerite* is blackish-green, from Arendal; H.=5·5; G.=2·63—2·66; it contains, acco
ing to Rammelsberg, 5 p. c. of pyroxene. Hermann figures (J. pr. Ch., xlvi. 396) a crystal hav
the planes and nearly the form of f. 302. Named from ὑπό, *under*, σκληρός, *hard*, with reference
the inferior hardness.

(*f*) Lamellar; *cleavelandite;* a white kind found at Chesterfield, Mass., and named after Dr.
Cleaveland, the mineralogist.

2. *Compact; albitic felsite;* smooth on surface of fracture, whitish, grayish, or reddish-gray
color, and very tough. H.=6·5—7·5; G.=2·6—2·65. See also under OLIGOCLASE.

Analyses; 1, G. Rose (Gilb. Ann., lxxiii. 173); 2, Tengström (Ann. Phil., 1824); 3, Strome
(Untersuch., 300); 4, Laurent (Ann. Ch. Phys., lx.); 5, Thaulow (Pogg., xlii. 571); 6, Bro
(Pogg., lxi. 392); 7, Abich (B. H. Ztg., i.): 8, Erdmann (Jahresb., xxi. 192); 9, Abich (Pogg.,
526); 10, C. G. Gmelin (Pogg., vii. 79); 11, Kersten (Jahrb. Min. 1845, 648); 12, Diday (Cr
from melaphyre of Agay, Ann. d. M., V. ii. 184, 193); 13, Rammelsberg (Pogg., lxxix. 305);
Lohmeyer (Pogg., lxi. 390); 15, Desclabissac (ZS. G., x 207); 16, Scheidtauer (Pogg., lxi. 39
17, Richter (Pogg., lxxxix. 17); 18, Rube (ZS. G., xiv. 49); 19, Redtenbacher (Pogg., lii. 48);

21, Brush and Weld (Am. J. Sci., II. viii. 390); 22, T. S. Hunt (Phil. Mag., IV. i. 222, Am. J. Sci., II. xii. 212); 23, F. A. Genth (Am. J. Sci., II. xxviii. 249); 24, E. H. Twining (Am. J. Sci., II. xxxi. 357); 25, 26, Boye & Booth (Proc. Am. Phil. Soc., ii. 190):

	S̈i	Ä̶l	F̶e	Ṁg	Ċa	Ṅa	K̇
1. Arendal	68·46	19·30	0·28	——	0·68	[11·27]	——=100 G. Rose.
2. Finland	67·99	19·61	0·70	——	0·66	11·12	——=100·08 Tengström.
3. Chesterfield	70·68	19·80	0·11	——	0·28	9·06	——=99·88 Stromeyer.
4. "	68·4	20·8	0·1	——	0·2	10·5	——=100 Laurent.
5. St. Gothard, *cryst.*	69·00	19·43	——	——	0·20	11·47	——=100·10 Thaulow.
6. St. Gothard, *white*	67·39	19·24	——	0·61	0·31	6·23	6·77=100·55 Brooks.
7. Miask, *cryst.*	[68·45]	18·71	0·27	0·18	0·50	11·24	0·65, Ṁn *tr.*=100 Abich.
8. Brevig	69·11	19·34	0·62	*tr.*	*tr.*	10·98	0·65, Ṁn *tr.*=100·70 Erdmann.
9. Pantellaria	68·23	18·30	1·01	0·51	1·26	7·99	2·53=99·83 Abich.
10. Zöblitz	67·94	18·93	0·48	——	0·15	9·99	2·41, ign. 0·36=100·26 Gmelin.
11. Marienbad	68·70	17·92	0·72	——	0·24	11·01	1·18=99·77 Kersten.
12. *Albite, cryst.*	67·0	19·2	0·3	1·8	1·2	7·2	2·2=98·9 Diday.
13. *Hyposclerite*	67·62	16·59	2·30	1·46	0·85	10·24	0·51=98·8 Rammelsberg.
14. Schreibershau, *w.* (¾)	68·75	18·79	0·54	0·09	0·51	10·90	1·21=100·79 Lohmeyer.
15. Oberhalbstein	68·50	18·11	——	0·66	0·56	[12·17]	=100 Desclabissac.
16. Snarum	66·11	18·96	0·34	0·16	3·72	9·24	0·57=99·10 Scheidtauer.
17. " *Olafite*	66·83	19·90	0·39	0·39	1·56	10·13	——, Ṁn 0·20, Ḣ 0·25=99·65 R.
18. Drehfeld, *w.*	66·99	18·40	0·76[a]	0·21	0·90	12·10	0·74=100·10 Rube.
19. Pennsylvania (⅔)	67·20	19·64	——	0·31	1·44	9·91	1·57=100·07 Redtenbacher.
20. Unionville, Pa.	66·65	20·79	——	0·52	2·05	9·36	——=99·42 Brush.
21. "	66·86	21·89	——	0·48	1·79	8·78	——, Ḣ 0·48=100·27 Weld.
22. *Peristerite*	66·80	21·80	0·30	0·20	2·52	7·00	0·58, ign. 0·6=99·80 Hunt.
23. Calaveras Co.	68·39	19·65	0·41	——	0·47	10·97	*tr.*, ign. 0·21=100·10 Genth.
24. Moriah, N. Y., *gnh.*	67·01	19·42	0·95	*tr.*	0·39	11·47	0·25, ign. 0·24=99·73 Twining.
25. Wilmington, Pa.	67·72	20·54	——	0·34	0·78	10·65	0·16=100·19 B. & B.
26. "	65·46	20·74	0·54	0·74	0·71	9·98	1·80=99·97 B. & B.

[a] As impurity, or mainly so.

In anal. 1, G.=2·61; 7, G.=2·624; 9, G.=2·595; 11, G.=2·612; 12, G.=2·478; 18, G.=2·63; 14, G.=2·624; 18, G.=2·61; 20, G.=2·619; 24, G.=2·633 Brush.

The *hyposclerite* (anal. 13) afforded Hermann (l. c.) S̈i 56·43, Ä̶l 21·70, F̶e 0·75, Ṁn 0·39, Ċe, L̇a 2·00, Ċa 4·83, Ṁg 3·39, K̇ 2·65, Ṅa 5·79=99·80, giving the abnormal and improbable O. ratio 1 : 2 : 6, which Rammelsberg's later analysis appears to show to be incorrect, or the composition of an altered form of it. Its inferior hardness would indicate alteration.

The albite from Pennsylvania, analyzed by Redtenbacher (anal. 19), is called *oligoclase-albite* by Scheerer; it gives the O. ratio 1·1 : 3 : 11·7. He applies the same name to the Snarum feldspar analyzed by Richter, which he says has the external form of scapolite, and G.=2·59; oxygen ratio 1 : 3 : 11·3. It is the *olafite.* That of Snarum, analyzed by Scheidtauer, was in snow-white crystals, and gave 1·2 : 3 : 11·8; it holds an excess of protoxyds, owing to the lime present, which may be a result of alteration.

Felsite or compact feldspar has usually some free silica disseminated through it. The following are analyses of some kinds, either *albite-felsite* or *oligoclase-felsite.* The presence of lime is in favor of the latter. *Adinole* is probably albitic; it is reddish, from Sala, Sweden. Amausite *Gerhard* has been considered as oligoclase in base; the name was given to a granulite (Weissstein) of Namiest in Moravia. The analysis here cited of the North Carolina mineral, by Genth, is in the Am. J. Sci., II. xxviii. 249:

	S̈i	Ä̶l	F̶e	Ṁg	Ċa	Ṅa	K̇
1. Sala, *Adinole*	79·5	12·2	0·5	1·1	——	6·0	——=99·3 Berthier.
2. Lehrbach	71·60	14·75	1·41	*tr.*	1·06	10·06	0·32=99·20 Schnedermann.
3. N. Carolina, *gray*	60·29	19·66	4·63	0·23	1·83	9·90	1·71, Ṁn *tr.*, ign. 1·20=99·45 G
4. Pehrberg	77·93	13·19	0·59	0·22	1·22	5·93	0·08, Ḣ 0·26 Svanberg.
5. "	74·95	11·73	1·60	1·32	0·50	6·49	0·35, Ḣ 0·21 Svanberg.
6. *Amausite*	75·83	11·37	——	0·91	1·30	5·20	0·16, Ḣ 1·12.

See under ORTHOCLASE for other felsites.

Pyr., etc.—B.B. fuses at 4 to a colorless or white glass, imparting an intense yellow to the flame. Not acted upon by acids.

Obs.—Albite is a constituent of several rocks. With hornblende it constitutes *dioryte* or greenstone. It occurs with orthoclase in some granite, as in that of Pompey's Pillar, and in such cases is usually distinguishable by its greater whiteness. It is common also in gneiss, and sometimes in the crystalline schists. Veins of albitic granite are often repositories of the rarer granite minerals and of fine crystallizations of gems, including beryl, tourmaline, allanite, columbite, etc. It occurs also in some trachyte, as that of Montagna, Island of Pantellaria; in phonolite, at Laugafjall, Iceland; in granular limestone in disseminated crystals, as near Modane in Savoy.

In the compact condition, felsite, it constitutes the base of *albite porphyry*, a rock sometimes red (as at Agay) with scattered whitish crystals of albite; also the same of some *spilyte*, as at Fréjus, a compact grayish rock, containing globules of carbonate of lime, the base of which, according to Diday, is 70 p. c. albite; also of some *granulyte* or *weissstein* (white stone).

Many localities of albite are mentioned above. It occurs with epidote and garnet at Arendal; with eudialyte and hornblende in Greenland.

In the United States, in *Maine*, at Paris, with red and blue tourmalines. In *Mass.*, at Chesterfield, with the same minerals, in lamellar masses (cleavelandite), slightly bluish, also fine granular, and rarely in small crystals; at Goshen. In *New Hamp.*, at Acworth and Alstead. In *Conn.*, at Haddam, with chrysoberyl, beryl, columbite, and black tourmaline; at the Middletown feldspar quarry, in fine transparent or translucent crystals (fig. 305); at Monroe, a fine granular variety containing beryl. In *N. York*, at Granville, Washington Co., white transparent crystals; at Moriah, Essex Co., of a greenish color, with smoky quartz, and resembling green diallage. In *Penn.*, at Unionville, Delaware Co., a granular variety is the matrix of the corundum (see anals. 20 and 21), having the hardness of quartz (7—7·25). It had been taken for indianite. A similar variety, equally hard, is found with idocrase at Sanford, Maine. In *California*, Calaveras Co., with native gold and auriferous pyrites.

In Canada, in fine crystals, at the Suffield silver mine, near L. Massawippi, N E. of L. Memphremagog.

The name *Albite* is derived from *albus*, white, in allusion to its color, and was given the species by Gahn and Berzelius in 1814.

For recent observations on cryst., Descl. Min., i. 317; Hessenberg, Min. Not., No. i., ii., v.; G. Rose, Pogg., cxxv. 457, cxxix. 1. Figs. 307–309, are from Rose's papers. The twin form of fig. 304 occurs at Middletown, Ct.

For *Altered forms and Artificial albite*, see under ORTHOCLASE.

ZYGADITE *Breith.* (Pogg., lxix. 441). Zygadite, according to Descloizeaux (Min. i. 326), is probably albite. Occurs in thin tables, which are twins, appearing like the twin crystals of Benhomme and Modane. Translucent or milky. In lustre and hardness like albite. Color yellowish-white, to reddish. G.=2·511—2·512, Breith. Plattner obtained in his trials indications of silica, alumina, and lithia, and no water. Found with milky quartz, stilbite, and blende, in fissures in argillyte, at Andreasberg in the Harz. It was named from ζυγάδην, *in pairs*, or *twinned*.

316. ORTHOCLASE. Silex ex eo ictu ferri facile ignis elicitur—ex cubis aliisque figuris intersectis constans, *Agric.*, Foss., 314, 1546. Felt-Spat, Spatum pyrimachum (VAR. album, cinereum, rubrum), *Wall.*, Min., 65, 1747. Fältspat, Spatum scintillans, *Cronst.*, 60, 1758. Feldspath *Germ.*, *Fr.* Feldspar *Engl.* Felspar *bad orthogr.* Feldstein *Hausm.*, Handb., 528, 1813, Orthose *H.*, Tr., iv. 1801, in Index alone, p. 394, 4to edition. Adular *Breith.*, Char., 35, 1820. [In the preceding, the whole *group* of feldspars is included in the one species.]

Feldspath (Albite excluded) *Berz.*, 1815, N. Syst. Min., 1819. Feldspath (Albite, Labradorite, and Anorthite excl.) *G. Rose*, Gilb. Ann., lxxiii. 173, 1823. Orthoklas (id. excl.) *Breith.*, Char., 1823; (id. + Oligoklas excl.) *Breith.*, Pogg., viii. 79, 1826. Potash-feldspar. Kalifeldspath *Germ.*

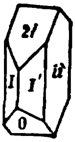
VAR. *introd. as sp.* Adulaire *Pini*, Mem. Feldsp., Milan, 1783; Adular *Germ.*; Adularia *Engl.*; Feldspath nacré *H.*; Mondstein var. Feldspath, *Wern.*, Ueb. Cronst., 1780; id.=Adularia *Wern.*, Bergm. J., 375, 1789; Moonstone. Sanidin *Nose*, Nöggerath Min. Stud. Geb. Niederrhein, 1808; Glasiger Feldspath *Klapr.*, Beitr., i. 15, 1795, and others. Necronite *Hayden*, Am. J. Sci., i. 306, 1819. Pegmatolith *Breith.*, Char., 1823, 1832. Murchisonite *W. Phillips*, Phil. Mag., II. i. 448, 1827. Ryakolith *G. Rose*, Pogg., xv. 193, 1829, xxviii. 143, 1833; Rhyacolite. Valencianit, Mikroklin *Breith.*, Schw. J., lx. 322, 324, 1830. Erythrite, Perthite, *Thom.*, Phil. Mag., xxii. 188, 189, 1843. Loxoklas *Breith.*, Pogg., lxvii. 419; Loxoclase. Chesterlite *Seal*, This Min., 678, 1850. Felsit von Marienberg *Breith.*, Pogg., lxvii. 421, Handb., 527

1847=Paradoxit *Breith.*, B. H. Ztg., xxv. 35, 1866. Felsit von Mulda *id.*, Handb., 528=Muldan *id.*, ib., 39, Cottait *id.*, ib. Weissigit *Jenzsch*, Jahrb. Min., 1853, 396. Lasur-Feldspath *N. Nordensk.*, Bull. Nat. Moscow, xxx. 225, 1857.

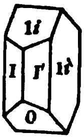
Hälleflinta, Petrosilex, Lapis Corneus, pt., *Cronst.*, Min., 57, 1758. Felsite. Leelite (fr. Westmannland) *Clarke*, Ann. Phil., 1818.

Monoclinic. *C*=63° 53′, *I* ∧ *I*=118° 48′, *O* ∧ 1-ì=153° 28′; *a* : *b* : *c*= 0·844 : 1 : 1·5183. Observed planes: *O*; vertical, *I*, *i*-ì, *i*-3̆, *i*-*i*; clinodomes, $\frac{2}{3}$-ì, 2-ì, 6-ì; hemidomes, $\frac{1}{2}$-*i*, $\frac{2}{3}$-*i*, $\frac{7}{6}$-*i*, 1-*i*, $\frac{4}{3}$-*i*, $\frac{5}{3}$-*i*, 2-*i*, −2-*i*; hemioctahedral, $\frac{1}{2}$, 1, 2, −1, −2; 3-3̆, 4-2̀, −4-2̀; $\frac{7}{6}$-8.

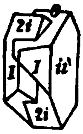
310



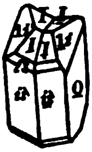
311



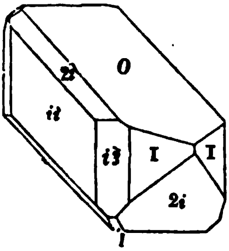
314



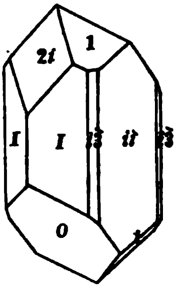
316



318

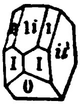


319

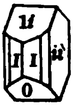


Loxoclase.

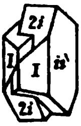
312



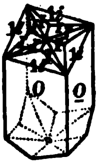
313



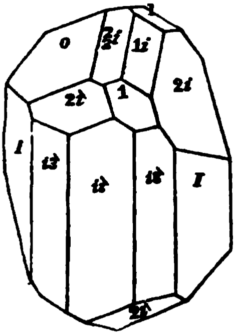
315



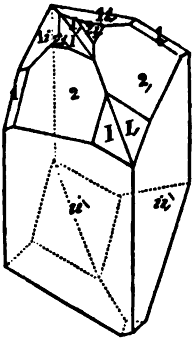
317



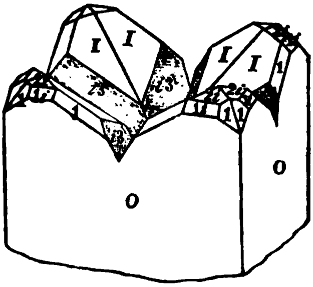
320



321



322



O ∧ $\frac{2}{3}$-*i*=145° 47′
O ∧ 1-*i*=129 41
O ∧ $\frac{4}{3}$-*i*=116 33
O ∧ 2-*i*=99 38
O ∧ −2-*i*=139
O ∧ *i*-*i*=116 7
O ∧ $\frac{1}{2}$=150 52
O ∧ 1=124 42

O ∧ −1=146° 30′
O ∧ 2=98 4
O ∧ *i*-3̆=77 31
O ∧ $\frac{2}{3}$-ì=161 36
O ∧ 2-ì=135 3
O ∧ *i*-ì=90
O ∧ *I*=67 44
i-ì ∧ *i*-*i*=90

i-ì ∧ *i*-3̆=150° 35′
i-ì ∧ 4-2̀=142 25
i-ì ∧ −4-2̀=130 50
i-ì ∧ 3-3̆=146 40
I ∧ 2-*i*=134 19
I ∧ 1-*i*=110 40
1 ∧ 1=126 14
−1 ∧ −1=142 40

Cleavage: *O* perfect; *i*-ì less distinct; *i*-*i* faint; also imperfect in the direction of one of the faces *I*. Twins: 1. Composition-face *i*-ì, axis of revolution normal to *i-ĭ*, the forms not showing the composition externally, except sometimes by sutures. 2. C.-face *i-ĭ*, axis of revolution vertical, producing, with the form in f. 310, the twins f. 314, 315, which are right- or left-handed, according as one or the other of the parts is the one revolved; with the form in f. 311, the planes 1-*ĭ* and *O* nearly coincide in the twin. 3. C.-face 2-*ĭ*, as in f. 321, in which the prism is made up of two adjoining planes *O* and two *i-ĭ*, and is nearly square, because $O \wedge i\text{-}\breve{\imath}=90°$, and $O \wedge 2\text{-}\breve{\imath}=135° 3'$; $I \wedge I=169° 28'$; also the same in a twin of 4 crystals, f. 317, each side of the prism then an *O*; same in a twin of 3 crystals, one of the four being absent, and that side of the prism made up of the planes *i-ĭ*, *i-ĭ*; again the twin of 4 crystals takes, by cross-interpenetration of each, the form in f. 322, consisting apparently of 8 crystals, or four twins of the kind in f. 321; $I \wedge I=169° 28'$, as above. 4. C.-face *O*, f. 316.

Often massive, granular; sometimes lamellar. Also compact crypto-crystalline, and sometimes flint-like or jasper-like.

H.=6–6·5. G.=2·44–2·62, mostly 2·5–2·6. Lustre vitreous; on cleavage-surface sometimes pearly. Color white, gray, flesh-red, common; greenish-white, bright green. Streak uncolored. Transparent to translucent. Fracture conchoidal to uneven. Optic-axial plane sometimes in the orthodiagonal section and sometimes in the clinodiagonal; acute bisectrix always negative, normal to the orthodiagonal; inclined at 18° C., in adularia, according to Angström, 4° 6′ to the clinodiagonal, and 112° 1′ to edge *I*/*I*; and according to Descloizeaux, at 22° C. these angles are 5° 18′ and 110° 49′ for the red rays; angle of divergence in adularia of St. Gothard 112° to 123°; in transparent from Wehr in the Eifel, only 18° to 21°, with other optical peculiarities.

Comp., Var.—O. ratio 1 : 3 : 12; $(\frac{1}{4}\dot{\text{K}}^3+\frac{3}{4}\bar{\text{A}}\text{l})^2\ddot{\text{Si}}^3+6\ddot{\text{Si}}$; or else with half the excess of silica basic;=Silica 64·6, alumina 18·5, potash 16·9=100; with soda sometimes replacing part of the potash. The orthoclase of Carlsbad contains rubidium.

The varieties depend mainly on structure, variations in angles, the presence of soda, and the presence of impurities.

The amount of soda detected by analyses varies greatly, the ratio to the potash being from 1 : 100 to 1 : ½. But recent chemical investigations have shown, what Breithaupt indicated from ocular examination in 1861, that some of the sodiferous varieties owe the soda to a crystalline combination of the orthoclase with albite. The *perthite* (see beyond) has thus been found to consist of thin alternate layers of these two feldspars. How far this explanation extends to other sodiferous kinds remains to be ascertained.

The variations in angles are large, and they occur sometimes even in specimens of the same locality. In crystals of the kind called *chesterlite*, which are to all appearance regular and undistorted, the angle *I*′ (right prismatic plane) ∧ *I* (left id.) varies from 121° to 127°, according to the author's measurements; and other angles make the form *triclinic*, *O* ∧ *I* and *O* ∧ *I*′ sometimes differing 5°, one being 110° and the other 115°; while twins compounded parallel to the clinodiagonal section, which are common, prove, by the absence of any reëntering angle on the base, that the form is *not triclinic* (although so made by Breithaupt, who refers the species (B. H. Ztg., xvii. 1) to albite). The crystallization is normally monoclinic, and the variations are simply irregularities. There are also large optical variations in orthoclase, on which see Descl. Min., i. 329.

The variations in amount of soda and in angles have led Breithaupt to make several species out of the species orthoclase. But until it is proved that crystals of certain specific angles have uniformly the same specific chemical composition, and further, that kinds having the same specific chemical composition wherever occurring, always, when crystallized, present the same angles, such species cannot properly be recognized as distinct. The varieties that have been named are the following:

Var. 1. *Ordinary*. In crystals, or cleavable massive. (*a*) *Adularia*. Transparent, cleavable, usually with pearly opalescent reflections, and sometimes with a play of colors like labradorite, though paler in shade. *Moonstone* (Hecatolite *Delameth.*, T. T., ii. 201, fr. Ἑκάτη, *the moon*) belongs in part here, the rest being albite and oligoclase. *Valencianite*, from the silver mine of Valenciana, Mexico, is adularia. Breithaupt finds for ordinary orthoclase (which he calls *pegmatolite*) G.$=$2·539$-$2·578 (B. H. Ztg., xxv. 38). Kokscharof obtained (Min. Russl., v. 115) from crystals from the Grisons, Switzerland, for $I \wedge I = 118^\circ\ 48'\ 20''$; $O \wedge I$, acute, $=67^\circ\ 45'\ 50''-47'$; $O \wedge I$, obtuse, $=112^\circ\ 12'\ 20''-14'\ 10''$; $O \wedge 1\text{-}i = 129^\circ\ 32'$. For crystals from Zillerthal, $I \wedge I = 118^\circ\ 45\tfrac{1}{2}'-50'$ (mean, $118^\circ\ 47'\ 21''$); $O \wedge I$, acute, $=67^\circ\ 47'\ 20''-50'$ (mean, $67^\circ\ 47'\ 38''$); $O \wedge I$, obtuse, $=112^\circ\ 10'\ 20''-13'$ (mean, $112^\circ\ 12'\ 57''$); $O \wedge 1\text{-}i = 129^\circ\ 43'\ 10''-50'$ (mean, $129^\circ\ 42'\ 38''$). He gives as the calculated results for adularia, $I \wedge I = 118^\circ\ 47'$ and $61^\circ\ 13'$; $O \wedge I = 67^\circ\ 47'\ 20''$ and $112^\circ\ 12'\ 40''$; $O \wedge 1\text{-}i = 129^\circ\ 43'\ 26''$; $O \wedge 2\text{-}i = 135^\circ\ 3'\ 39''$; $C\,(O \wedge i\text{-}i) = 63^\circ\ 56'\ 46''$.

(*b*) *Sunstone*, or *aventurine feldspar* (Heliolite *Delameth.*, T. T., ii. 200). In part orthoclase; rest albite or oligoclase (q. v.).

(*c*) *Necronite.* A cleavable feldspar, fetid in odor when struck. The original was found by Hayden near the York and Lancaster road, 21 m. from Baltimore, in granular limestone, and was whitish or bluish in color. Named from νεκρός, *a corpse.*

(*d*) *Amazonstone.* Bright verdigris-green, and cleavable.

(*e*) *Erythrite.* Flesh-red, from amygdaloid, near Kilpatrick. Made out by Thomson to contain 3 p. c. of magnesia. Named from ἐρυθρός, *red.*

(*f*) *Sanidin* of Nose, or *glassy feldspar*, including much of the *Ice-spar*, part of which is anorthite. Occurs in transparent glassy crystals, mostly tabular (whence the name from σάνις, a board) in lava, pumice, trachyte, phonolite, etc. Proportion of soda to potash varies from 1 : 20 to 2 : 1. A. Mitscherlich finds in some kinds 0·79—2·33 p. c. of baryta. *Rhyacolite* is the same; the name was applied to glassy crystals from Mt. Somma (Eisspath *Wern.*). Rose has since observed (Kryst. Ch. Min., 88) that the specimen he analyzed (Pogg., xxviii. 143) probably contained some mixed nephelite, and that the mineral is *orthoclase.* Named from ῥύαξ, *stream* (lava stream), and λίθος, *stone.*

(*g*) *Chesterlite.* In white crystals, smooth, but feebly lustrous, implanted on dolomite in Chester Co., Penn., and having the variations in its angles above stated. It contains but little soda. Twins occur with composition parallel to O, and also parallel to both O and $i\text{-}i$, the latter apparent by the meeting of striæ along the middle of an O, and the former by the same on an $i\text{-}i$. Crystals vary from a line in breadth to 1½ in. G.$=$2·531 Silliman. Erni's analysis (This Min., 3d edit., 1850, 678) is erroneous, and therefore not cited here.

(*h*) *Microclin.* Usually in cleavable masses, whitish, grayish, or reddish, and opalescent. The original was from the zircon-syenite of Fredericksvärn and Laurvig and Brevig, Norway. Breithaupt made the angle between the two cleavage planes $90^\circ\ 22'-90^\circ\ 23'$, instead of 90°; and hence derived the name, from μικρός, *little*, and κλίνω, *I incline.* The analysis (No. 55) gives for the ratio of $\dot{N}a$ to $\dot{K}$ 3 : 2. But Breithaupt has since referred to microclin the feldspar of Arendal, which afforded him the same angle, but yet contains but a trace of soda (No. 22). He also refers here a feldspar from Kangerdluarsuk, Greenland (anal. 54), which is near the first-mentioned in composition, and gave the angles $O \wedge i\text{-}i = 90^\circ\ 22'$, $O \wedge I = 112^\circ\ 9'$, $O \wedge I' = 113^\circ\ 10'$, $O \wedge 1\text{-}\bar{i} = 129^\circ\ 34'$, $i\text{-}i \wedge I' = 119^\circ\ 13'$ $I \wedge I' = 119^\circ\ 4'$, $I \wedge i\text{-}i = 121^\circ\ 43'$; also the feldspar of the micaceous rock (called *Miascyte*) of Miask (Urals), which has Na : K$=$1 : 1, with an excess of silica, according to an unsatisfactory analysis; also a Bodenmais feldspar of gray and greenish colors, with G.$=$2·575$-$2·594, but he suggests that Kerndt's analysis (No. 56) was probably made on a mixture of microclin and oligoclase, the two occurring together; while Potyka found that the green variety (anal. 25) contained little soda. Potyka also states that the actual form was triclinic, and that the cleavage face had the usual striæ of triclinic feldspars; but Kenngott observes (Ueb., 1861, 73) that he did not find the striæ on a Bodenmais specimen, and H. Fischer none on the feldspar of the zircon-syenite. Other loc. reported by him are: Lewis Co., N. Y., with black pyroxene; Baveno in Italy; Lomnitz and Fischbach in Silesia, of red color; Scholtzenberg and Kunersdorf, Silesia; Olbern-hau in Silesia, grayish-white, G.$=$2·593; Sforzella in Predazzo, white, G.$=$2·596; syenite of the Plauen-Grund, near Dresden—an extension of its distribution which must make it easy to test the value of its distinctive characters.

Notwithstanding the measurements of Breithaupt, microclin is probably monoclinic. Descloizeaux, after optical investigations (Min., i. 341), refers it to orthoclase. It is to be observed that these angles were obtained from kinds having little soda as well as others having much. Moreover, loxoclase, in which the amount of soda is still larger, is monoclinic.

(*i*) *Loxoclase.* In grayish-white or yellowish crystals, a little pearly or greasy in lustre, often large, feebly shining, lengthened usually in the direction of the clinodiagonal. $O \wedge I = 112^\circ\ 30'$, $O \wedge I' = 112^\circ\ 50'$, $I \wedge I' = 120^\circ\ 20'$, $O \wedge i\text{-}i$ (cleavage angle)$=90^\circ$, Breith. G.$=$2·6$-$2·62, Plattner. The analyses find much more soda than potash, the ratio being about 3 : 1, but how far this is due to mixture with albite has not been ascertained. From Hammond, St. Lawrence Co., N. Y. Named from λοξός, *transverse*, and κλάω, *I cleave*, under the idea that the crystals are peculiar in having cleavage parallel to the orthodiagonal section.

(*j*) Breithaupt has added still other names. His *Paradoxite*, from tin mines near Marienberg, etc., has (l. c.) $I \wedge I = 119^\circ\ 0'$; $I \wedge i\text{-}i = 120^\circ\ 40'$, $I \wedge i\text{-}i = 120^\circ\ 20'$; H.$=$5½$-$6; G.$=$2·440$-$2·455; color flesh-red. Contains potash as the alkali, with little or no soda. (*k*) His *Cottaite* is the grayish-white orthoclase in twins from granite in Carlsbad, Bohemia, circle of Elbogen; by h trials it has G.=2·6091—2·6098, H.=6—6½, and $I \wedge I'$ about 120°; and by Rœssler's analysi (B. H. Ztg., xxv. 39) it contains 8 p. c. of soda to 5 of potash. But Redner and Bulk have foun (anal. 14, 15) that it is an ordinary potash-feldspar with over 14 p. c. of potash, and has G.=2·5 —2·573. (*l*) His *Muldan* is from Mulda near Freiberg; it is stated to have $I' \wedge i\text{-}i$=117°, $I' \wedge i$ =116°, $O \wedge I$=116°—116½°, $O \wedge I$=117°; G.=2·54—2·56. Moll's analysis (No. 12) shows th it is common orthoclase, although irregular in its angles.

(*m*) *Lazurfeldspar* (Lasurfeldspath), a feldspar having H.=6, and G.=2·597, and the cleava of orthoclase, found near Lake Baikal with lapis lazuli.

(*n*) *Perthite.* A flesh-red aventurine feldspar, consisting of interlaminated albite and orth clase, as shown beyond. From Perth, Canada East.

(*o*) *Murchisonite* is similar flesh-red feldspar to perthite, with gold-yellow reflections in one d rection, like sunstone; and stated to have also an unusual cleavage direction besides the two o served. From Dawlish and Exeter, England. Named after its discoverer, Murchison the geologis

Weissigite, of Jenzsch, is in small whitish or reddish-white twin crystals, and is from the ca ties of amygdaloid at Weissig near Dresden; G.=2·538—2·546. I. Lea has named (Proc. A Philad., May, 1866) a greenish orthoclase from Lenni, Delaware Co., Pa., "almost without clea age," *lennilite;* other specimens of the same locality, pearly and distinctly cleavable, *delawarit* and a dull bluish-green subtransparent kind, of an aventurine character, containing minute par cles bright and hexagonal (hematite?) from Blue Hill, 2 m. N. of Media, Pa., *cassinite.* The are announced only as varieties of orthoclase; but their distinctive characters are n such as to entitle them to special names. There is no place in the *science* of Mineralogy f names so given.

2. COMPACT ORTHOCLASE or ORTHOCLASE-FELSITE. This crypto-crystalline variety is comm and occurs of various colors, from white and brown to deep red.

There are two kinds (*a*) the *jasper-like*, with a subvitreous lustre; and (*b*) the *ceratoid* or *wax-li* with a waxy lustre. Some red kinds look closely like red jasper, but are easily distinguished by t fusibility. The orthoclase differs from the albite felsite in containing much more potash than so *Leelite*, named after J. F. Lee, is a deep, flesh-red variety, of waxy lustre, from Gryphyttan, Swed

The Swedish name *Hälleflinta* means *false flint.*

A. *Proportion of soda much less than that of potash; from* $\frac{1}{20}$ and less to $\frac{2}{3}$.

Analyses: 1, Val. Rose (Scheerer's J., viii. 244); 3, Dürre (Ramm. Min. Ch., 623); 3, S. Hayes (Pogg., cxiii. 468); 4, Abich (Pogg., li. 528, B. H. Ztg., Jahrg., 19); 5, Schwalbe (Ken Ueb., 1861, 73); 6, 7, Abich (l. c.); 8, Plattner (Pogg., xlvi. 299); 9, Brongniart & Malaguti (A d. M., IV. ii. 465); 10, Kröner (Pogg., lxvii. 421); 11, Kersten (J. pr. Ch., xxxvii. 172); 12, M (Ramm. Min. Ch., 624); 13, Jenzsch (Pogg., xcv. 304); 14, 15, Redner and Bulk (ZS. G. xviii. 39 16, A. Streng (Jahrb. Min. 1867, 541); 17, v. Hauer (Kenng. Ueb., 1856–7, 106); 18, 19, Dele (Bull. G. Soc., II. x. 568); 20, C. Bischof (Bischof, Lehrb. Geol., II. 2171, 2187); 21, H. Ri (Geol. Beschr. Baden, 1861); 22, Jevreinof (Pogg., xlvii. 196); 23, Schultz (Ramm. Min. Ch., 62 24, Jenzsch (Jahrb. Min. 1855, 800); 25, J. Potyka (Pogg., cviii. 363); 26–30, Richter (ZS. xiv. 49, 53); 31, Haughton (Rep. Brit. Assoc., 1863, 55, Q. J. G., xx. 269); 32, Id. (Phil. Mag., xxxii. 221); 33–35, C. W. C. Fuchs (Jahrb. Min. 1862, 787, 788); 36, 37, Lasch (v. Dechen, Beschr. Siebengeb., Verh. pr. Rheinl. Jahrg., 9, 289); 38–39, Lewinstein (J. pr. Ch., lxviii. 9 40, Rammelsberg (Min. Ch., 1003); 41, F. A. Genth (Keller & Tied., iii. 486); 42, Smith & Br (Am. J. Sci., II. xvi. 42); 43, 44, J. D. Whitney (Am. J. Sci., II. xv. 440, xxviii. 16); 45, 46, B & Booth (Proc. Am. Phil. Soc. Philad., ii. 53, Jahrb. Min., 1845); 47, T. S. Hunt (Rep. G. Can., 1 474); 48 Smith & Brush (Am. J. Sci., II. xvi. 44); 49, G. F. Barker ib. xxvi. 70).

B. *Proportion of soda to potash between* $\frac{2}{3}$: 1 and 2 : 1.

50, 51, G. Gmelin (Pogg., lxxxi. 313); 52, 53, Scheerer (Pogg., cviii. 426); 54, 55, Utendö (Breith. B. H. Ztg., 1858, No. 6, xvii. 11); 56, Kerndt. (B. H. Ztg., xvii. 11); 57, Rube (ZS. G., 53); 58, T. S. Hunt (Phil. Mag., IV. i. 322, Am. J. Sci., II. xii. 212); 59, C. W. C. Fuchs (Ja Min., 1862, 789); 60, Heffter & Joy (Ramm. Min. Ch., 626); 61, G. Bischof (Lehrb. Geol., I. 62, Abich (l. c.); 63, G. Rose (Pogg., xxviii. 143); 64, 65, Lewinstein (l. c.); 66, Schnabel (Ra Min. Ch., 626); 67, 68, G. Bischof (l. c.); 69, v. Rath (ZS. G., xii. 44); 70–73, T. S. Hunt (R G. Can., 1863, 476).

C. *Proportion of soda to potash over* 2 : 1.

74, 75, Smith & Brush (Am. J. Sci., II. xvi. 43); 76, Plattner (Pogg., lxvii. 419); 77, F. Sa berger (Geol, Beschr. Baden, Carlsruhe, 1861, 48); 78, Delesse (Ann. Ch. Phys., III. xxv):

A. Proportion of soda much less than that of potash; from $\frac{1}{20}$ and less to $\frac{2}{3}$.

		$\ddot{\mathrm{S}}\mathrm{i}$	$\ddot{\bar{\mathrm{A}}}\mathrm{l}$	$\ddot{\bar{\mathrm{F}}}\mathrm{e}$	$\dot{\mathrm{M}}\mathrm{g}$	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\mathrm{N}}\mathrm{a}$	$\dot{\mathrm{K}}$	ign.	
1. Lomnitz, Silesia		66·75	17·50	1·75	——	1·25	——	12·00	——	=98·25 Rose.
2. " "		67·01	8·60	0·85	0·19	0·56	2·01	11·41	——	=100·63 Dürre.
3. " "	*rdh.*	65·10	20·12		——	——	2·42	12·80	——	=100·44 Hayes

		S̈i	A̶l	F̶e	Ṁg	Ċa	Ṅa	K̇	ign.	
4.	St. Gothard, *Adu.*	65·69	17·97	—	—	1·34	1·01	13·99	—	=100 Abich.
5.	" Fibia	64·62	18·50	—	0·21	0·70	1·55	15·58	—	, Ḃa 0·17=101·38 S.
6.	Baveno, *green*	65·72	18·57	—	0·10	0·34	1·25	14·02	—	=100 Abich.
7.	Siberia, *Amaz.*	65·32	17·89	0·30	0·09	0·10	2·81	13·05	—	, Ṁn 0·19, Ċa *tr.*=99·76 Ab.
8.	Mexico, *Valenc.*	66·82	17·58	0·09	—	—	—	14·80	—	=99·29 Plattner.
9.	Ceylon, *Moonstone*	64·00	19·43	—	0·20	0·42	—	14·81	[1·14]	=100 B. & M.
10.	Marienberg, *rdh.*	66·43	17·03	0·49	—	1·03	0·91	13·96	—	=99·85 Kröner.
11.	Fürstenstollen, Sax.	65·52	17·61	0·80	—	0·94	1·70	12·98	—	=99·55 Kersten.
12.	Mulda, Sax., *bh.-w.*	65·75	17·72	—	—	0·82	3·66	12·05	—	=100 Moll.
13.	Radeberg, Sax., *wh.*	65·24	20·40	—	0·84	—	0·27	12·35	0·52	, L̇i 0·71=100·38 J.
14.	Carlsbad, *twins*	63·02	18·28	—	0·14	—	2·41	15·67	—	, Ḃa 0·48=100 Rednen
15.	"	65·23	18·26	0·27	—	*tr.*	1·45	14·66	—	=99·87 Bulk.
16.	Kyffhäuser Mts.	62·75	17·71	2·87	*tr.*	1·50	2·03	12·24	1·64	=100·74 Streng.
17.	Brazil	63·84	19·24	—	—	0·41	2·48	12·66	0·35	=98·98 Hauer.
18.	Chamouni, *wh.*	66·48	19·06	—	—	0·63	2·30	10·52	—	=98·99 Delesse.
19.	Vosges, *rdh.*	64·26	19·27	0·50	0·77	0·70	2·88	10·58	0·40	=99·36 Delesse.
20.	Schemnitz	64·00	18·00	0·53	0·31	0·78	0·79	15·43	0·54	, Ṗb & Ċa 0·32=100·70 Bischof
21.	Baden, *rdh.*	65·32	19·52	—	—	0·15	3·12	11·66	—	=99·77 Risse.
22.	Arendal, *Microclin*	65·76	18·31	—	—	1·20	*tr.*	14·06	—	=99·32 Jevreinof.
23.	" "	65·55	17·99	—	—	1·50	1·54	13·74	—	=100·32 Schultz.
24.	*Weissigite*	65·00	19·54	—	1·61	0·19	—	12·69	0·35	, L̇i 0·56=99·94 J.
25.	Bodenmais, *gn.*, *Micr.*	63·12	19·78	Ḟe1·51	0·18	0·66	2·11	12·57	—	=99·87 Potyka.
26.	Himmelfahrt, *w.* ($\frac{3}{2}$)	65·71	18·75	*tr.*	0·25	0·85	1·05	12·79	0·17	=99·87 Richter.
27.	Glashutte, *red*	64·53	17·96	1·31*	*tr.*	0·72	*tr.*	14·90	0·45	=99·57 Richter.
28.	Eppendorf, *wh.*	65·00	18·76	0·82	0·10	0·32	0·66	13·99	0·22	=99·87 Richter.
29.	Churprinz, *rdh.*	65·10	17·41	1·08	0·15	0·52	2·23	13·21	0·39	=100·04 Richter.
30.	Emanuel Erbst., *rdh.*	66·21	18·01	1·37	0·18	0·98	3·87	8·99	0·19	=99·75 Richter.
31.	Donegal. Irel. ($\frac{3}{3}$)	63·20	18·64	0·68	0·11	2·75	0·78	14·92	—	=101·08 Haughton.
32.	Greenland	64·40	18·96	1·04	0·14	0·45	2·35	13·07	—	=100·41 Haughton.
33.	Ockerthal, *w.*, ($\frac{2}{2}$)	66·92	18·50	2·78	—	1·81	2·56	7·83	0·34	=100·24 Fuchs.
34.	Rehberg, *gnh.* ($\frac{3}{2}$)	65·53	20·62	Ḟe1·90	0·13	0·46	3·26	7·95	0·09	=99·93 Fuchs.
35.	Meineckeb., *rdh.* ($\frac{4}{2}$)	66·80	17·97	Ḟe2·91	*tr.*	0·52	3·67	7·58	0·30	=99·74 Fuchs.
36.	Sutterbach, *Sanidin*	65·62	17·16	1·67	—	2·44	0·44	12·67	—	=100 Lasch.
37.	Scharfenberg. "	67·42	15·88	2·83	0·15	2·77	0·43	10·55	—	=100 Lasch.
38.	Perlenhardt, "	65·26	17·62	0·91	0·35	1·05	2·49	11·79	—	=99·47 Lewinstein.
39.	Drachenfels, "	65·59	16·45	1·58	0·93	0·97	2·04	12·84	—	=100·40 Lewinstein.
40.	" "	65·87	18·53	—	0·39	0·95	3·42	10·32	0·44	=99·92 Rammelsberg.
41.	Davidson Co., N. C.	65·30	20·20	*tr.*	*tr.*	0·05	0·79	14·35	—	=100·69 Genth.
42.	*Chesterlite* ($\frac{3}{2}$)	64·97	17·65	0·50	0·27	0·61	1·69	14·02	0·65	=100·36 S. & B.
43.	L. Superior, *rdh.*	66·70	18 68		—	0·30	3·58	9·57	0·70	=99·53 Whitney.
44.	" *red*	65·45	18·26	0·57	—	—	0·65	15·21	—	=100·14 Whitney.
45.	Tucker's Qu., Del., *w.*	65·24	19·02	*tr.*	0·13	0·33	3·06	11·94	—	=99·72 B. & B.
46.	Wilmington, Del., *g.*	66·51	17·67	1·33	0·30	1·24	3·03	9·81	—	=99·89 B. & B.
47.	Argenteuil, Can., *w.*	65·75	19·40	—	—	0·45	0·69	13·60	0·25	=100·14 Hunt.
48.	Danbury, Ct., *w.* ($\frac{2}{2}$)	63·88	18·97	—	0·20	0·70	3·78	11·19	0·40	=99·12 S. & B.
49.	"	64·25	18·80	—	—	1·20	2·40	12·44	0·30	=99·39 Barker.

* Impurity, or mostly so.

B. Proportion of soda to potash between ½ : 1 and 2 : 1.

		S̈i	A̶l	F̶e	Ṁg	Ċa	Ṅa	K̇	ign.	
50.	Fredericksv'n, *Micr.*	65·18	19·99	0·63	—	0·48	7·08	7·03	0·38	=100·77 Gmelin.
51.	Laurvig, "	65·90	19·46	0·44	—	0·27	6·14	6·55	0·12	=98·88 Gmelin.
52.	*Zircon-Syenite*, "	66·03	19·17	0·31	—	0·20	6·83	6·96	0·21	=99·71 Scheerer.
53.	" " "	65·68	19·53	0·52	—	0·22	7·11	6·93	0·11	=100·10 Scheerer.
54.	Kangerdluarsak, "	68·9	17·8	0·5	—	0·6	6·5	8·3	—	=100·6 Utendörffer.
55.	Miask, "	68·16	20·50	—	—	—	4·72	6·62	—	=100 Utendörffer.
56.	Bodenmais, "	63·66	17·27	Ḟe0·45	2·28	0·39	5·13	10·66	—	, Ṁn 0·15 Kerndt.
57.	Hartha, Erzg., *rdh.*	66·69	18·44	1·28	0·34	0·85	4·28	7·48	—	=99·36 Rube.
58.	*Perthite*,	66·44	18·35	1·00	0·24	0·67	5·56	6·37	0·40	=99·03 Hunt.
59.	Radauthal, *trp.* ($\frac{2}{2}$)	66·05	20·52	*tr.*	*tr.*	0·72	5·41	6·96	0·19	=99·85 Fuchs.
60.	Kostenblatt, *San.*	65·36	19·41	0·43	0·87	0·55	4·06	9·32	—	=100 H. & J.
61.	Ischia, "	67·09	18·88	1·25	0·03	0·35	4·59	7·58	—	=99·77 Bischof.

		S̈i	Ⱥl	F̶e	Ṁg	Ċa	Ṅa	K̇	ign.	
62.	Epomeo, Ischia, *San.*	66·73	17·56	0·81	1·20	1·23	4·10	8·27	——=99·90	Abich.
63.	Eifel, *bnh.*, “	66·30	18·81	*tr.*	0·75	1·50	4·61	7·89	——=99·86	Rose.
64.	“ *cryst.* “	66·50	16·69	1·36	1·43	0·35	4·93	8·44	——=99·70	Lewinstein.
65.	Pappelsberg, “	66·03	17·87	0·52	0·19	0·47	6·08	8·86	——=100·02	Lewinstein.
66.	Langenberg, “	66·33	19·02	0·52	——	0·76	7·32	6·02	——=99·97	Schnabel.
67.	“ “	68·18	18·33	0·71	0·16	0·51	4·66	7·15	——=99·70	Bischof.
68.	Rosenau, “	67·90	19·25	1·42	0·64	——	4·98	5·35	——=99·49	Bischof.
69.	Löwenberg “	69·0	19·7	——	*tr.*	1·4	5·0	5·3	0·4=100·8	v. Rath.
70.	Chambly, Can., *San.*	66·15	19·75	——	——	0·95	5·19	7·53	0·55=100·12	Hunt.
71.	Broome Mtn., “ “	65·70	20·80	——	——	0·84	6·43	6·52	0·50=100·79	Hunt.
72.	Shefford Mtn., “ “	65·15	20·55	——	——	0·73	6·39	6·67	0·50=99·99	Hunt.
73.	Mt. Royal, “ “	63·25	22·12	——	——	0·56	5·92	6·29	0·93=99·07	Hunt.

C. Proportion of soda to potash over 2 : 1.

		S̈i	Ⱥl	F̶e	Ṁg	Ċa	Ṅa	K̇	ign.	
74.	*Loxoclase*	65·40	19·48	1·25	0·20	2·26	7·23	2·76	0·76=99·34	S. & B.
75.	“	66·31	18·23	0·67	0·30	1·09	7·81	4·35	0·20=98·96	S. & B.
76.	“	63·50	20·29	0·67	——	3·22	8·76	3·03	——, S̈i, F, Ḣ 1·23=100·7	P.
77.	Lochwald, *w.*	66·37	19·95	*tr.*	0·40	——	9·64	3·42	——=99·77	Sandberger.
78.	Dransfeld, *glassy*	64·86	21·46	*tr.*	——	*tr.*	10·52	2·62	——=98·99	Delesse.

In anal. 5, G.=2·5685, colorless, trl.; 6, G.=2·555; 10, G.=2·44?, gangue of tinstone; 13, G.=2·548; 16, G.=2·56, in dioryte; 23, G.=2·575; 24, in amygdaloid, altered laumontite; 26–30, from the Erzgebirge; 33, G.=2·592, O. ratio 1 : 2·9 : 11·9, in granite with oligoclase and quartz, Harz; 34, G.=2·58, O. ratio 1 : 3·4 : 12·4, Harz; 35, G.=2·573, O. ratio 1 : 2·8 : 11·7, Harz; 36, G.=2·60; 39, G.=2·547; 45, G.=2·585; 46, G.=2·603, 3 m. from Wilmington; 49, G.=2·58; 50, G.=2·58; 54, G.=2·584–2·598, from Greenland, green; 55, G.=2·587–2·590, Breith.; 58, G.=2·57–2·58; 59, G.=2·595, O. ratio 1 : 3·4 : 12·5, Harz, in granite-like gangue from the Gabbro, with oligoclase; 60, in phonolite, Bohemia; 61, lava between Lecco and Forio; 63, 64, G.=2·576, from volcanic sand of Rockeskill; 66, 67, trachyte conglomerate of Langenberg in the Siebengebirge; 68, trachyte conglomerate of "Kleinen Rosenau" in the Siebengebirge; 69, from doleryte in the Siebengebirge, G.=2·567; 70, from porphyritic trachyte; 71, from granitoid trachyte; 73, compact white trachyte; 77, in a fine-grained granite.

Phillips, in an imperfect analysis of *murchisonite* (Phil. Mag. & Ann., i. 448), obtained S̈i 68·6, Ⱥl 16·6, K̇ 14·8. The mineral came from Dawlish, and is evidently orthoclase.

The *perthite* afforded Gerhard (ZS. G., xiv. 151) the same composition as obtained by Hunt, viz.: S̈i 65·83, Ⱥl 18·45, F̶e 1·72, Ċa *tr.*, Ṅa 5·06, K̇ 8·54, ign. 0·32=99·92. But he found, further, that it was divisible into thin reddish and whitish layers, which were respectively orthoclase and albite. Those layers afforded him (l. c.):

	S̈i	Ⱥl	F̶e	Ċa	Ṅa	K̇
1. Red layers, *Orthoclase*	65·36	18·27	1·90	*tr.*	2·25	12·16=99·94
2. White layers, *Albite*	67·23	18·52	1·47	*tr.*	8·50	3·34=99·06

Thus proving that the supposed soda-orthoclase is really an intercrystallization of two homœomorphous species; and suggesting that other similar anomalies among the feldspars may have an analogous origin. The O. ratio in No. 1 is 0·94 : 3 : 12·49; in No. 2, 0·96 : 3 : 12·09.

An orthoclase, monoclinic in crystals and cleavage, fr. the nephelin-doleryte of Vogelsgebirge, afforded A. Knop (Jahrb. Min. 1865, 687) S̈i 59·69, Ⱥl 21·04, Ḟe 2·27, Mn *tr.*, Ṁg *tr.*, Ċa 0·95, Ṅa 6·55, K̇ 8·61, Ḃa 2·27, Ṡr 0·36, T̈i *tr.*=101·74. The mineral is remarkable for the small amount of silica, large of alumina, and the presence of baryta. The peculiar constitution may be a result of partial alteration, or of crystallinic mixture; which is true is not ascertained. It is intermediate between orthoclase and hyalophane.

The following are analyses of different felsites, additional to those under ALBITE on page 351

	S̈i	Ⱥl	F̶e	Ṁg	Ċa	Ṅa	K̇	Ḣ	
1. *Leelite*	81·91	6·55	6·42	——	——	——	8·88	——	Thomson.
2. Dannemora, *Hellfl.*	81·24	9·78	0·64	0·21	0·78	3·34	3·10	——	Erdmann.
3. Saxony, *gyh.-red*	68·0	19·0	4·5	1·1	——	——	5·6	——	
4. Nantes, *gnh.-gy.*	75·2	15·0	——	2·4	1·2	——	3·4	1·5	Berthier.
5. Brittany, *gnh.-gy.*	75·4	15·5	1·20	1·4	——	——	3·8	——	Durocher.
6. Pentland Hills	71·17	13·60	1·40	0·1	0·40	——	8·19	3·5	
7. Harz	73·29	16·61	——	1·76	3·01	2·38	3·49	——	Missokadis.
8. Jungfrug	76·15	13·46	1·90	1·52	0·45	2·84	3·51	——	
9. Saxa-knut, Sweden	79·55	11·31	0·42	0·10	2·52	3·68	2·38	0·69	

Other analyses of felsites: C. W. C. Fuchs, Jahrb. Min., 1862, 803.

Pyr., etc.—B.B. fuses at 5; varieties containing much soda are more fusible. Loxoclase fuses at 4. Not acted upon by acids.

Obs.—Orthoclase is an essential constituent of many rocks.

1. *Granular crystalline.* *Granite* and *gneiss*, which consist of orthoclase, quartz, and mica. *Mica schist*, the same with less orthoclase and more mica. *Syenite* and *syenitic gneiss*, like the preceding, but containing hornblende in place of mica. *Granulyte*, a mixture of granular orthoclase and more or less quartz. *Albitic granite*, a granite containing albite as well as orthoclase. A similar rock contains oligoclase in place of albite. *Pyroxenyte*, a rock consisting of orthoclase and pyroxene. *Miascyte*, a granular slaty rock consisting of orthoclase and elæolite, from Miask in the Ural. These rocks contain the orthoclase in cleavable grains, and sometimes also in distinct disseminated crystals; when the latter is the case the rock is said to be *porphyritic*. The finest and largest crystals of orthoclase occur in granitic or feldspathic veins.

2. *Compact cryptocrystalline.* Orthoclase-*felsite*, or *leelite*, already described. It sometimes contains quartz in disseminated grains; and Dürocher has observed cases in which a felsite graduated into a granite or granulyte. As the rock was originally a clayey rock (derived from the wear (not the decomposition) of the minerals of granitic rocks) it is natural that there should be the transition here mentioned. The feldspar in some of the analyses below may be partly of oligoclase or albite. The *hälleflinta* of Sweden is for the most part here included.

As the granular orthoclase rocks, granite, gneiss, and the like, graduate into others containing hornblende, such as syenite, syenitic gneiss, etc., so the compact orthoclase-felsites may graduate into others that are hornblendic, though not visibly so;—and these last will indicate their hornblendic composition, not merely by their composition as ascertained by chemical analysis, but also by their high specific gravity. The spherules of *variolyte* of a white, grayish, or greenish-white color, are mostly a compact feldspar or felsite of some kind.

Porphyry, in part, consisting of a felsite base with disseminated opaque crystals of orthoclase; but this felsite base is seldom pure orthoclase. In the green antique porphyry, it is an intimate mixture of orthoclase and hornblende. [The feldspar is oligoclase or albite in some porphyry.]

Phonolyte (or clinkstone), a compact grayish rock, often containing crystals of glassy feldspar, and having a zeolite in the base along with orthoclase. [In some phonolite the feldspar is oligoclase.]

Trachyte, a grayish igneous rock of rough fracture, intermediate between phonolite and a granular crystalline rock, it owing its roughness of surface largely to the grains of glassy feldspar which mainly constitute it.

Argillyte and *talcose schist* generally contain more or less of orthoclase in a cryptocrystalline or undistinguishable state. Often, however, as analyses show, the alkalies are mostly wanting; and when so, the amount of feldspar is small; and it may be wholly absent.

3. *Amorphous.* *Obsidian* or volcanic glass is sometimes an impure orthoclase in a glassy state; and in other cases it is a mixture of orthoclase or labradorite and augite with chrysolite and much iron, the materials varying with the lavas of a volcano; for any lava will become glassy, and thus make obsidian, by rapid cooling. G.=2·25—2·8.

Pitchstone has the lustre of pitch rather than glass; *pearlstone* has a pearly lustre, and is sometimes in spherules (*spherulite*), or consists of spheroidal concretions. G.=2·3—2·4. The spherules of pyromeride, porphyry, etc., are quite similar, though usually having an excess of silica from mixed quartz. Pitchstone and pearlstone are sometimes in composition albite or oligoclase rocks rather than orthoclase, that is, contain soda, or soda and lime, instead of potash. See analyses below. Fuchs has suggested that these rocks derive their glassy portion from solidified water-glass and not from the fusion of a feldspar.

Krablite Forchhammer, or Baulite, appears to be a siliceous feldspathic mineral related to these concretions. It forms the basis of the trachyte, obsidian, and pitchstone of Iceland. According to von Walterhausen, it occurs also in triclinic crystals; and he deduces the oxygen ratio 1 : 3 : 24=$(\dot{R}+\dddot{Al})\,\ddot{Si}^{12}$. B.B. fuses only in thin splinters; in acids insoluble. H.=6. G.=2·656, Forch., 2·572, Walt.*

---

* The following are analyses of pumice, obsidian, spherulite, krablite, etc.: 1, Berthier (Ann. d. M., III. v. 543); 2, Vauquelin (Gehl. N. allg. J., v. 230); 3, 4, Erdmann (J. f. techn. Ch., xv. 32); 5, Thomson; 6, Trommsdorf (N. J. d. Pharm., iii. 301); 7, Erdmann (l. c.); 8, Ficinus (Schw. J., xxix. 136); 9, Erdmann (l. c.); 10, Klaproth (Beitr., ii. 62, iii. 262); 11, Berthier (Ann. d. M., vii.); 12, 13. B. Silliman, Jr. (Dana's G. Rep., 200); 14, Waltershausen (Vulk. Gest., 211); 15, Delesse (Bull. G. Fr., II. ix. 175); 16, Forchhammer (Skand. Nat. Samm. i. Stockh.); 17, Genth (Ann. Ch. Pharm., lxvi. 271):

			$\ddot{Si}$	$\dddot{Al}$	$\dddot{Fe}$	$\dot{Ca}$	$\dot{Mg}$	$\dot{Na}$	$\dot{K}$	
1.	*Obsidian*,	Pasco	69·46	2·60	2·60	7·54	2·60	5·08	7·12,	$\dot{H}$ 3·00=100 Berth.
2.	"	Mexico	78	10	2	1	—	—	—,	Mn 1·6=98 6 Vauq.

Many localities have been enumerated above. Fine crystals are found at Carlsbad and Elbogen in Bohemia (twins, f. 314, 315); Katherinenburg in Siberia; Arendal in Norway; Baveno in Piedmont; Lomnitz in Silesia; Land's End and St. Agnes in Cornwall; Albaschka near Mursinsk, and near Schaitansk in the Urals; the Mourne mountains, Ireland, with beryl and topaz; at Rubieslaw in Aberdeenshire, Scotland, etc.; in great abundance in the trachyte of the Drachenfels on the Rhine; also in the lavas which devastated the island of Ischia, near Naples, in 1302; at Vesuvius, where it may be obtained in profusion in the valley called Fossa Grande.

In the U. States, orthoclase in crystals occurs in *Maine*, on the island Mt. Desert, fine green; at the tourmaline locality, Paris. In *N. Hamp.*, at the Acworth beryl locality. In *Mass.*, at South Royalston and Barre, often large crystals; at Three Rivers, in Palmer. In *Conn.*, at the gneiss quarries of Haddam and the feldspar quarries of Middletown, crystals a foot long, and 6 or 8 in. thick; near Bradleysville, in the western part of Litchfield, crystals 2–3 in. long, abundant. In *N. York*, in St. Lawrence Co., at Rossie, 2 m. N. of Oxbow; the crystals are white or bluish-white, and sometimes an inch across; also 8 m. from Potsdam, on the road to Pierremont, where crystals a foot through are said to have been found; and near DeLong's mills in the town of Hammond, with apatite and zircon, where the *loxoclase* is obtained; in Lewis Co., orthoclase occurs both crystallized and massive in white limestone near Natural Bridge, with scapolite and sphene; in Orange Co., crystals near West Point; more abundant and interesting forms are found at Rocky Hill, in Warwick, with tourmaline and zircon; and at Amity and Edenville; in Saratoga Co., at the Greenfield chrysoberyl locality, white translucent crystals, usually coated with silvery mica. In *Penn.*, in crystals at Leiperville, Mineral Hill, Delaware Co., and W. Bradford, at Poor House quarry, Chester Co. (chesterlite); sunstone in Kennett Township. In *N. Car.*, at Washington Mine, Davidson Co., in white and yellowish crystals (anal. 41).

Massive orthoclase is abundant at the above-mentioned localities, besides many others. Green at Mt. Desert, Me., near S. W. Harbor; at Rockport, Mass. An aventurine variety, with bright coppery reflections in spots, at Leiperville, Pennsylvania. Adularia, at the Falls of the Yantic, near Norwich, Conn., at Brimfield, Mass., with iolite, and at Parsonfield, Me.; and sunstone at Lyme, Conn. (Some of these may be oligoclase.) Kaolin, at Andover, Mass., and abundantly in New Milford, Kent, and Cornwall, Conn., and in the counties of Essex and Warren, New York; also in New Garden, Chester Co., Pa., abundant. Necronite, at Roger's Rock, Essex Co., and at Thomson's quarry, near 196th street, New York.

For recent observations on cryst., see Descl. Min., i.; Hessenberg's Min. Notizen, Nos. I., II., IV., V.; Websky, ZS. G., xv. 677; Kokscharof, Min. Russl., v. 115; F. Scharff., Abh. d. Senck. Ges., vi.

Alt.—Feldspar may be altered through infiltrating waters carrying more or less carbonic acid in solution (Forchhammer, Fournet, Bischof); also through the action of waters rendered acid by the decomposition of sulphids (Mitscherlich); also by ordinary waters holding traces of alkaline and other ingredients in solution (Bischof).

The presence of a sulphid of iron, or a mineral containing protoxyd of iron, as some mica, garnet, etc., is often the first occasion of the change. The decomposition of the mineral with the attendant oxydation of the iron distributes ferruginous waters through the rock (or sulphate of iron from the altered sulphid), and thus, by a disaggregating or decomposing action, prepares the way for other agencies.

	S̈i	A̶l	F̶e	Ċa	Ṁg	Ṅa	K̇	
3. *Obsidian*, Telkban.	74·80	12·40	2·03	1·96	0·90	—	6·40,	Ṁn 1·31=99·80 Erdm.
4. *Pitchstone*, Meis.	75·60	11·60	1·20	1·35	6·69	2·77		Ḣ 4·73=103·95 Erdm.
5. " Arran	63·50	12·74	Ḟe 3·80	4·46	—	6·22	—,	ign. 8·0=98·71 Th.
6. " *bk.* Dresden	74·00	17·00	F̶e 2·75	1·50	—	—	—,	L̇i 3·00=98·25 Tr.
7. *Pearlstone*, Hun.	72·87	12·05	1·75	1·30	1·10	6·18		Ḣ 3·0=98·20 Erdm.
8. " "	79·12	12·00	2·45	—	1·10	3·58		Ḣ 1·76=100·01 F.
9. *Spherulite*, "	77·20	12·47	2·27	3·34	0·73	4·27		=100·28 Erdmann.
10. *Pumice*, Lipari	77·50	17·50	1·75	—	—	3·00		=99·75 Klaproth.
11. " "	70·00	16·00	0·50	2·50	—	—	6·50,	Ḣ 3·00=98·50 Berth.
12. *Pélé's Hair*,	51·19	—	—	—	18·16	—	—,	Ḟe 30·26=99·61 S.
Hawaii, *volc. glass*	39·74	10·55	—	2·74	2·40	21·62	—,	Ḟe 22·29, Ḣ 0·33=99·67 S.
14. *Sideromelane*	49·25	15·18	20·23	9·61	2·10	2·51	1·12	=100 Waltersh.
15. *Spher. in pyrom.*	88·09	6·03	0·58	0·28	1·65	2·53		Ḣ 0·84=100 Delesse.
16. *Krablite*, Iceland	74·83	13·49	4·40	1·98	0·17	5·56	*tr.*	=100·43, F. G =2·389.
17. " "	80·23	12·08	—	0·95	—	2·26	4·92	=100·44 Genth.

Other analyses of obsidian, Deville (Bull. G. Soc. Fr., II. viii. 427); of pumice, ib.; also Schäffer J. pr. Ch., liv. 16).

When the infiltrating waters contain traces of carbonic acid, the feldspar acted on first loses its lime, if a lime feldspar, by a combination of the lime with this acid; next, its alkalies are carried off as carbonates, if the supply of carbonic acid continues, or otherwise as silicates in solution. The change thus going on ends in forming *kaolin* or some other hydrous silicate. The carbonate of soda or potash, or the silicate of these bases, set free, may go to the formation of other minerals —the production of pseudomorphic or metamorphic changes—and the supplying fresh and marine waters with their saline ingredients.

Kaolin is generally a simple hydrous silicate of alumina (see KAOLINITE), expressed by the formula $\bar{Al}\,\ddot{Si}^2+2\,\dot{H}$=Silica 46·3, alumina 39·8, water 13·9. Orthoclase in changing to it loses 1 $\dot{K}$ + § $\ddot{Si}$. Part of the silica set free may go off with more or less of the potash, or may form opal, quartz, siliceous sinter. The alumina also is often in part removed. The same explanation is readily applied to the change in albite or other feldspars.

When the change is not carried on to the exclusion of the protoxyd bases, certain zeolites may result, especially, as Bischof states, when labradorite is the feldspar undergoing alteration, which species he describes as giving origin to the species mesolite. Massive nepheline or elæolite is a still more common source of zeolites. Anal. 52, by Scheerer, is of orthoclase enveloping the zeolite bergmannite, and 53, of the same enclosed in bergmannite, this zeolite having apparently been formed out of other portions of the orthoclase.

When the waters contain traces of a magnesian salt—a bicarbonate or silicate—the magnesia may replace the lime or soda, and so lead to a steatitic change, or to a talc when the alumina is excluded; and when augite or hornblende is present, it may give origin to chlorite.

The action of sulphurous acid from volcanic fumaroles produces often a complete destruction of the feldspar and other minerals present, giving rise to deposits or incrustations of silica, in some of its various forms, and also halloysite, kaolin, etc.

Steatite, talc, chlorite, kaolin, lithomarge, mica, laumontite, occur as pseudomorphs after orthoclase or albite; and tin ore and calcite often replace these feldspars by some process of solution and substitution. Labradorite more rarely forms kaolin.

Orthoclase is also described as occurring altered to albite. This has been mentioned as an example of *paramorphism*, the two species being dimorphous. But as these feldspars occur together in the same rock, and must have been formed under very similar circumstances, we can hardly suppose that either is liable to a change like that of a dimorphous compound to the form of the other.

Artif.—Artificial feldspar has been observed in crystals in furnace scoria at Mansfeld, Sangerhausen, near Laimbach, and near Stolberg. Analyses: 1, 2, Heine; 3, Abich; 4, Rammelsberg:

	$\ddot{Si}$	$\bar{Al}$	$\bar{Fe}$	$\dot{Mg}$	$\dot{Ca}$	$\dot{Na}$	$\dot{K}$	
1. Sangerhausen	64·53	19·20	1·20	—	1·33	—	—	, $\dot{Cu}$ 0·27 Heine.
2. "	65·95	18·50	0·68	—	4·28	10·47	—	, $\dot{Cu}$ 0·13 Heine.
3. "	65·03	16·84	0·88	0·34	0·34	0·65	15·26	, $\dot{Cu}$ 0·30 Abich.
4. Laimbach	63·96	—	20·04	0·54	0·43	0·65	15·26	=98·21 Ramm.

The oxygen ratio afforded is 1 : 3 : 12. But the last is an *iron-orthoclase*, the alumina being replaced by sesquioxyd of iron.

ERSBYITE. (Wasserfreier Scolezit [fr. Pargas] *N. Nordensk.*, Schw. J., xxxi. 417, 1821. Anhydrous Scolecite. Scolexerose *Beud.*, Tr., ii. 55, 1832. Var. of Labrador *Frankenheim*, Syst. d. Kryst., 136, 1842. Ersbyit *A. E. Nordensk.*, Finl. Min., 129, 1853. Kalk-Labrador *Ramm.*, Min. Ch., 595, 1860.) Monoclinic, with the angles nearly of orthoclase; *I* ∧ *I*=118° 44′, *O* ∧ *i-i*=115° 12′ and 64° 48′, *I* ∧ *i-3*=149° 55′, *i-i* ∧ *i-3*=150° 16′, *I* ∧ 2-*i*=134° 49′, *O* ∧ 2-*i*=99° 48′ (angles by Nord., with the common goniometer). Observed planes: *O*; vertical, *I*, *i-i*, *i-3*; clinodome, 1-*i*; hemidome, 2-*i*. Cleavage: *O* perfect; *i-i* less perfect. H.=6; lustre vitreous, pearly on surface of cleavage; color white or grayish-white. N. Nordenskiöld obtained in an analysis (l. c.) $\ddot{Si}$ 54·13, $\bar{Al}$ 29·23, $\dot{Ca}$ 15·46, $\hat{H}$ 1·07=99·87, which affords the O. ratio 1 : 3 : 6, or that of labradorite, to which species it has been referred by Frankenheim and Rammelsberg. A labradorite without alkali and with the angles of orthoclase is so much of an anomaly as to be at least of very improbable existence. It may well be *altered orthoclase* and thereby pseudomorphous. Nordenskiöld, while making the form *monoclinic* in the text, states that he obtained the angle 90° 22′ between the two cleavages with a reflective goniometer, and suggests that the form may possibly be triclinic. Still the other angles are so closely those of orthoclase that this view appears quite improbable, as he also must regard it, since he does not adopt it in the text. It was called *anhydrous scolecite* by N. Nordenskiöld, because the O. ratio was that of scolecite *minus* the water.

III. SUBSILICATES.

ARRANGEMENT OF THE SPECIES.

A. Oxygen ratio of bases and silica 4 : 3.

I. CHONDRODITE GROUP.

319. CHONDRODITE	$\dot{Mg}^8\ddot{Si}^3$	$Mg_8\Theta_2\|(\Theta, F)_{12}\|S$

II. TOURMALINE GROUP. Rhombohedral. Containing boric acid as a base.

320. TOURMALINE	$(\dot{R}^3, \dddot{R}, \dddot{B})^8\ddot{Si}^9$	$(R_2, R, \beta Al, \beta B)_8\Theta_2\|(\Theta, F)_{12}\|Si$

B. Oxygen ratio of bases and silica 3 : 2.

1. *Containing no titanic acid.*

I. GEHLENITE GROUP. Tetragonal; isomorphous with the scapolite group.

321. GEHLENITE	$(\frac{1}{2}\dot{R}^3 + \frac{1}{2}\dddot{R})\ddot{Si}$	$(\frac{1}{2}Ca + \frac{1}{2}\beta Al)_3\Theta\|\Theta_4\|Si$

II. ANDALUSITE GROUP. Anisometric. Containing only sesquioxyds.

322. ANDALUSITE	$\dddot{Al}\ddot{Si}$	$\beta Al_2\Theta\|\Theta_4\|Si$
323. FIBROLITE	$\dddot{Al}\ddot{Si}$	$\beta Al_2\Theta\|\Theta\ \|Si$
324. KYANITE	$\dddot{Al}\ddot{Si}$	$\beta Al_3\Theta\|O_4\|Si$
325. TOPAZ	$\dddot{Al}\ddot{Si}$, with F repl. one-fifth the O	$\beta Al_2 F\|\Theta_4\|Si$

III. EUCLASE GROUP. Monoclinic. Containing other bases besides sesquioxyds.

326. EUCLASE	$(\frac{1}{6}\dot{H}^3 + \frac{2}{6}\dot{Be}^3 + \frac{3}{6}\dddot{Al})\ddot{Si}$	$(\frac{1}{6}H_2 + \frac{2}{6}Be + \frac{3}{6}\beta Al)_3\Theta\|\Theta_4\|Si$
327. DATOLITE	$(\frac{1}{6}\dot{H}^3 + \frac{2}{6}\dot{Ca}^3 + \frac{3}{6}\dddot{B})\ddot{Si}$	$(\frac{1}{6}H_2 + \frac{2}{6}Ca + \frac{3}{6}\beta B)_3\Theta\|\Theta_4\|Si$

2. *Containing titanic acid.*

I. GUARINITE GROUP. Tetragonal.

328. GUARINITE	$(\dot{Ca} + \ddot{Ti})\ddot{Si}$, or $(\frac{1}{3}\dot{Ca}^3 + \frac{2}{3}\ddot{Ti}^{\frac{3}{2}})\ddot{Si}$	$(\frac{1}{3}Ca + \frac{2}{3}\gamma Ti)_3\Theta\|\Theta_4\|Si$

II. TITANITE GROUP. Anisometric.

329. TITANITE	$(\frac{1}{3}\dot{Ca}^3 + \frac{2}{3}\ddot{Ti}^{\frac{3}{2}})\ddot{Si}$	$(\frac{1}{3}Ca + \frac{2}{3}\gamma Ti)_3\Theta\|\Theta_4\|Si$
330. GROTHITE	$(\dot{R}^3, \dddot{R}, \ddot{Ti}^{\frac{3}{2}})\ddot{Si}$	$(\frac{3}{8}Ca + \frac{1}{8}\beta Fe + \frac{4}{8}\gamma Ti)_3\Theta\|\Theta_4\|Si$
331. KEILHAUITE	$(\dot{R}^3, \dddot{R}, \ddot{Ti}^{\frac{3}{2}})\ddot{Si}$	$(\frac{5}{15}R + \frac{3}{15}\beta R + \frac{7}{15}\gamma Ti)_3\Theta\|\Theta_4\|Si$
332. TSCHEFFKINITE	$(\dot{R}^3, \ddot{Ti}^{\frac{3}{2}})\ddot{Si}$	$(\frac{5}{8}R + \frac{3}{8}\gamma Ti)_3\Theta\|\Theta_4\|Si$

C. Oxygen ratio of bases and silica 2 : 1.

I STAUROLITE GROUP. Containing no titanic acid.

333. **Staurolite** $(\dot{H}^3, \dot{R}^3, \bar{R})^4\,\ddot{Si}^3$ $(\frac{1}{5}(H_2, R) + \frac{4}{5}\beta R)_4\Theta_2|\Theta_4|Si$

II. SCHORLOMITE GROUP. Containing titanic acid as a base.

334. **Schorlomite** $(\dot{R}^3, \bar{R}, \ddot{Ti}^{\frac{3}{2}})^4\,\ddot{Si}^3$ $(\frac{4}{11} R + \frac{4}{11}\beta R + \frac{4}{11}\gamma R)_4\Theta_2|\Theta_4|Si$

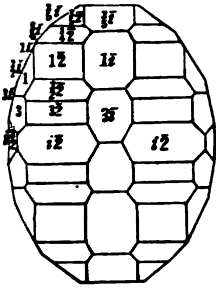
Appendix.—335. **Sapphirine**, $\ddot{Si}$, $\ddot{\bar{Al}}$, $\dot{Mg}$.

In the Andalusite group, the species andalusite and topaz are approximately isomorphous; for if i-$\breve{2} \wedge i$-$\breve{2}$ in the latter is made the fundamental prism, then $I \wedge I = 93°\ 11'$, while it is $90°\ 44'$ in andalusite. Euclase, datolite, and the species of the Titanite group are also isomorphous; the angle of I being severally, 115°, 115° 3′, and 113° 31′; and O on a clinodome=161° 51′, 162° 27′, 159° 39′.

319. CHONDRODITE. Chondrodit [= Silicate of Magnesia and Iron] *d'Ohsson*, Ak. H. Stockh., 206, 1817. Condrodite *H.* Maclureite, Fluosilicate of Magnesia (fr. Sparta, N. J.), *Seybert*, Am. J. Sci, v. 336, 1822. Brucite (fr. N. J. and N. Y.) *Gibbs*, Cleaveland's Min., 295, 1822, Nuttall in Am. J. Sci., v. 245, 1822. Humite *Bourn.*, Cat, 52, 1817.

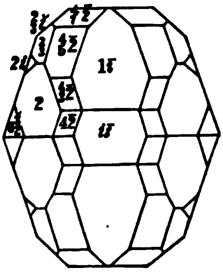
Orthorhombic. Often hemihedral in octahedral planes, producing forms monoclinic in character. $I \wedge I = 94°\ 26'$ and $83°\ 34'$. Crystals of three types, as in the following figures.

323



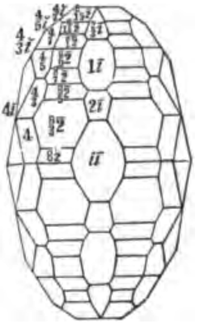
Humite: Type I.

324



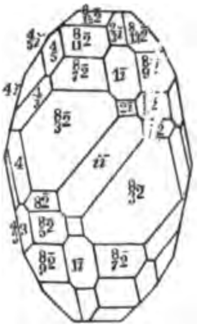
Humite: Type II.

325



Humite: Type III.

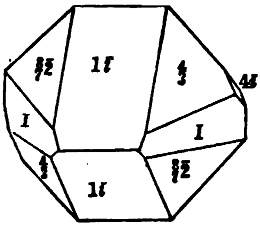
326



Humite: hemihedral.

Type I., $a : b : c = 1{\cdot}4678 : 1 : 1{\cdot}0805$; II., $1{\cdot}5727 : 1 : 1{\cdot}0805$; III., $1{\cdot}4154 : 1 : 1{\cdot}0805$. Observed planes in Vesuvian crystals as in figs. 323 to 326, with also $\frac{2}{5}$-$\breve{i}$ in type II.; the two unlettered planes on figs. 325, 326, 4-$\frac{3}{2}$, 12-$\frac{3}{2}$; another plane in the same series (f. 325) 1-$\breve{\frac{3}{2}}$. Observed planes in chondrodite as in fig. 327, with also O, i-$\bar{i}$, 2-$\bar{i}$, $\frac{2}{3}$-$\breve{i}$, $\frac{3}{4}$-$\frac{\bar{3}}{2}$, $\frac{5}{4}$-$\frac{\bar{5}}{2}$. Fig. 326 left-handed hemihedral, 327 right-handed hemihedral. Angles in the different types of humite:

327



Choudrodite.

I. $O \wedge 1\text{-}\bar{\imath}=124^\circ\ 16'$
$O \wedge 1=116\ 34$
$O \wedge 3\text{-}\bar{\imath}=102^\circ\ 48'$
$O \wedge 3\text{-}\breve{\imath}=103\ 47$
$O \wedge 1\text{-}\breve{2}=121\ 44$
$1\text{-}\bar{\imath} \wedge 1\text{-}\bar{\imath}$, bas., $111\ 28$
$O \wedge \frac{3}{2}\text{-}\breve{2}=112\ 24$
$i\text{-}\breve{\frac{3}{2}} \wedge i\text{-}\breve{\frac{3}{2}}$, front, $=71\ 32$

II. $O \wedge 1\text{-}\bar{\imath}=122\ 27$
$O \wedge 2=103\ 8$
$O \wedge \frac{2}{3}\text{-}\breve{\imath}=135\ 52\frac{1}{2}$
$O \wedge 4\text{-}\breve{2}=98\ 13$
$O \wedge 2\text{-}\breve{\imath}=108\ 58$
$1\text{-}\bar{\imath} \wedge 1\text{-}\bar{\imath}$, ov. $i\text{-}\bar{\imath}$, $=115\ 6$

III. $O \wedge 1\text{-}\bar{\imath}=125^\circ\ 14\frac{1}{2}'$
$O \wedge 2\text{-}\bar{\imath}=109\ 27$
$O \wedge 4=97\ 23$
$O \wedge \frac{4}{3}\text{-}\breve{\imath}=119\ 47$
$O \wedge 4\text{-}\breve{\imath}=100\ 48$
$O \wedge \frac{8}{15}\text{-}\breve{2}=140\ 15$
$O \wedge \frac{8}{7}\text{-}\breve{2}=119\ 17$
$O \wedge 8\text{-}\breve{2}=94\ 35$
$O \wedge \frac{4}{3}=111\ 15$
$1\text{-}\bar{\imath} \wedge 1\text{-}\bar{\imath}=109\ 31$
$1\text{-}\bar{\imath} \wedge \frac{4}{3}=134\ 23$
$\frac{4}{3} \wedge \frac{8}{7}\text{-}\breve{2}$, ov. I, $=126\ 58$

Observed angles with the common goniometer in chondrodite of N. Jersey (Dana): $1\text{-}\bar{\imath} \wedge 1\text{-}\bar{\imath}=112^\circ$ (for mean of humite types $112^\circ\ 2'$); $1\text{-}\bar{\imath} \wedge \frac{4}{3}=136^\circ$; $1\text{-}\bar{\imath} \wedge \frac{8}{7}\text{-}\breve{2}=157^\circ$, $\frac{4}{3} \wedge \frac{8}{7}\text{-}\breve{2}$, ov. I, $=127^\circ$, $I \wedge I$, adj., $=85^\circ$, $4\text{-}\bar{\imath}$ on edge above it 168°; of Pargas (Nordenskiöld) $1\text{-}\bar{\imath} \wedge 1\text{-}\bar{\imath}=114^\circ\ 37'$ (in type II. above $115^\circ\ 6'$), $O \wedge \frac{2}{3}\text{-}\breve{\imath}=136^\circ\ 1'$, $O \wedge 2\text{-}\breve{\imath}=109^\circ\ 3'$.

Twins: composition-face $\frac{8}{7}\text{-}\bar{\imath}$ in type I.; $\frac{2}{3}\text{-}\breve{\imath}$ and $\frac{8}{5}\text{-}\breve{\imath}$ in II.; $\frac{4}{3}\text{-}\breve{\imath}$ in III.; the last sometimes producing stellate forms of six crystals, each hemihedral. Cleavage indistinct. Usually in imbedded grains or masses of a somewhat granular texture.

H.=6—6·5. G.=3·118—3·24. Lustre vitreous—resinous. Color white, yellow, pale yellow or brown; sometimes red, apple-green, black, gray. Streak white, or slightly yellowish, or grayish. Transparent—subtranslucent. Fracture subconchoidal—uneven.

Var.—1. Ordinary *chondrodite*. In imbedded crystals, masses, or grains, subtranslucent or opaque, more or less resinous in lustre, and surfaces hardly polished; the crystals sometimes 2 inches or more broad. Colors the above, excepting white. G.=3·118, from N. Jersey, Thomson; 3·24, fr. Eden, N. Y., id.; 3·199, fr. Finland, Haidinger.

2. *Humite*. In small implanted, transparent to translucent, polished glassy crystals, from Vesuvius; (*a*) type I.; (*b*) type II.; (*c*) type III., the most common. Colorless to citron-yellow, honey-yellow, and brownish. G.=3·234, white, type I.; 3·177, yellow, type II.; 3·199, brown, type III.; 3·186, yellowish, type III.; Scacchi.

Comp.—$\dot{M}g^8\ \ddot{S}i^3$, with part of the oxygen replaced by fluorine; $\frac{1}{12}$ in chondrodite; $\frac{1}{24}$ in humite, type I., $\frac{1}{18}$ in type II., $\frac{1}{36}$ in type III., Ramm.

Analyses: 1, Dr. W. Langstaff (Am. J. Sci., vi. 172, analysis made in 1811); 2, Seybert (Am. J. Sci., v. 336); 3, Rammelsberg (Pogg., liii. 130, and 1st Suppl., 38); 4, W. Fisher (Am. J. Sci. II. ix. 85); 5, Thomson (Ann. Lyc. N. York, iii. 54); 6–10, Rammelsberg (Pogg., liii. 130, lxxxvi 413):

		$\ddot{S}i$	$\dot{F}e$	$\dot{M}g$	F
1.	New Jersey	32·	6·	51·	8·55, $\dot{H}$ and loss 2=99·55 Langstaff.
2.	"	32·67	2·33	54·00	3·89, $\dot{H}$ 1·0, $\dot{K}$ 2·11=96·00 Seybert.
3.	" *yellow*	33·06	3·65	55·46	7·60=99·77 Ramm.
4.	" *red*	33·35	5·50	53·05	7·60=99·50 W. Fisher.
5.	"	36·00	$\ddot{F}e$ 3·97	54·64	3·77, $\dot{H}$ 1·62=99·98 Thomson.
6.	Pargas, *yellow*	33·10	2·35	56·61	8·69=100·75 Ramm.
7.	" *gray*	33·19	6·75	54·50	9·69=104·13 Ramm.
8.	*Humite, type* I.	34·80	2·40	60·08	3·47=100·75 Ramm.
9.	" " II.	33·26	2·30	57·92	5·04, $\dot{C}a$ 0·74, $\ddot{A}l$ 1·06=100·32 Ramm.
10.	" " III.	36·67	1·67	56·83	2·61=97·78 Ramm.

Pyr., etc.—B.B. infusible; some varieties blacken and then burn white. Fused with salt of phosphorus in the open tube gives a reaction for fluorine. With the fluxes a reaction for iron. Gelatinizes with acids. Heated with sulphuric acid gives off fluorid of silicon.

Obs.—Chondrodite occurs mostly in granular limestone. It is found near Abö, in the parish of Pargas in Finland, and at Aker and Gulsjö in Sweden; at Taberg in Wermland; at Boden in Saxony; on Loch Ness in Scotland; at Achmatovsk in the Ural, along with perofskite; and in the mines of Schischimsk with red apatite. Humite occurs at Somma, in ejected masses of a kind of granitic rock, along with forsterite, biotite, pyroxene, magnetite, etc.

Abundant in the counties of Sussex, N. J., and Orange, N. Y., where it is associated with spinel, and occasionally with pyroxene and corundum. In *N. Jersey*, at Bryam, orange and straw-colored chondrodite, and also a variety nearly black, occurs with spinel; at Sparta, a fine locality of honey-yellow chondrodite; a mile to the north of Sparta the best locality of this mineral in N. J.; at Vernon, Lockwood, and Franklin. In *N. York*, in Orange Co., in Warwick, Monroe, Cornwall, near Greenwood Furnace, and at Two Ponds, and elsewhere; near Edenville in fine specimens on the land of Mr. Houston; also sparingly in Rossie, on the bank of Laidlaw Lake. In *Mass.*, at Chelmsford, with scapolite. In *Penn.*, near Chaddsford, in Harvy's quarry, of yellow and orange colors, abundant. In *Canada*, in limestone at St. Crosby, St. Jerome, St. Adele, Grenville, etc., abundant.

The name chondrodite is from χόνδρος, *a grain*, alluding to the granular structure. *Brucite* was given by Col. Gibbs after Dr. Bruce, editor of the American Mineralogical Journal; *Maclureite* by Seybert, after Wm. Maclure. The mineral was first discovered in New Jersey by Dr. Bruce. Fluorine was first detected in it in 1811, by Dr. Langstaff of New York, whose analysis (No. 1) gives very nearly the correct constitution of the species. Cleaveland, in the first edition of his mineralogy (issued in 1816), at p. 185, in a brief mention of the undescribed species, speaks of it as a *fluate*, calling it *fluate of magnesia*, he evidently having had an imperfect report of Dr. Langstaff's examination, the results of which had not then been published. Dr. Torrey obtained similar results to those of Dr. Langstaff in 1818. See on these points Am. J. Sci., vi. 171, 1823. D'Ohsson analyzed the mineral in 1817 without finding the fluorine, he obtaining (l.c.) $\ddot{\mathrm{Si}}$ 38·00, $\dot{\mathrm{Mg}}$ 54·00, $\dot{\mathrm{Fe}}$ 5·10, $\ddot{\mathrm{Al}}$ 1·50, K 0·86 $\dot{\mathrm{Mn}}$ *tr.*, a result very wide from the true composition. Humite was shown to be identical with chondrodite in composition by Rammelsberg.

On cryst. see Scacchi, Pogg., 1851, Ergänz., iii. 161, who identified and described the three types of humite; also Hessenberg, Min. Not., ii. 15; Nordenskiöld on chondrodite of Pargas, Pogg., xcvi. 118. The author adopts a modified view of Scacchi's types, first brought out in Am. J. Sci., II. xiv. 175.

Alt.—Chondrodite altered to serpentine has been observed at Sparta, N. J., with spinel and mica.

320. TOURMALINE. *Early syn. of precious T.* Turamali, Turmalin (fr. Ceylon), *Ceylon name, Garmann*, Curiosæ Speculationes, etc., von einem Liebhaber, der Immer Gern Speculirt, Chemnitz, 1707. Pierre de Ceylan; un petit aiman; *M. Lemery* la fit voir, etc., Hist. Ac. Sci., Paris, 1717, p. 8. Aschentrecker *Holl.*; Aschenzieher *Germ.*; Ash-drawer *Engl.* [alluding to electrical property]. Zeolithus vitreus electricus, Tourmalin, *Rinmann*, Ak. H. Stockh., 1766; *v. Born*, Lithoph., i. 47, 1772. Borax electricus *Linn.*, Syst., 96, 1768. Tourmaline Garnet *Hill*, Foss., 148, 1771. Tourmaline *Kirw.*, Min., i. 271, 1794.

Early syn. of opaque T. Schurl pt. *Erker*, 1595; Schirl pt. *Brückmann*, 1727 [see p. 206]. Skiörl pt., Corneus crystallisatus pt., *Wall.*, 139, 1747. Basaltes cryst. pt., Sköřl-Crystall pt., *Cronst.*, 70, 1758. Schörl, Stangenschörl, *Germ.*; Shorl, Shirl, Cockle, *Engl.* Borax Basaltes *Linn.*, Syst., 95, 1768. Basaltes crystallisatus *v. Born*, Lithoph., i. 34, 1772, ii. 95, 1775. Shorl *Kirw.*, Min., i. 265, 1794.

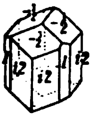
Syn. from union of T. and S. in one species. Tourmaline ou Basalte transparent=Schorl, *de Lisle*, Crist., 266, with fig. cryst. (and proofs of ident. of T. & S.), 1772. Schorl transparent rhomboidal dit Tourmaline et Peridot=Schorl, *de Lisle*, Crist., ii. 344, with figs., 1783. Schörl, Stangenschörl (incl. var. (1) Schwarzer S., (3) Elektrischer S.=Turmalin), *Wern.*, Cronst., 169, 1780; Bergm. J., i. 374, 1789; *Jameson*, Min., 1816. Tourmaline *H.*, Tr., iii. 1801.

Var. introd. as Sp. Rubellite (fr. Siberia) *Kirw.*, Min., i. 288, 1794=Daourite *Delameth.*, T. T., ii. 303, 1797=Siberite *l'Hermina*, J. de l'Ecole Polytechn., i. 439=Tourmaline apyre *H.*, iv. 1801=Apyrit *Hausm.*, Handb., 642, 1813. Indicolite and Aphrizite (fr. Norway) *d'Andrada*, J. de Phys., li. 243, 1800, Scherer's J., iv. 19, 1800. Taltalite *Domeyko*, Min., 139, 1860=Cobre negro estrellado de Tantal (Atacama).

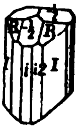
Var. introd. as Subsp. Achroit (fr. Elba) *Herm.*, J. pr. Ch., xxxv. 232, 1845.

Rhombohedral. $R \wedge R=103°$, $O \wedge R=134° 3'$; $a=0·89526$. Observed planes: rhombohedrons, $\frac{1}{4}$, 1 (R), $\frac{5}{4}$, $\frac{7}{4}$, $\frac{5}{2}$, 5, $\frac{11}{2}$?, -2, $-\frac{5}{4}$, $-\frac{7}{8}$, $-\frac{1}{2}$, $-\frac{1}{8}$; scale-hedrons, $\frac{1}{2}^2$, $\frac{1}{2}^3$, $\frac{1}{2}^5$, $1\frac{3}{4}$, 1^2, $\frac{1}{4}^3$, $\frac{2}{5}^3$ (the last replacing angle between $-\frac{1}{2}$, $\frac{1}{4}$, and $\frac{1}{4}^3$); prisms, I, i-2, i-$\frac{7}{5}$, i-$\frac{5}{4}$. Usually hemihedral, being often unlike at the opposite extremities, or hemimorphic, and the prisms often triangular. Cleavage: R, $-\frac{1}{2}$, and i-2, difficult. Sometimes massive compact; also columnar, coarse or fine, parallel or divergent.

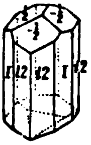
328



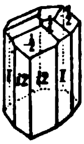
229



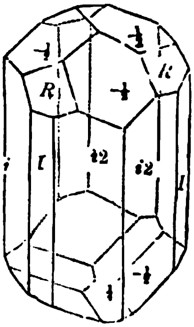
330



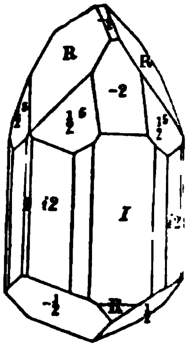
331



332

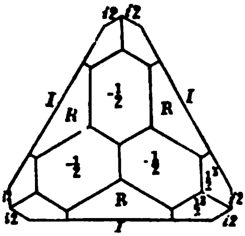


333



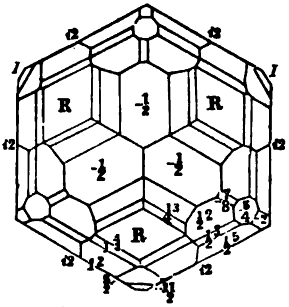
St. Lawrence Co., N. Y.

334



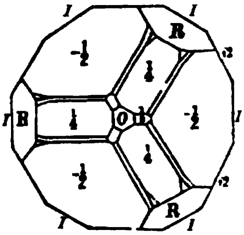
Unionville, Pa.

336



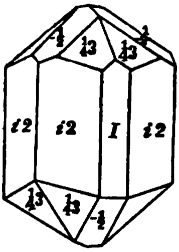
Hunterstown, C. E.

335

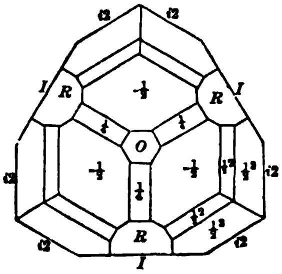


Canada.

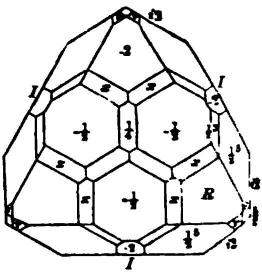
337



338. Analogue Pole.



339. Antilogue Pole.



Gouverneur, N. Y.

$O \wedge \frac{1}{4}=165° 31'$
$O \wedge \frac{1}{2}=152\ 40$
$O \wedge \frac{5}{4}=129\ 21$
$O \wedge 2=115\ 49$
$O \wedge \frac{5}{2}=111\ 9$
$O \wedge \frac{11}{2}=99\ 58$

$\frac{1}{4} \wedge \frac{1}{4}=154° 59'$
$\frac{1}{2} \wedge \frac{1}{2}=133\ 8$
$i\text{-}2 \wedge \frac{1}{2}=113\ 26$
$i\text{-}2 \wedge R=128\ 30$
$i\text{-}2 \wedge \frac{1}{2}^{5}=155\ 14$
$i\text{-}2 \wedge \frac{1}{2}^{3}=142\ 26$

$i\text{-}2 \wedge \frac{1}{2}^{3}=130° 55'$
$i\text{-}2 \wedge 1\frac{1}{3}=136\ 41$
$i\text{-}2 \wedge 1^{3}=147\ 51$
$i\text{-}2 \wedge i\text{-}\frac{5}{4}=160\ 54$
$i\text{-}2 \wedge i\text{-}\frac{7}{6}=166\ 6$
$i\text{-}2 \wedge I=150.$

H.=7–7·5. G.=2·94–3·3. Lustre vitreous. Color black, brownish-black, bluish-black, most common; blue, green, red, and sometimes of rich shades; rarely white or colorless; some specimens red internally and green externally; and others red at one extremity, and green, blue, or black at the other. Dichroic; some, yellowish-brown axially, asparagus-green transversely; dark brownish-violet axially, greenish-blue transversely; purple axially, bluish transversely; etc. Streak uncolored. Transparent—opaque; greater transparency across the prism than in the line of the axis. Fracture subconchoidal—uneven. Brittle. Pyroelectric.

Var.—1. *Ordinary.* In crystals. (*a*) *Rubellite;* the red sometimes transparent; the Siberian is mostly violet-red, the Brazilian rose-red; that of Chesterfield and Goshen, Mass., pale rose-red and opaque; that of Paris, Me., fine ruby-red and transparent. (*b*) *Indicolite;* the blue, either pale or bluish-black; named from the indigo-blue color. (*c*) *Brazilian Sapphire* (in jewelry); Berlin-blue and transparent; (*d*) *Brazilian Emerald, Chrysolite* (or *Peridot*) *of Brazil;* green and transparent. (*e*) *Peridot of Ceylon;* honey-yellow. (*f*) *Achroite;* colorless tourmaline, from Elba. (*g*) *Aphrizite;* black tourmaline, from Kragerōe, Norway. (*h*) *Columnar* and *black;* coarse columnar. Resembles somewhat hornblende, but has a more resinous fracture, and is without distinct cleavage or anything like a fibrous appearance in the texture.

Kupffer found the angle $\frac{1}{2} \wedge \frac{1}{2}$ in the green tourmaline of St. Gothard 133° 8'; in the black of Siberia, 133° 13'; in the red of Siberia, 133° 2'; giving 134° 6', 134° 3', and 133° 50' for $O \wedge \frac{1}{2}$. Brooke found for the angle $O \wedge \frac{1}{2}$ in a white crystal, 134° 7'; green, 134° 2' 24"; clear brown, 133° 56'; red, 133° 48'; black, 133° 47' 12".

The varieties in composition and the subdivisions suggested thereby are given below.

Comp.—O. ratio for bases (the boric acid here included) and silica 4 : 3 (Ramm.); whence $(\dot{R}^3, \bar{R}, \bar{B})^4 \ddot{Si}^3$. The O. ratio for the protoxyds, sesquioxyds, and boric acid ($\dot{R}$, $\bar{R}$, $\bar{B}$) varies greatly: group I. (see beyond) affording mostly 4 : 12 : 4; II., 4 : 15 : 5; III., 4 : 21 : 6, 4 : 24 : 7, etc.; IV., 4 : 40 : 12, 4 : 36 : 11, etc.; V., 4 : 48 : 13, 4 : 56 : 12, etc. The special formula for group I. would consequently be $(\dot{R}^3)^4 \ddot{Si}^3+3\,\bar{R}^4 \ddot{Si}^3+\bar{B}^4 \ddot{Si}^3$ or $(\frac{1}{5}\dot{R}^3+\frac{3}{5}\bar{R}+\frac{1}{5}\bar{B})^4 \ddot{Si}^3$; for analysis 23 in group V. $(\dot{R}^3)^4 \ddot{Si}^3+14\bar{R}^4 \ddot{Si}^3+3\bar{B}^4 \ddot{Si}^3$ or $(\frac{1}{18}\dot{R}^3+\frac{14}{18}\bar{R}+\frac{3}{18}\bar{B})^4 \ddot{Si}^3$, and these (excluding analysis 26) are the extreme variations.

A. Mitscherlich, by a new method of analysis (J. pr. Ch., lxxxvi. 1), obtained the iron as protoxyd in several trials, finding 16·06 and 16·30 in that of Bovey Tracey (No. 13, beyond); 5·69 and 5·66 in that of St. Gothard (No. 9); 17·14 and 17·29 in that of Sonnenberg (No. 15); 7·54, 7·65, and 7·57 in that of Sarapulsk near Mursinsk (No. 17); and 6·74 in that of Brazil (No. 21). But Scheerer takes the ground that Mitscherlich's method of analysis is less satisfactory than others, and the subject is still in doubt. Mitscherlich's determinations, introduced into Rammelsberg's analyses as done by himself, afforded, in the 14 cases which he investigated, the following for the oxygen of $\dot{R}+\bar{R}+\bar{B}$, that of the $\ddot{Si}$ being 3: I., *Iron-magnesia tourmaline*—3·90 (No. 7); 4·10 (No. 8); 4·09 (No. 9); 4·07 (fr Havredal); 4·15 (fr. Ramfosse); 4·11 (No. 10, Haddam); 4·12 (No. 11, Haddam); 4·21 (No. 12, Unity, Me.); II., *Iron tourmaline*—4·09 (No. 13); 4·32 (No. 14); 4·09 (No. 15); 4·23 (fr. Saar); 4·12 (fr. Langenbielau); 3·99 (No. 16). The results leave little question as to the normal ratio for the species being 4 : 3

Analyses: 1–26, Rammelsberg (Pogg., lxxx 409, lxxxi. 1) arranged as follows:

I. *Magnesia tourmaline*, G.=3–3·07, mean 3·05.
II. *Iron-magnesia tourmaline*, G.=3·05–3·2, mean 3·11.
III. *Iron tourmaline*, G.=3·13–3·25.
IV. *Iron-manganese-lithia tourmaline*, G.=2·94–3·11, mean 3·083.
V. *Lithia tourmaline*, G.=3–3·1, mean 3·041.

Anal. 27–29, Gmelin (Schw. J., 299, xxxviii. 514, Pogg., ix. 172); 30, Ulex (J. pr. Ch., xcvi. 37); 31, C. W. C. Fuchs (Jahrb. Min. 1862, 800); 32, 34, 35, 37, 38, Gmelin (l. c.): 33, 36, 39, 40, Hermann (J. pr. Ch., xxxv. 232):

			G	$\ddot{\mathrm{Si}}$	$\dddot{\mathrm{B}}$	$\overline{\mathrm{Al}}$	$\overline{\mathrm{Mn}}$	$\overline{\mathrm{Fe}}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Na}}$	$\dot{\mathrm{K}}$	$\dot{\mathrm{Li}}$	$\overline{\mathrm{P}}$	F	ign.
-	1.	*Brown*, Gouverneur	3·049	38·85	8·25	31·32	—	1·27	—	14·89	1·60	1·28	0·26	—	—	2·28=100.	3·19
	2.	" W. Kappel	3·035	38·08	9·39	34·21	—	1·43	—	11·22	0·61	2·37	0·47	—	0·12	2·10=100.	2·98
	3.	*Greenish*, Eibenstock	3·034	37·83	8·88	30·86	—	4·85	—	11·62	0·88	2·27	0·30	—	—	2·51=100.	3·50
	4.	*Brown*, Orford, N. H.	3·068	38·33	9·86	33·15	—	3·07	0·12	10·89	0·77	1·52		—	0·24	2·50=100·45.	3·49
	5.	" Monroe, Ct.	3·068	39·01	9·04	31·18	—	3·44	0·98	9·90	1·81	1·82	0·44	—	—	2·38=100.	3·32
	6.	*Black*, Zillerthal	3·054	37·94	8·58	33·64	—	2·79	0·37	10·46	0·98	2·13	0·37	—	0·24	2·50=100.	3·54
II.	7.	*Black*, Greenland	3·072	37·70	7·36	34·53	—	4·63	0·25	9·51	1·25	2·00	0·43	—	0·11	2·23=100.	3·11
	8.	" Texas, Pa.	3·048	38·45	8·48	34·56	$\dot{\mathrm{M}}$n0·09	3·31	—	9·11	0·71	2·00	0·73	—	0·20	2·36=100.	3·30
	9.	*Brownish-black*, St. Gothard	3·055	38·00	8·99	32·28	—	6·36	1·51	7·27	1·31	1·43	0·28	—	0·24	2·33=100.	3·25
	10.	*Black*, Haddam, Gneiss q'ries	3·136	37·50	7·94	30·87	—	8·31	1·06	8·60	1·61	1·60	0·73	—	*tr.*	1·78=100.	2·49
	11.	" " Chrysob. loc.	3·132	36·55	4·87	32·46	—	11·08	0·50	8·51	1·80	2·28		—	—	1·95=100.	2·72
	12.	" Unity, Me.	3·192	36·29	6·94	30·44	—	13·08	2·38	6·32	1·02	1·94		—	—	1·59=100.	2·22
III.	13.	*Black*, Bovey Tracey	3·205	37·00	7·66	33·09	—	9·33	6·19	2·58	0·50	1·39	0·65	—	0·12	1·49=100.	2·09
	14.	" Alabaschka, Ural	3·227	37·54	8·00	34·40	—	7·61	8·60	1·76	0·86	1·02	0·47	—	—	1·54=100.	2·15
	15.	" Sonnenberg, Harz	3·243	36·51	7·62	32·92	$\dot{\mathrm{M}}$n0·11	8·13	9·51	0·78	0·72	1·36	0·58	—	0·12	1·64=100.	2·31
	16.	" Krummau, Bohemia	3·135	38·43	8·06	34·25	—	9·98	1·44	3·84	0·44	1·36	0·30	—	—	1·90—100.	2·66
IV.	17.	*Bluish-black*, Sarapulsk, Ural	3·162	38·30	6·52	36·17	3·71	6·35	3·84	0·53	0·27	2·37	0·33	—	0·96	1·75=100.	3·28
	18.	*Black*, Elba	2·942	36·71	6·49	36·00	6·14	7·14	—	2·30	0·80	2·04	0·38	—	—	2·00=100.	—
	19.	*Green*, "	3·112	38·19	7·10	39·16	4·74	3·14	—	1·10	0·84	2·40	0·34	0·74	—	2·35=100.	2·44
	20.	" Paris, Me.	3·069	38·47	7·51	40·93	1·78	3·08	—	1·21	0·88	2·36	0·36	1·47	—	2·00=100.	—
	21.	" Brazil	3·107	38·55	7·21	38·40	0·81	5·13	2·00	0·73	1·14	2·37	0·87	1·20	—	2·09=100.	2·92
	22.	" Chesterfield, Mass.	3·108	40·26	7·79	38·00	0·90	2·61	3·80	0·80	0·81	2·09	0·64	0·20	—	2·10=100.	2·94
V.	23.	*Red*, Elba	3·022	39·27	7·87	44·41	0·64	—	—	0·78	—	2·00	1·30	1·22	0·10	2·41=100.	3·37
	24.	" Paris, Me.	3·019	38·33	9·00	43·15	1·12	—	—	1·02	—	2·60	0·68	1·17	0·27	2·58=99·92.	3·61
	25.	" Schaitansk	3·082	38·38	7·41	43·97	2·60	—	—	1·60	0·62	1·97	0·21	0·48	0·27	2·47=100.	3·45
	26.	" Rozena	2·998	41·16	8·56	41·83	0·97	—	—	0·61	—	1·37	2·17	0·41	0·22	2·70=100.	3·76
																ign.	
II.	27.	*Brown*, St. Gothard		37·81	4·18	31·61	1·11	7·77		5·99	0·98	—	1·20	—	—	0·24=90·89 G.	
	28.	*Black*, Greenland		38·79	3·63	37·19	*tr.*	5·81		5·86	—	8·13	0·22	—	—	1·86=96·48 Gmelin.	
	29.	" Karingbricka		37·65	3·83	33·46	—	9·38		10·98	0·25		2·53	—	—	0·03=98·11 Gmelin.	
	30.	*Taltalite*		39·6	7·5	35·5	—	7·2	—	4·3	2·2	1·6	0·3	—	—	—=98·2 Ulex.	
III.	31.	*Black*, Rosstrappe	(?)	37·25	5·45	34·64	—	4·66	9·73	0·65	0·38	2·47	2·71	—	1·79	1·03=100 Fuchs.	
	32.	" Bovey		35·20	4·11	35·50	0·43	17·86		0·70	0·55	2·09	—	—	- -	—=96·44 Gmelin	
	33.	*Brown*, Mursinsk		37·80	9·90	30·56	$\dot{\mathrm{M}}$ 2·50	0·50	12·07	1·42	—	2·09	—	0·50	—	—, C̈ 1·66=100 H.	
	34.	*Green*, Brazil		39·16	4·59	40·00	$\dot{\mathrm{M}}$ 2·14	5·96		—	—	—	3·59	—	—	1·58=97·02 Gmelin.	
	35.	" Chesterfield		38·80	3·88	39·61	" 2·88	7·43		—	—	4·95	—	—	—	0·78=98·33 Gmelin.	
V.	36.	" Totsch, Gora		40·54	11·78	31·77	$\dot{\mathrm{M}}$ 0·90	—	3·65	6·44	—	—	—	2·09 C̈r 1·17		—, C̈ 1·66=100 H.	

	S̈i	B̶	A̶l	M̶n	Ṁg	Ṅa	K̇	L̇i	ign.	
37. *Red*, **Rozena**	42·13	5·74	36·43	6 32	Ċa 1·20	—	2·41	2·04	1·31	=97·58 Gmelin
38. " Perm	39·37	4·18	44·00	5·02	—	—	1·29	2·52	1·58	=97·56 Gmelin
39. *Achroite*, Elba	42·89	5·34	44 09	Ṁ 0·27	0·45	3·12	—	2 19	—,	Ċ 1 66=100 H
40. *Red*, Sarapulsk	39·70	6 65	40·29	" 2·30	0·16	7·88	—	3 02	—	=100 Hermann.

Pisani has examined a specimen of true taltalite (Am. J. Sci., II. xliii. 407), and shown that it is tourmaline with oxyd of copper and other impurities. Domeyko made it a silicate of copper (l. c., and Forbes, Phil. Mag., IV. xxv. 111). Ulex's specimen (anal. 30) was procured from a cargo of copper ores landed at Hamburg, and identified as taltalite by its characters.

Pyr., etc.—I., fuse rather easily to a white blebby glass or slag; II., fuse with a strong heat to a blebby slag or enamel, either white, greenish, or brownish; III., fuse with difficulty, or, in some, only on the edges, to a brownish, brownish-red, gray, or black slag; IV., fuse on the edges, and often with great difficulty, to a yellowish, grayish, bluish, or whitish slag or enamel, and some are infusible; V., infusible, but becoming white or paler, sometimes, as the Paris (Me.) rubellite, affording a fine enamel on the edges (Ramm.). With the fluxes many varieties give reactions for iron and manganese. Fused with a mixture of bisulphate of potash and fluor-spar gives a strong reaction for boric acid. By heat alone tourmaline loses weight from the evolution of fluorid of silicon and perhaps also fluorid of boron; and only after previous ignition is the mineral completely decomposed by fluohydric acid. Not decomposed by acids (Ramm.). After fusion perfectly decomposed by sulphuric acid (v. Kobell).

Obs.—Tourmaline is usually found in granite, gneiss, syenite, mica, chloritic or talcose schist, dolomite, granular limestone, and sometimes in sandstone near dykes of igneous rocks. The variety in granular limestone or dolomite is commonly brown.

Foreign localities are mentioned above. Small brilliant black crystals in decomposed feldspar, at Sonnenberg in the Harz, are called *aphrizite*. Rubellite and green tourmaline occur near Katherinenburg in Siberia; pink crystals are found at Elba. Pale yellowish-brown crystals in talc at Windisch Kappell in Carinthia; green at Airolo, Switzerland; white specimens (*achroite*) come from St. Gothard, Siberia, and Elba. A specimen, formerly in the Grand Duke's collection at Florence, measuring 11 inches square, contains 4 erect green tourmalines and 1 prostrate, 2, 4, and 2½ inches long, and ¾ to 1 inch thick.

In Great Britain, fine black crystals have been obtained near Bovey Tracey in Devon; also found in Cornwall at different localities; green near Dartmoor in Devon; black near Aberdeen in Scotland, and elsewhere; dark brown at Dalkey in Co. Dublin, Ireland; green near Dunfanaghy, Co. Donegal; green and red at Ox mountain, near Sligo.

In the U. States, in *Maine* at Paris and Hebron, magnificent red and green tourmalines with lepidolite, etc., some crystals over an inch in diameter, transparent, ruby-red within, surrounded by green, or red at one extremity and green at the other; also blue and pink varieties; at Albany, green and black; at Streaked Mtn., black. In *Mass.*, at Chesterfield, red, green, and blue, in a granite vein with albite, uranite, and microlite, the crystals small and curved, nearly opaque, and fragile, the green crystals often with distinct prisms of red color inside, especially when in smoky quartz; at Goshen, similar, the blue in greater perfection; at Norwich, New Baintree, and Carlisle, good black crystals. In *N. Hamp.*, Alstead, Grafton, Sullivan, Acworth, and Saddleback Mt.; at Orford, large brownish-black crystals abundant in steatite. In *Vermont*, at Brattleboro, black. In *Conn.*, at Monroe, perfect dark brown crystals in mica-slate near Lane's mine, sometimes two inches in length and breadth; at Haddam, interesting black crystals in mica slate with anthophyllite, also in granite with iolite, and also at the gneiss quarries, on the east side of the river. In *N. York*, near Gouverneur, light and dark brown crystals, often highly modified, with apatite and scapolite in granular limestone (f. 358, 339); at Canton; in simple prisms in the same rock near Port Henry, Essex Co.; at Schroon, with chondrodite and scapolite; at Crown Point, one mile south of village, fine brown crystals; at the chrysoberyl locality near Saratoga, N. Y., black; at Alexandria, Jefferson Co.; at Kingsbridge, brown, yellowish or reddish-brown crystals in dolomite; near Edenville, gray or bluish-gray and green in three-sided prisms occur; short black crystals in the same vicinity, and at Rocky Hill, sometimes 5 inches in diameter; a mile southwest of Amity, yellow and cinnamon-colored crystals with spinel in calcite; also near the same village a clove-brown variety with hornblende and rutile in granular limestone. In *N. Jersey*, at Franklin, Hamburg, and Newton, black and brown crystals in limestone, with spinel. In *Penn.*, at Newlin, Chester Co.; at London Grove and near Unionville, of a light yellow or brownish-yellow (f. 458), in limestone, and rarely *white*; at Parksburg, Chester Co; in Delaware Co., at Aston; at Chester, fine black; Middletown, black; Marple, of a green color in talc; opposite New Hope, Buck's Co.; in New Garden township, Chester Co., in limestone, light brown to yellow and sometimes transparent; near New Hope on the Delaware, large black crystals, in which the prismatic faces are sometimes almost obsolete. In *S. Car.*, in Cheowee valley. In *Georgia*, Habersham Co. In *California*, black crystals, 6–8 in. in diameter, in foldspar veins, in the mountains between San Diego and the Colorado desert, bordering the el vated valley of San Felipe.

In *Canada*, superb greenish-yellow crystals, 1 inch through, in limestone at G. Calumet Id amber-colored at Fitzroy, C. W.; transparent-brown (f. 336) at Hunterstown, C. E., with idocra and garnet; black at Bathurst and Elmsley, C. W., and St. Jerome, C. E.

The name *turmalin*, from *Turamali* in Cingalese, was introduced into Holland in 1703, with lot of gems from Ceylon. The property of attracting the ashes of burnt peat, after friction, led its being very soon named in Holland *Aschentrecker*, or *ash-drawer*. In 1717, Lemery, in h Memoir in the Hist. de l'Acad. des Sci., France, referred the attraction to magnetism; and 1756 to 1762, appeared the several Memoirs of Æpinus (published in the Mem. Acad. Berlin, vo xii., and at St. Petersburg) on the *electrical* properties of tourmaline. The name *tourmaline* wa slow of introduction into mineralogical treatises. The first specimens from Ceylon were cut gem so that the common characteristics of tourmaline and schorl were not apparent. Linnæus, in h Syst. Nat., 1768, suggests the relation between them, but de Lisle was the first to describe Ce lon crystals, and bring the two minerals into one species. On the name *schorl*, see pages 204 206. Long after the union of tourmaline and schorl, the species continued to bear the latter these names; and even in 1816, Jameson, in his System of Mineralogy, retains schorl as th name of the species, with *common schorl* and *tourmaline* or *precious schorl* as two subspecies.

Alt.—Tourmaline occurs altered to mica, chlorite, cookeite, steatite. The mica is lepidolite, species which is related in composition to some tourmaline, and is a frequent associate of the red an green varieties. It appears to take place through the addition of alkalies. Some rubellites an green tourmalines at Chesterfield are hollow, evidently from decomposition and removal of th interior; and in the cavities are occasionally observed small crystals of yellow uranite (Tesch macher).

ZEUXITE, Thomson (Ann. Phil., iv. 299, 1814) was found in 1814 in acicular interwoven crystals Huel Unity, Cornwall; color brown, slightly greenish in some lights; G.=3·051; H.=4·25; prism stated to be flat rectangular. Thomson's analysis afforded $\ddot{\mathrm{Si}}$ 33·48, $\bar{\mathrm{Al}}$ 31·85, $\dot{\mathrm{Fe}}$ 26·01, $\dot{\mathrm{Ca}}$ 2·4 $\dot{\mathrm{H}}$ 5·28=99·07. B.B. becomes scoriaceous at the edges. Loses over 5 p. c. when heated in glass tube. Greg supposes that this loss may have been of boric acid instead of water, and th the mineral is a ferriferous tourmaline (Phil. Mag., IV. x. 118).

321. GEHLENITE. Gehlenit *Fuchs*, Schw. J., xv. 377, 1815. Stylobat *Breith.*, Leon Taschenb., x. 600, 1816, Hoffm. Min., iv. b, 109, 1817.

Tetragonal; near meionite in form (p. 318). $O \wedge 1\text{-}i = 158° 12'$; a= 0·400. Observed planes: O; vertical, $i\text{-}i$, $i\text{-}3$; octahedral, 1, $\frac{8}{7}$, 2, $\frac{7}{3}$- Descl. $O \wedge 1 = 150° 30'$, $O \wedge 2 = 131° 28'$, $O \wedge \frac{8}{7} = 147° 7'$, $O \wedge \frac{7}{3}\text{-}i = 136°$ 5 (135°—136° obs.). Crystals usually short square prisms, sometimes tabula Cleavage: O imperfect; $i\text{-}i$ in traces.

H.=5·5—6. G.=2·9—3·067. Lustre resinous, inclining to vitreou Color different shades of grayish-green to liver-brown; none bright. Faintl subtranslucent—opaque. Fracture uneven—splintery. Streak white- grayish-white. Double refraction feeble; axis negative.

Comp.—O. ratio for $\dot{\mathrm{R}}$, $\bar{\mathrm{R}}$, $\ddot{\mathrm{Si}}$=1 : 1 : $\frac{4}{3}$, or 3 : 2 between bases and silica, as in andalusite. Formu $(\frac{1}{2}\dot{\mathrm{R}}^3+\frac{1}{2}\bar{\mathrm{R}})\ddot{\mathrm{Si}}$=, if $\bar{\mathrm{Al}}$ to $\bar{\mathrm{Fe}}$=5 : 1, Silica 29·9, alumina 21·5, sesquioxyd of iron 6·6, lime 42·0=10 Analyses: 1, Fuchs (Schw., xv. 377); 2, Thomson (Min., i. 281); 3, v Kobell (Kastn. Arch., i 313); 4, Damour (Ann. Ch. Phys., III. x. 66); 5, 6, Kühn (Ann. Ch. Pharm., lix. 371); 7, Ra melsberg (3d Suppl., 47):

		$\ddot{\mathrm{Si}}$	$\bar{\mathrm{Al}}$	$\bar{\mathrm{Fe}}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{H}}$
1.	Fassa	29·64	24·80	6·56		—	35·30	8·30=99·60 Fuchs.
2.	"	29·13	25·05	—	4·35	—	37·38	4·54=100·45 Thomson.
3.	"	31·0	21·4	—	4·4	3·4	37·4	2·0=99·6 Kobell.
4.	"	31·60	19·80	5·97	—	2·20	38·11	1·53, $\dot{\mathrm{Na}}$ 0·33=99·54 Damour.
5.	"	30·47	17·79	7·30	—	2·99	36·97	3·62=99·14 Kühn.
6.	"	29·53	19·00	—	7·25	1·41	36·55	5·55=99·28 Kühn.
7.	"	29·78	22·02	3·22	1·73	3·88	37·90,	$\dot{\mathrm{H}}$ and loss 1·28, $\dot{\mathrm{Mn}}$ 0·19 Ramm.

Rammelsberg has cleared up in part the discrepancies in the analyses by discovering that t mineral contains both *sesquioxyd* and *protoxyd* of iron. The oxygen ratio from his analyses 3·4 : 3 : 4·1, for which he substitutes 3 : 3 : 4=1 : 1 : $\frac{4}{3}$.

Pyr., etc.—B.B. thin splinters fuse with difficulty (F.=5·7, v. Kobell) to a gray glass. With borax fuses slowly to a glass colored by iron. Gelatinizes with muriatic acid, yielding a solution containing both protoxyd and sesquioxyd of iron.

Obs.—Gehlenite is found only at Mount Monzoni, in the Fassa valley, in isolated or aggregated crystals, invested by calcite.

Named by Fuchs after his colleague, Gehlen.

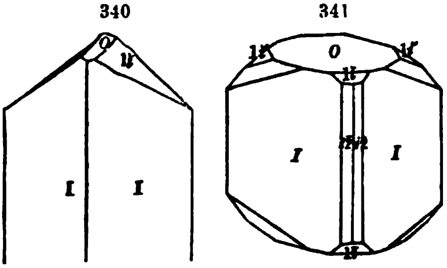
Alt.—Gehlenite occurs altered to steatite. A partially altered specimen afforded G. Bischof $\ddot{\mathrm{Si}}$ 31·62, $\overline{\mathrm{Al}}$ 23·79, $\overline{\mathrm{Fe}}$ 9·43, $\dot{\mathrm{Mg}}$ 2·84, $\dot{\mathrm{Ca}}$ 31·13, ign. 1·28=100·09, with some mixed carbonate of lime.

Artif.—Not unfrequent among furnace scoria, in thin square tables, or 8-sided prisms, with cleavage parallel to the lateral planes of a square prism. Has been observed at Dawes' furnace, Oldbury in England, and at Holzhausen in Hessia. Analyses: 1, Percy (Rep. Brit. Assoc., 1846, Am. J. Sci., II. v. 128); 2, Bunsen:

	$\ddot{\mathrm{Si}}$	$\overline{\mathrm{Al}}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Mn}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Na}}$	$\dot{\mathrm{K}}$	$\dot{\mathrm{Ca}}\dddot{\mathrm{S}}$	Ca S	
1. Dawes', Oldbury	28·32	24·24	0·27	0·07	2·79	40·12	——	0·64	0·26	3·38	=100·09 Percy.
2. Holzhausen	32·22	27·81	——	2·67	5·57	17·35	11 30	3·05	——	——	=99·97 Bunsen.

322. ANDALUSITE. Spath adamantin d'un rouge violet (fr. Forez) *Bourn*, J. de Phys., xxxiv. 453, 1789. Feldspath du Forez *Guyton*, Ann. Ch., i. 190, 1789. Andalousite (fr. Spain and Forez) *Delameth.*, J. de Phys., xlvi. 386, 1798. Andalusite. Feldspath apyre *H.*, Tr., iv. 1801. Micaphilit, Micaflit (fr. Lahmorwinkel), *Brunner*, Moll's Ann. B. H., iii. 294, 1804, Efem., i. 51, 1805; Micaphyllit, *bad orthogr.* Stanzait (fr. Bavaria at Stanzen near Bodenmais, and Herzogau) *Flurl*, Gebirgs-Form. Churpfalzbaierischen Staaten, 5, 1806. Hartspat *Wern.* Macle hyaline *Cordier.*

Silex niger cum cruce candida: Darinn ein weiss Kreutz, *Gesner*, Foss., 45, 1565. Lapis crucifer (fr. Compostella) quem Hispani vocat cruciatum, *Mercati*, Metallotheca Vaticana, 237, 1617. Pierres de Macles (fr. id.) *Robien*, N. ideés sur la Format. d. Foss., 108, 1751 (with fig). Spanish Shirl, Cross-Stone, *Hill*, Foss., 152, 1771. Pierre de Croix, Macle basaltique, Schorl en prismes—dont les angles obtus sont de 95°, *de Lisle*, Crist., 1772, ii. 440, 1783. Crucite *Delameth.*, T. T., ii 292, 1797. Chiastolith *Karst.*, Tab., 28, 73, 1800. Chiastolite. Macle *H.*, Tr., iii. 1801. Hohlspath *Wern.*, 1803, Ludwig's *Wern*, 210, 1804. Chiast. ident. with Andal. *Bernhardi*, Moll's Efem., iii. 32, 1807, *Beud.*, Tr., 363, 1824.



Westford Mass.

Orthorhombic. *I* ∧ *I*=90° 48′, *O* ∧ 1-ī=144° 32′; *a* : *b* : *c*=0·71241 : 1 : 1·01405. Observed planes: *O*; vertical, *I*, *i*-ī, *i*-ĭ, *i*-2̄, *i*-2̆; domes, 1-ī, 1-ĭ; octahedral, 1, 2-2̆. *O* ∧ *I* =90°, *O* ∧ 1-ĭ=144° 55′, *i*-2̆ ∧ *i*-2̆ =127° 30′, 1-ī ∧ 1-ī=109° 4′, 1-ĭ ∧ 1-ĭ=109° 50′. Cleavage: *I* perfect in crystals from Brazil; *i*-ī less perfect; *i*-ĭ in traces. Massive, imperfectly columnar, sometimes radiated, and granular.

H.=7·5; in some opaque kinds 3—6. G.=3·05—3·35, mostly 3·1—3·2. Lustre vitreous; often weak. Color whitish, rose-red, flesh-red, violet, pearl-gray, reddish-brown, olive-green. Streak uncolored. Transparent to opaque, usually subtranslucent. Fracture uneven, subconchoidal. Double refraction strong; optic-axial plane *i*-ĭ; angle very large over 80°; bisectrix negative, normal to *O*.

Var.—1. ***Ordinary.*** H.=7·5 on the basal face, if not elsewhere. For sp. gr., see below.

2. ***Chiastolite*** (macle). Stout crystals having the axis and angles of a different color from the rest, owing to a regular arrangement of impurities through the interior, and hence exhibiting a colored

cross, or a tesselated appearance in a transverse section. H.=3—7·5, varying much with the degree of impurity. The following figures show sections of some crystals. Fig. 342, by C. T. Jackson in J. Soc. N. Hist., Bost., i. 55; figs. *a* and *b* are from opposite extremities of the same crystals; so also *c* and *d*; *e* and *f*; *h* appears to be a twin crystal.

342

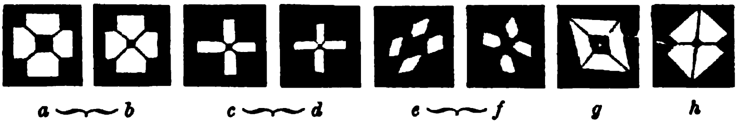
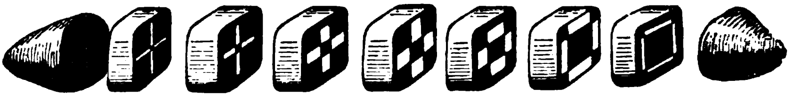
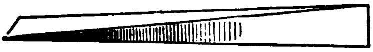


Fig. 343 shows the successive parts of a single crystal, as dissected by B. Horsford of Springfield, Mass.; 344, one of the four white portions; and 345, the central black portion. The forms of the white and black portions vary much. Bernhardi showed in 1807 (l. c.) that the central column sometimes widened *from the middle* toward each end.

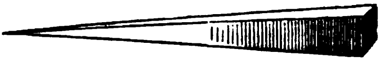
343



344



345



The name *macle* is from the Latin *macula*, *a spot*, and, as Robien observes, it alludes to the use of the "*mascle*" in heraldry, in which the word signifies *a voided lozenge*, or a rhomb with open centre (l. c., 1751, in de Lisle, Crist.). Chiastolite is from *chi*, the Greek name for the letter X.

Comp.—O. ratio for $\overline{\mathrm{R}}$, $\ddot{\mathrm{Si}}$=3 : 2; $\dddot{\overline{\mathrm{Al}}}\,\ddot{\mathrm{Si}}$=Silica 36·8, alumina 63·2=100, with little, if any, sesquioxyd of iron replacing the alumina. Analyses: 1, Bucholz (Moll's Efem., iv. 190); 2, Thomson (Min., i. 232); 3, Bunsen (Pogg., xlvii. 186); 4, A. Erdmann (Jahresb., xxiv. 311); 5, Roth (ZS. G., vii. 15); 6–8, Hubert (Jahrb. G. Reichs., i. 350, 358); 9, Kersten (J. pr. Ch., xxxvii. 162); 10–12, Pfingsten & E. E. Schmid (Pogg., xcvii. 113); 13, Svanberg (Jahresb., xxiii. 279); 14, 15, Jeremejef (Verh. Min. Ges. St. Pet., 1863, 140, 145); 16, Arppe (Act. Soc. Fenn., v. 1857); 17, Damour (Ann. d. M., V. iv. 53); 18, Bunsen (l. c.); 19, Jackson (J. N. Hist Boston, i. 55); 20, Renou (Expl. Sci. de l'Algerie, 1848, 58); 21, Jerofejef (Verh. Min. Ges. St. Pet., 1863, 147):

		$\ddot{\mathrm{Si}}$	$\dddot{\overline{\mathrm{Al}}}$	$\dddot{\overline{\mathrm{Fe}}}$	$\overline{\mathrm{Mn}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Na}}$	$\dot{\mathrm{K}}$	$\overline{\mathrm{H}}$		
1.	Herzogau	36·5	60·5	4·0	—	—	—	—	—	—	=101·0	Bucholz.
2.	Tyrol	35·30	60·20	$\dot{\mathrm{Fe}}$ 1·32	—	1·00	—	—	—	2·03	=99 86	Thomson.
3.	" Lisens	40·17	58·62	—	0·51	—	0·28	—	—	—	=99·58	Bunsen.
4.	" "	39·99	58·60	0·72	0·83	—	—	—	—	—	=100·14	Erdmann.
[5.	" " *Pseud.*	36·74	59·65	2·80	—	—	0·49	—	—	—	=99·68	Roth.
6.	" Langtauf V.	39·24	59 49	0 63	—	0·25	0·51	—	—	—	=100·12	Hubert.
[7.	" " *Pseud.*	36·66	60·00	1·33	—	—	0·93	—	—	—	=99·92	Hubert.
[8.	Krumbach, *Pseud.*	37·63	59·14	0·86	—	0·50	2·01	—	—	—	=100·14	Hubert.
9.	Munzig	37·51	60·01	1·49	—	0·46	0·48	—	—	—	=99·95	Kersten.
10.	Katharinenburg	35·74	56·98	5·71	—	0·20	0·15	—	—	—	=98·78	Pfingsten.
11.	Robschütz	36·84	55·82	3·22	—	1·14	1·09	—	—	—	=98·11	Pfingsten.
12.	Bräunsdorf	37·57	59·88	1·33	—	0·17	0·61	—	—	—	=99·56	Pfingsten.
13.	Fahlun, Sw.	37·65	59·87	1·87	—	0·38	0·58	—	—	—	=100·35	Svanberg.
14.	Mankova, *Chiast.*	35·33	62·20	0 30	*tr.*	—	0·50	0 10	1·50	0·25	=100·18	Jerem.
15.	Schaitansk, *Andal.*	36·78	61·70	0·20	—	*tr.*	0·90	*tr.*	0·30	0·56	=100·39	Jerem.
16.	Kalvola, Finl.	37·41	61·26	1·86	—	—	—	—	—	—	=100·53	Arppe.
17.	Brazil ([illegible])	37·05	61·45	1·17	*tr.*	—	—	—	—	—	=99·65	Damour.
18.	Lancaster, *Chiast.*	39·09	58·56	—	0·53	—	0·21	—	—	0·99	=99·38	Bunsen.
19.	" "	38·0	61·0	$\dot{\mathrm{Fe}}$ 4·0	—	—	—	—	—	1·5	=99·5	Jackson.
20.	Algeria, "	36·0	61·9	—	—	—	—	—	—	—	=98 5	Renou.
21.	Ruskiala, Finl, "	38·42	50·96	3·20	—	*tr.*	4·12	*tr.*	0·50	2·60	=99·80	Jerof.

Anal. No. 4, G.=3·154; 5, cyanite pseudomorphous after andalusite, G.=3·401; 6, G.=3·103 7, pseudomorphous cyanite, forming the exterior of 6, G.=3·327; 8, pseudomorphous cyanite after andalusite, from the Koralp in Styria, G.=3·648; 9, G=3·152; 10, G.=3·12; 11, G.=3·11; 12, G.=3 07; 15, G.=3·14; 17, G.=3·160; 20, G=3·1, $I \wedge I = 93\frac{1}{2}°$.

Pyr., etc.—B.B. infusible. With cobalt solution gives a blue color. Not decomposed by acids. Decomposed on fusion with caustic alkalies and alkaline carbonates.

Obs.—Most common in argillaceous schist, or other schists imperfectly crystalline; also in gneiss, mica schist, and related rocks; rarely in connection with serpentine. Found in Spain, in Andalusia (first loc. discovered), and thence the name of the species; in the Tyrol, Lisens valley, in large cryst. with cyanite; in Saxony, at Bräunsdorf, Rohschütz, Munzig, Penig; in Moravia, at Goldenstein; Bavaria, at Lahmerwinkel, Rabenstein, Hogenau, Tillenburg, etc.; Austria, at Felling, near Krems, in serpentine; France, Dept. of Var, near Hyères; Barèges in the Pyrenees; Finland; Russia, at Schaitansk in the Ural; Makova, etc., in Nertschinsk. In Ireland at Killiney Bay, in mica schist; near Balahulish in Argyleshire· Cumberland, England. In Brazil, province of Minas Geraes, in fine crystals and as rolled pebbles.

In N. America, in *Maine* at Mt. Abraham, Bangor, Searsmont, Camden, S. Berwick. *N. Hamp.*, at White Mtn. Notch; Boar's Head, near Rye; at Charleston. *Vermont*, near Bellows Falls. *Mass.*, at Westford, abundant in cryst., sometimes rose-colored; Lancaster, both varieties; Sterling. chiastolite. *Conn.*, at Litchfield and Washington, good cryst. *Penn*, in Delaware Co., near Leiperville, large cryst.; at Marple, Upper Providence, and Springfield, good cryst.; one weighing $7\frac{1}{2}$ lbs, and a group of crystals, free from the gangue. of about 60 lbs. *Calif.*, along the Churchillas rivers, San Joaquin val., at crossing of road to Ft. Miller. In *Canada*, at L. St. Francis, in reddish trl. cryst., in mica schist, both var. In *N. Scotia*, at Cape Causeau

Alt.—Andalusite occurs altered to kaolin; sometimes to mica; also to cyanite (anal. 5, 7, 8); crystals being found consisting of cyanite, or mica, as a result of the alteration.

A partially altered andalusite from the Tutchaltui Mtn., Nertschinsk, afforded Jeremejef (l. c.) $\ddot{\mathrm{S}}\mathrm{i}$ 53·6, $\ddot{\bar{\mathrm{A}}}\mathrm{l}$ 43·1, $\bar{\mathrm{F}}\mathrm{e}$ 1·01, $\dot{\mathrm{M}}\mathrm{g}$ *tr.*, $\dot{\mathrm{C}}\mathrm{a}$ 0·93, $\dot{\mathrm{N}}\mathrm{a}$ *tr.*, $\dot{\mathrm{K}}$ 0·8, ign. 0·87=100·34; G.=2·944. The crystals were distinctly altered to a depth of 2 lines, and this part was B.B. fusible. $I \wedge I = 93\frac{1}{2}°$, the surfaces not smooth.

Artif.—Formed in crystals by the action of a current of gaseous fluorid of silicon on calcined alumina, the angle $I \wedge I$ of the crystal 91°, and composition $\ddot{\mathrm{S}}\mathrm{i}$ 29·5, $\ddot{\bar{\mathrm{A}}}\mathrm{l}$ 70·2=99·7=$\ddot{\bar{\mathrm{A}}}\mathrm{l}^4\ddot{\mathrm{S}}\mathrm{i}^3$; also by the action of fluorid of aluminum on silica (Deville & Caron).

MYELIN *Breith.*, Handb, ii. 358, 1841; Talksteinmark *Freiesleben*, Mag. Orykt. Sachs., v. 131, has, as Hausmann observes, the composition of cyanite or andalusite. It is soft, having a hardness of about 2, yellowish or reddish-white to whitish color. with colorless streak. G.=2·45–2·53; a somewhat greasy feel 1, Kersten (Schw. J., lxvi. 16); 2, Kussin (Ramm. Min. Ch., 581):

	$\ddot{\mathrm{S}}\mathrm{i}$	$\ddot{\bar{\mathrm{A}}}\mathrm{l}$	$\dot{\mathrm{M}}\mathrm{n}$	$\dot{\mathrm{M}}\mathrm{g}$
1.	37·62	60·50	0·63	0·82=99·57.
2.	36 01	63·72	——	——=99·73.

Breithaupt says that it contains 5 p. c. of water; but neither of the analyses made sustain this.

323. FIBROLITE. Faserkiesel (fr. Bohemia) *Lindacker*, Mayer's Samml. phys. Aufs., ii. 277, 1792, Bergm. J., ii. 65, 1792. Fibrolite (fr. the Carnatic) *Bournon*, Phil. Trans., 1802, 289, 335; =Bournonite *Lucas*, Tabl., ii. 216, 1813. Bucholzit (fr. Tyrol) *Brandes*, Schw. J., xxv. 125, 1819. Sillimanite (fr. Conn.) *Bowen*, Am. J. Sci., viii. 113, 1824. Wörthite *Hess*, Pogg., xxi. 73, 1830. Xenolit *Nordensk.*, Act. Soc. Sc. Fenn., i. 372, Pogg., lvi. 643, 1842. Bamlit *Erdmann*, Ak. H. Stockh., 1842, 19. Monrolite (fr. Monroe, N. Y.) *Silliman*, Am. J. Sci., II. viii. 335, 1849.

Monoclinic. $I \wedge I = 96°$ to 98° in the smoothest crystals; usually larger, the faces I striated, and passing into $i\text{-}2$. Cleavage: $i\text{-}\bar{i}$ very perfect, brilliant. Crystals commonly long and slender. Also fibrous or columnar massive, sometimes radiating.

H.=6–7. G.=3·2–3·3. Lustre vitreous, approaching subadamantine. Color hair-brown, grayish-brown, grayish-white, grayish-green, pale olive-green. Streak uncolored. Transparent to translucent. Double refraction very strong; optic-axial plane $i\text{-}\bar{i}$; angle about 44° for the red ray; bisectrix positive, normal to O; Descl.

Var.—1. *Sillimanite.* In long, slender crystals, passing into fibrous, with the fibres separable G.=3·238, fr. Norwich, Ct., Dana; 3·232, fr. id., Brush; 3·239, fr. Yorktown, Norton.

2. *Fibrolite.* Fibrous or fine columnar, firm and compact, sometimes radiated; grayish-white tc pale brown, and pale olive-green or greenish-gray. *Bucholzite* and *monrolite* are here included: the latter is radiated columnar, and of the greenish color mentioned. G.=3·24, fibrolite, Bournon; 3·19—3·21, id., Damour; 3·239, bucholzite, fr. Chester, Pa., Erdmann; 3·04—3·1, monrolite, B. Silliman; 3·075, id., Brush.

Bamlite, from Bamle, Norway, resembles the monrolite, being columnar subplumose, silky; G. =2·984, and color greenish-white or bluish-green. The analysis of Erdmann (see below) gave a large excess of silica; but L. Sæmann observes that there are minute prisms of quartz among the fibres of bamlite.

Xenolite also resembles fibrolite closely, excepting in the high specific gravity, 3·58, which suggests an identity rather with cyanite. But the prisms are stated to have the angle 91°, which is the angle of andalusite; and Descloizeaux says that it is optically like fibrolite, and not like cyanite. From Petershoff, Finland, and near St. Petersburg.

Wörthite is hydrous, and appears to be a somewhat altered form. H.=7·25; color white; translucent. Optically like the above. From near St. Petersburg.

Comp.—$\bar{\dddot{\text{Al}}}$ $\ddot{\text{Si}}$, as for andalusite=Silica 36·8, alumina 63·2=100, as in Damour's analysis of fibrolite, and Connell's, Staaf's, and Silliman's of sillimanite. Damour obtained in his analysis of sillimanite 39 p. c. of silica, and others still more, showing apparently that the mineral is not always pure.

Analyses of fibrolite, etc.: 1, Chenevix (J. d. Mines, xiv. 86); 2, B. Silliman, Jr. (Am. J. Sci., II. viii. 388); 3, 4, Damour (C. R., lxi. 319); 5, Brandes (J. de Pharm., xci. 237); 6, Thomson (Ann. Lyc. N. York, iii. and Min., i. 235); 7, A. Erdmann (Ak. H. Stockholm, 1842, 19); 8, 9, B. Silliman, Jr. (l. c.); 10, Bowen (Am. J. Sci., viii. 113); 11, Hayes (Alger's Min., 601); 12, Connell (Jameson's J., xxxi. 232); 13, Staaf (Jahresb., xxv. 348); 14, Silliman, Jr. (l. c.); 15, Damour (Ann. d. M., V. xvi. 219); 16, Norton (This Min., 2d ed., 378, 1844); 17, 18, Smith & Brush (Am. J. Sci., II. xvi. 49); 19, Komonen (l. c.); 20, Hess (Pogg., xxi. 73):

	$\ddot{\text{Si}}$	$\bar{\dddot{\text{Al}}}$	$\bar{\dddot{\text{Fe}}}$	$\dot{\text{Mg}}$	$\dot{\text{H}}$
1. Carnatic, *Fibrolite*	38·00	58·25	0·75	——	——=97·00 Chenevix.
2. " "	36·31	62·41	——	0·70	——=99·42 Silliman.*
3. Brioude, "	37·18	61·17	——	——	1·06=100·11 Damour.
4. Morbihan, "	37·10	61·03	0·71	——	1·20=100·04 Damour.
5. Tyrol, *Bucholzite*	46·00	50·00	2·50	——	——, $\dot{\text{K}}$ 1·5=100 Brandes.
6. Chester, Pa. "	46·40	52·92	*tr.*	——	——=99·32 Thomson.
7. " "	40·05	58·88	0·74	——	0·40=100·07 Erdmann=$\bar{\dddot{\text{Al}}}^{8}$ $\ddot{\text{Si}}^{9}$.
8. " "	35·96	64·43	——	0·52	——=100·91 Silliman.
9. Brandywine Sp., *fibrous*	36·16	63·52	——	——	——=99·68 Silliman.
10. Chester, Ct., *Sillimanite*	42·66	54·11	2·00	——	0·51=99·28 Bowen.
11. " "	42·60	54·90	1·10	0·40	——, $\dot{\text{Ca}}$ 0·31=99·31 Hayes.
12. " "	36·75	58·94	0·90	——	——=96·68 Connell.
13. " "	37·36	58·62	2·17	0·40	0·43=98·98 Staaf.
14. " "	37·65	62·41	——	——	——=100·06 Silliman.
15. " "	39·06	59·53	$\dot{\text{Fe}}$ 1·42	——	——, $\dot{\text{Mn}}$ 0·28=100·28 Damour.
16. Fairfield, N. Y. "	37·70	62·75	2·29	——	——=102·74 Norton.†
17. *Monrolite*	37·20	59·02	2·08	——	1·03=99·33 Smith & Brush.
18. "	37·03	61·90		——	0·85=99·78 Smith & Brush.
19. *Xenolite*	47·44	52·54	——	——	——=99·98 Komonen.
20. *Wörthite*	40·58	53·50	——	1·00	4·63=99·71 Hess.

An analysis of bamlite afforded Erdmann (l. c.) $\ddot{\text{Si}}$ 56·90, $\bar{\dddot{\text{Al}}}$ 40·78, $\bar{\dddot{\text{Fe}}}$ 1·04, $\dot{\text{Ca}}$ 1·04, F *tr.*= 99·71.

Pyr., etc.—Same as given under andalusite.

Obs.—Occurs in gneiss, mica schist, and related metamorphic rocks.

Observed near Moldau and Schuttenhöfen in Bohemia (*faserkiesel*); at Fassa in the Tyrol (*bucholzite*); in the Carnatic with corundum (*fibrolite*); at Bodenmais in Bavaria; near Eger in Bohemia; Marschendorf in Moravia; in France, in the vicinity of Issoire in boulders, and also in the canton of Paulhaguet, and in the vicinity of Chavagnac and Ourouze with cyanite and corundum, and between St. Eble and Crespignac.

---

* One of Bournon's own specimens, received by Col. Gibbs (from whom the original part of the Yale Cabinet was obtained) from Count Bournon himself.

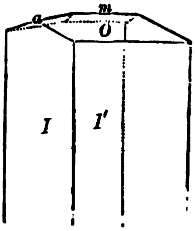
† Prof. Norton states that in his analysis the excess of alumina was probably owing to the presence of aluminate of potassa, which remained with the alumina after separating the oxyd of iron by caustic potassa; subtracting this excess, the analysis corresponds to those by Silliman.

In the United States, in *Massachusetts*, at Worcester. In *Connecticut*, at the falls of the Yantic, near Norwich, with zircon, monazite, and corundum; and at Chester, near Saybrook (*sillimanite*); at Humphreysville. In *N. York*, at Yorktown, Westchester Co., 10 m. N.E. of Sing Sing; near the road leading from Pine's Bridge to Yorktown P. Office, in distinct crystals, with monazite, tremolite, and magnetite, the crystals often running through the magnetite; in Monroe, Orange Co. (*monrolite*), with mica, garnet, magnetite, etc. In *Penn.*, at Chester on the Delaware, near Queensbury forge; in Delaware Co., in Birmingham, Middletown, Concord, Aston, Darby. In *Delaware*, at Brandywine Springs

Fibrolite was much used for stone implements in western Europe in the "Stone age." (Anal. 3, 4.)

The crystallization of sillimanite, fibrolite, bucholzite, and also of bamlite and xenolite, was first shown to be orthorhombic by Descloizeaux, on optical grounds. The terminal planes in the crystal figured by the writer (annexed figure) were rough, and, as stated in the last edition, of too doubtful import to be relied on for their angles or their indications as to the symmetry of the crystals. Afforded *O*∧*I'*=105°; *O*∧*m*=133° 30', *m*∧*I'*, back,=120° 30'.

346



The species approximates closely to andalusite, but appears to differ in its cleavage, that parallel to *i-ī* being very perfect, with none parallel to *I*; and in its *positive* bisectrix and much smaller optic-axial angle.

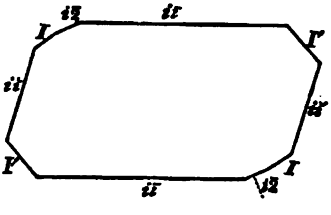
Named *fibrolite* from the fibrous massive variety; *bucholzite*, after the chemist Bucholz; *sillimanite*, after Prof. Silliman.

324. CYANITE. Talc bleu *Sage*, Descr. Cab. de l'Ecole des Mines, 154, 1784. Sappare *Saussure fils*, J. de Phys., xxxiv. 213, 1789. Beril feuilleté *Sage*, J. de Phys., xxxi. 39, 1789. Cyanit (fr. Greiner) *Wern.*, Hoffm., Bergm. J., 377, 393, 1789; *Wern.*, ib., 164, 1790; Kyanite. Disthene *H.*, Tr., iii. 101. Rhætizit (fr. Pfitschthal, or ancient Rhætia) *Wern.*, Hoffm. Min., ii. b, 318, 1815, iv. b, 128, 1817.

Triclinic. In flattened prisms, having the planes *i-ī*, *i-ĭ*, *I*, *I'*, *i-2*, as in the annexed transverse section (fig. 347); *O* rarely observed. Crystals oblong, usually very long and blade-like.

O ∧ *i-ĭ*=93° 15'	*I* ∧ *I'*=97° 4'
O ∧ *i-ī*=100 50	*i-ĭ* ∧ *I*=140 35
O ∧ *I'*=96 42	*i-ī* ∧ *I*=145 41
O ∧ *I*=98 58	*i-ī* ∧ *I'*=131 23
I ∧ *i-ĭ*=122 21	*i-ī* ∧ *i-2*=159 15
i-ī ∧ *i-ĭ*=106 16	*I* ∧ *i-2*=166 26

347



Cleavage: *i-ī* perfect; *i-ĭ* less so; *O* imperfect. Twins: composition-face *i-ī*, the two planes *O* and *i-ĭ* making angles with one another; either *right*-handed or *left*-handed, analogous to right- and left-handed twins of orthoclase (f. 314, 315, p. 353); also a kind having the two crystals crossing at 60°. Also coarsely bladed columnar to subfibrous.

H.=5—7·25, the least on the lateral planes. G.=3·45—3·7; 3·559, white cyanite; 3·675, blue transparent; 3·661, Tyrol, Erdmann. Lustre vitreous—pearly. Color blue, white, blue along the centre of the blades or crystals with white margins: also gray, green, black. Streak uncolored. Translucent—transparent. Optic-axial plane inclined about 30° to edge *i-ī*/*i-ĭ*, and 60° 15' to edge *i-ī*/*O*; bisectrix negative, very nearly normal to *i-ī*.

Var.—The white cyanite is sometimes called *Rhætizite*.

Comp.—Äl S̈i=Silica 36·8, alumina 63·2=100.

Analyses: 1–3, Arfvedson (Ak. H. Stockholm, 1821, i. 148, and Schw. J., xxxiv. 203); 4, Rosales (Pogg., lviii. 160); 5, Marignac (Ann. Ch. Phys., xiv. 49); 6, 7, A. Erdmann (Jahresb., xxiv. 311);

8, Jacobson (Pogg., lxviii. 416); 9, Köhler (Ramm. Min. Ch., 557); 10, Modeen (Arppe Undersökn. 141); 11, Igelström (J. pr. Ch., lxiv. 61); 12, Smith & Brush (Am. J. Sci., II. xvi. 371):

		$\ddot{\mathrm{Si}}$	$\ddot{\bar{\mathrm{Al}}}$	$\bar{\mathrm{Fe}}$
1.	Röraas, Norway	36·4	68·8	——=100·2 Arfvedson.
2.	St. Gothard	34·38	64·89	——=99·22 "
3.	" *later an.*	36·9	64·7	——=101·6 "
4.	"	36·67	63·11	1·19=100·97 Rosales.
5.	"	36·60	62·66	0·84=100·60 Marignac. G.=3·6.
6.	Röraas	37·40	61·86	0·52, $\dot{\mathrm{Cu}}$ 0·19, $\dot{\mathrm{H}}$ 0·61=100·58 Erdmann. G.=3·6237.
7.	Tyrol	37·36	62·09	0·71=100·16 Erdmann. G.=3·661.
8.	Greiner, Tyrol	37·30	62·60	1·08=100·98 Jacobson. G.=3·678.
9.	Saualpe, Car.	37·92	61·60	1·04, $\dot{\mathrm{Ca}}$ 0·42=100·98 Köhler.
10.	Heräjoki Finl.	42·12	55·33	0·46, $\dot{\mathrm{Ca}}$ 2·21, $\dot{\mathrm{H}}$ 2·66=102·78 Mod. Mixed with quartz.
11.	Wermland	40·02	58·46	2·04=100·52 Igelström. G.=3·48.
12.	Lincoln Co., N. C.	37·60	60·40	1·60=99·60 Smith & Brush.

Pyr., etc.—Same as for andalusite.

Obs.—Occurs principally in gneiss and mica slate. Found in transparent crystals at St. Gothard in Switzerland; at Greiner and Pfitsch (*rhætizite*, or white variety) in the Tyrol; also in Styria; Carinthia; Bohemia; Norway; Finland; at Pontivy, France; Villa Rica, South America; in Scotland, at Botriphinie in Banffshire, at Banchory in Aberdeenshire, and near Glen Tilt; in the Shetlands at Hilswickness Point; in Ireland, at Donegal and Mayo.

In *N. Hamp.*, at Jaffrey, on the Monadnock Mtn. In *Mass.*, at Chesterfield, with garnet in mica schist; at Worthington and Blanford in good specimens; at Westfield and Lancaster. In *Conn.*, at Litchfield and Washington in large rolled masses, with corundum and massive apatite; at Oxford, near Humphreysville, in mica schist. In *Vermont*, at Thetford and Salisbury; at Bellows Falls in short disseminated crystals. In *Penn.*, in fine specimens near Philadelphia, on the Schuylkill road near the Darby bridge; near the Schuylkill. on the Ridge road, back of Robin Hood tavern; at East and West Branford, Chester Co.; at Darby and Haverford, Delaware Co. In *Maryland*, eighteen miles north of Baltimore, at Scott's mill; in Delaware near Wilmington. In *Virginia* at Willis's Mt., Buckingham Co, and two miles north of Chancellorville, Spotsylvania Co. In *N. Carolina*, on the road to Cooper's gap in Lincoln Co., near Crowder's Mtn., with lazulite. A black variety, associated with rutile, occurs in North Carolina.

Cyanite, when blue and transparent, and in sufficiently large pieces, is employed as a gem, and somewhat resembles sapphire.

Named from κυανός, *blue*. The name *sappare* arose from a mistake by Saussure, Jr., in reading a label of this mineral on which it was called sapphire; a copy of this label is given in J. de Phys., xxxiv. 213; the specimen thus labelled was from Botriphinie in Scotland, and was sent by the Duke of Gordon to Saussure the father. *Disthene* is from δίς, *twice*, or of two kinds, and σθένος, *strong*, alluding to the unequal hardness and electric properties in two different directions.

Von Kobell has shown (Ber. Ak. München, 1867) that the right and left-handed twins may be easily distinguished by means of polarized light; they give, with the stauroscope, a cross somewhat oblique in position; but the principal optical section does not revolve with the revolution of the crystal; while the colors change in different order with the revolution, according as the twin is right-handed or left-handed.

Alt.—Cyanite occurs altered to talc and steatite.

325. TOPAZ. Not Τοπάζιος, Topazius, *Gr.*, *Plin.*, or *Agric.* [=Chrysolite pt.]. Chrysolithos pt. *Plin.*, xxxvii. 42. Topasius vulgaris=Chrysolithus veterum *de Boot*, Gemm., 1636. Chrysolithus *de Laet*, De Gemm. et Lap., 1647. Topazius vera Saxonia (fr. Schneckenstein) *Henckel*, Act. Ac. N. Cur., iv. 316. Topas *Wall.*, 117, 1747. Topas pt. [rest Beryl, etc.] *Cronst.*, 43, 1758. Chrysolithus (fr. Saxony) *Linn.*, Syst., 1768. Topaze du Bresil, T. de Saxe, *de Lisle*, Crist., 1772, 1783, with figs. $\ddot{\mathrm{Si}}$, $\ddot{\bar{\mathrm{Al}}}$, $\dot{\mathrm{Ca}}$, $\dot{\mathrm{Fe}}$, *Bergm.*, Opusc., 1780. $\ddot{\mathrm{Si}}$, $\ddot{\bar{\mathrm{Al}}}$, and Fluorine *Klapr.*, Mem. read before Ac. Wiss. Berlin, 1804, Beitr., iv. 160, 1807; *Vauq.*, J. d. M., xvi. 469, 1804 (with ref. to anal. by Klapr.). Pyrophysalite (fr. Finbo) *His. & Berz.*, Afh., i. 111, 1806, Gehl. J., iii. 124, 1807=Physalith *Wern.*, Hoffm. Min., iv. b, 114, 1817.

PYCNITE. Weisser Stangenschörl *Germ.*; *Wern.*, Ueb. Cronst., 169, 1780. Schorl blanc en prismes striées (fr. Altenberg) *Sage*, Min., i. 204, 1777; *de Lisle*, Crist., ii. 420. 1783. Schörlartiger Beril [var. of Beryl] *Wern.*, Bergm. J., i. 374, 388, 1789. Stangenstein [species] *Karst.*, Mus Lesk., 1789; Tab., 10, 69, 1800. Schorl blanchâtre *Delameth.*, Sciagr., i. 289; Leucolite pt. *id.*

T. T., ii. 275, 1797. Schorlite *Klapr.*, Crell's Ann., i. 395, 1788. Shorlite *Kirwan*, Min., i. 286, 1794. Pycnite *H.*, Tr., iii. 1801. $\ddot{\text{Si}}+\dddot{\text{Al}}+\text{F}$ *Bucholz*, Schw. J., i. 385, 1803. Pycnite=Topaze =Silice fluatée alumineuse *H.*, Tabl., 1809.

Orthorhombic. $I \wedge I=124°\ 17'$, $O \wedge 1\text{-}\bar{i}=138°\ 3'$; $a:b:c=0{\cdot}90243:1:1{\cdot}8920$. Observed planes: O; vertical, I, $i\text{-}\breve{i}$, $i\text{-}\breve{\tfrac{4}{3}}$, $i\text{-}\breve{2}$, $i\text{-}\breve{\tfrac{5}{2}}$, $i\text{-}\breve{3}$, $i\text{-}\breve{4}$, $i\text{-}\breve{5}$; domes, $\tfrac{2}{3}\text{-}\bar{i}$, $1\text{-}\bar{i}$, $\tfrac{3}{2}\text{-}\bar{i}$, $2\text{-}\bar{i}$; $1\text{-}\breve{i}$, $\tfrac{4}{3}\text{-}\breve{i}$, $2\text{-}\breve{i}$, $\tfrac{16}{7}\text{-}\breve{i}$, $3\text{-}\breve{i}$, $4\text{-}\breve{i}$, $8\text{-}\breve{i}$; octahedral, $\tfrac{1}{2}$, $\tfrac{2}{3}$, 1, $\tfrac{3}{2}$, 2; $1\text{-}\breve{2}$, $\tfrac{4}{3}\text{-}\breve{2}$ · $\tfrac{10}{7}\text{-}\tfrac{5}{4}$; $\tfrac{14}{15}\text{-}\tfrac{7}{4}$; $2\text{-}\tfrac{3}{2}$; $1\text{-}\breve{2}$, $\tfrac{4}{3}\text{-}\breve{2}$, $\tfrac{3}{2}\text{-}\breve{2}$, $2\text{-}\breve{2}$, $\tfrac{7}{2}\text{-}\breve{2}$, $4\text{-}\breve{2}$; $1\text{-}\breve{3}$, $\tfrac{6}{5}\text{-}\breve{3}$; $\tfrac{8}{3}\text{-}\breve{4}$.

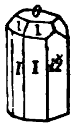
$O \wedge \tfrac{2}{3}\text{-}\bar{i}=148°\ 58'$
$O \wedge 2\text{-}\bar{i}=118\ \ 59$
$O \wedge \tfrac{1}{2}=152\ \ 56$
$O \wedge \tfrac{2}{3}=145\ \ 47$
$O \wedge 1=134\ \ 25$
$O \wedge 2=116\ \ 6$
$O \wedge \tfrac{4}{3}\text{-}\breve{2}=138\ \ 48$
$O \wedge \tfrac{6}{5}\text{-}\breve{3}=145\ \ 55$
$O \wedge 1\text{-}\breve{3}=150\ \ 35$

$O \wedge \tfrac{4}{3}\text{-}\breve{i}=147°\ 33'$
$O \wedge 2\text{-}\breve{i}=136\ \ 21$
$O \wedge 4\text{-}\breve{i}=117\ \ 40$
$I \wedge i\text{-}\breve{\tfrac{4}{3}}=169\ \ 27$
$I \wedge i\text{-}\breve{2}=161\ \ 16$
$I \wedge i\text{-}\breve{3}=150\ \ 6$
$i\text{-}\breve{2} \wedge i\text{-}\breve{2}$, ov. $i\text{-}\breve{i}$,$=93\ 11$
$i\text{-}\breve{i} \wedge i\text{-}\breve{2}=136\ \ 35\tfrac{1}{2}$
$i\text{-}\breve{i} \wedge i\text{-}\breve{3}=141\ \ 46$

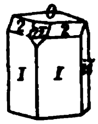
$\tfrac{2}{3} \wedge \tfrac{2}{3}$, mac.,$=149°\ 31'$
$1 \wedge 1$, " $=141\ 0$
$1 \wedge 1$, ov. O,$=88\ \ 49\tfrac{1}{2}$
$2 \wedge 2\text{-}\breve{i}=127\ \ 26\tfrac{1}{2}$
$2\text{-}\breve{i} \wedge 2\text{-}\breve{i}$, ov. O,$=92\ \ 42$
$2 \wedge 2$, mac.,$=130\ \ 22\tfrac{1}{2}$
$i\text{-}\breve{3} \wedge i\text{-}\breve{3}$, ov. $i\text{-}\breve{i}$,$=115\ \ 31\tfrac{1}{2}$
$i\text{-}\breve{4} \wedge i\text{-}\breve{4}$, ov. $i\text{-}\breve{i}$,$=129\ \ 22$

Crystals usually hemihedral, the extremities being unlike. Cleavage: basal, highly perfect. Also firm columnar; also granular, coarse or fine.

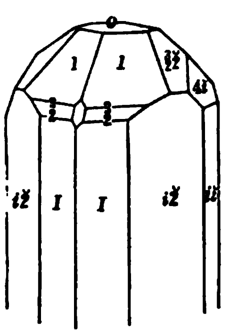
348



349

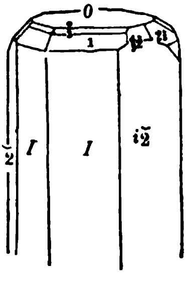


352



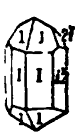
Trumbull, Ct.

353

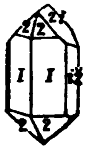


Schneckenstein.

350



351



H.=8. G.=3·4—3·65. Lustre vitreous. Color straw-yellow, wine-yellow, white, grayish, greenish, bluish, reddish; pale. Streak uncolored. Transparent—subtranslucent. Fracture subconchoidal, uneven. Pyroelectric. Optic-axial plane $i\text{-}\breve{i}$; divergence very variable, sometimes differing much in different parts of the same crystal; bisectrix positive, normal to O.

Var.—1. ***Ordinary.*** Usually in crystals; common form prismatic. The basal cleavage is an easily observed character. Crystals from La Paz, Mexico, gave Hessenberg $I \wedge I=124°\ 26'$.

Physalite, or ***pyrophysalite***, is a coarse nearly opaque variety, in yellowish-white large crystals from Finbo; it intumesces when heated, and hence its name from φυσάω, *to blow*, and πυρ, *fire*.

2. ***Pycnite.*** Structure columnar, but very compact. Has been considered a distinct species on the ground of composition (see anal.) and crystallization (made monoclinic by Forchhammer). But Rose has made out that the cleavage is the same, and the form probably the same; and Descloizeaux has shown that the optical characters are those of topaz. Finally, Rammelsberg's recent analysis gives the same composition. Named from πυκνός, *thick*.

Comp.—$\dddot{\text{Al}}\,\ddot{\text{Si}}$, with one-half of the oxygen of the silica replaced by fluorine; or, specially, $\dddot{\text{Al}}$ ($\tfrac{5}{6}$ Si O^2+$\tfrac{1}{6}$ Si F^2)=Silicon 15·17, aluminum 29·58, oxygen 34·67, fluorine 20·58=100; or, Silica

16·2, silicic fluorid 28·1, alumina 55·7=100. The formula agrees with Städeler's results, whc shows (J. pr. Ch., xcix. 65) that the fluorine present amounts to about 20·68 p. c. (see below).

Analyses: 1–3, Berzelius (Schweig J., xvi. 423, Afhandl., iv. 236); 4, 5, Forchhammer (J. pr. Ch., xxix. 195, xxx. 400); 6–10, Rammelsberg (J. pr. Ch., xcvi. 7); 11, Bucholz (Schw. J., i. 385); 12, Berzelius (l. c.); 13, Forchhammer (l. c.); 14, Rammelsberg (l. c.):

	$\ddot{\mathrm{Si}}$	$\ddot{\overline{\mathrm{Al}}}$	F		
1. Auerbach, Saxony	34 24	57·45	14·99	Berzelius.	
2. Brazil, *yellow*	34·01	58·38	15·06	Berzelius.	
3. Finbo, *pyrophysalite*	34·36	57·74	15·02	Berzelius.	
4. Finbo, "	35·66	55·16	17·79	Forchhammer.	
5. Trumbull, Ct.	35·39	55·96	17·85	Forchhammer.	
6. Schneckenstein	$(\frac{3}{2})$ 33·53	56·54	18·62	Ramm.	
7. Schlackenwald	$(\frac{3}{2})$ 33·37	56·76	18·54	Ramm.	G.=3·520.
8. Adun-Tschilon	33·56	56·28	18·30	Ramm.	G.=3·563.
9. Brazil	$(\frac{3}{2})$ 33·73	57·39	16·12	Ramm.	G.=3·561.
10. Trumbull	32·38	55 32	16·12	Ramm.	G.=3·514.
11. Altenberg, *Pycnite*	35·0	48·0	16·5	Bucholz.	
12. " "	38·43	51 00	17·09	Berzelius.	
13. " "	39 04	51·25	18·48	Forchhammer.	
14. " "	33·28	55·32	16·12	Ramm.	G.=3·514.

No. 10 gave 0·66 ign. Deville (C. R., lii. 782) obtained for topaz:

	$\ddot{\mathrm{Si}}$	$\ddot{\overline{\mathrm{Al}}}$	Si	F
1. Saxony	22·3	54·3	6 5	17·3=100·4.
2. Brazil	25·1	53·8	5·8	15·7=100·4.

Klaproth, in 1795 (Beitr., i. 10), found that pycnite lost 25 p. c. in a porcelain oven; and Forchhammer (J. pr. Ch., xxix. 194, xxx. 400) obtained for the loss, at the fusing-point of iron, of the topaz of Trumbull, Ct., 23·535 p. c.; of Brazil, 23·03; of Finbo, 24·80. H. St. Claire Deville states (C. R., xxxviii. 317) that topaz loses its fluorine as fluorid of silicon; 23 p. c. of this fluorid, in his trials, passed off. In recent experiments made under Rammelsberg's direction, the Finbo mineral lost in a porcelain oven 22·98 p. c.; Schneckenstein 20·73; Schlackenwald 17·73—16·23; Trumbull 16·27—19·55; Brazil 15·40—14·29; Altenberg pycnite 19 98. The topaz was not fused in the heating, yet somewhat blistered at surface. The Brazil topaz afforded Rammelsberg after the heating in which 15·4 p. c. were lost, $\ddot{\mathrm{Si}}$ 30·22, $\ddot{\overline{\mathrm{Al}}}$ 71·34, F 1·56=103·12; and after that in which the loss was 14·9 p. c., $\ddot{\mathrm{Si}}$ 30·10, $\ddot{\overline{\mathrm{Al}}}$ 70·38, F 2 47=102·95, showing that the part lost was not strictly fluorid of silicon, but may have included some fluorid of aluminum. G. Städeler (l. c.) has shown that part of the fluorine escapes as fluohydric acid, and makes 89·9 p. c. of the loss to be fluorine. This gives for the Trumbull topaz (anal. 5), 21·16 F; the Brazil, 20·71 F; the Finbo, 22·29, from Forchhammer's results, and 20 66 from Rammelsberg's; for the Saxon, 18·64 from Rammelsberg's trials, and 20·68 from Deville's; the mean of the whole 20·68.

Pyr., etc.—B.B. infusible. Some varieties take a wine-yellow or pink tinge when heated. Fused in the open tube with salt of phosphorus gives the reaction for fluorine. With cobalt solution the pulverized mineral gives a fine blue on heating. Only partially attacked by sulphuric acid. G. before ignition 3·539, after, 3·533, Church.

Obs.—Topaz occurs in gneiss or granite, with tourmaline, mica, and beryl, occasionally with apatite, fluor spar, and tin ore; also in talcose rock, as in Brazil, with euclase, etc., or in mica slate. With quartz, tourmaline, and lithomarge, it forms the topaz rock of Werner (*topazosème* of Haüy). Specimens of quartz crystal from Brazil, penetrated by topaz, are not uncommon.

Minute crystals of three or four different kinds, and two or three kinds of liquids, have been detected by Sir David Brewster in crystals of topaz. (Edinb. Trans., x., and Am. J. Sci., xii. 214; and later, Edinb. new Phil. J., II. xvi. 130, Proc. R. Soc. Edinb., iv. 548, v. 95.) See under ORGANIC COMPOUNDS.

Fine topazes come from the Urals, near Katharinenburg, and Miask; in Nertschinsk, beyond L. Baikal, in the Adun-Tschilon Mts., etc., one crystal from near the river Urulga, now in the imperial cabinet at St. Petersburg, being $11\frac{3}{8}$ in. long, $6\frac{1}{2}$ in. broad, weighing $22\frac{1}{2}$ lbs. av., and magnificent also in its perfect transparency and wine-yellow color. Found also in Kamschatka, of yellow, green, and blue colors; Villa Rica in Brazil, of deep yellow color, either in veins or nests in lithomarge, or in loose crystals or pebbles; sky-blue crystals in Cairngorm, Aberdeenshire; Jameson mentions one which weighed 19 oz.; at the tin mines of Schlackenwald, Zinnwald, and Ehrenfriedersdorf, and smaller crystals at Schneckenstein and Altenberg; the Mourne mountains, small limpid crystals with beryl, albite, and mica, in drusy cavities in granite. Physalite occurs ir crystals of great size, at Fossum, Norway; Finbo, Sweden, in a granite quarry, and at Broddbo in a boulder; one crystal from this last locality, at Stockholm, weighed eighty pounds.

Topaz occurs also in the Mercado Mtn., in Durango, Mexico, along with tin ore and magnetite; at La Paz, province of Guanaxuato. *Pycnite* is from the tin mine of Altenberg in Saxony; also those of Schlackenwald, Zinnwald in Bohemia, and Kongsberg in Norway.

In the United States, in *Conn.*, at Trumbull, with fluor and diaspore; at Middletown rare; at Willimantic, with columbite. In *N. Car.*, at Crowder's Mountain. In *Utah*, near 39° 40′ N. and 113½° W., W. of S. of Salt Lake, in Thomas's Mts., on Capt. Simson's return trail. At Trumbull the crystals are abundant, but are seldom transparent, except those of small size; these are usually white, or with a tinge of green or yellow. The large coarse crystals are sometimes six or seven inches in diameter.

A variety of topaz from Brazil, when heated, assumes a pink or red hue, resembling the Balas ruby. The finest crystals are brought from Minas Novas in Brazil. From their peculiar limpidity, topaz pebbles are sometimes denominated *gouttes d'eau.* The coarse varieties of topaz may be employed as a substitute for emery.

On the cryst. of topaz, see Kokscharof, Min. Russl., ii. 198, 344, iii. 195, 378; Hessenberg, Min Not., No. vii. 38.

The name topaz is from τοπάζιος, an island in the Red Sea, as stated by Pliny. But the topaz of Pliny was not the true topaz, as it "yielded to the file." Topas was included by Pliny and earlier writers, as well as by many later, under the name *chrysolite.*

Alt.—Topaz is found altered both to steatite, and kaolin or lithomarge.

326. EUCLASE. *Haüy; Delameth.*, J. de Phys., xli. 155, 1792 (without credit to Haüy); T. T., ii. 254, 1797 (with credit to Haüy); *Haüy*, J. d. Mines, v. 258, 1799, Tr., ii. 1801. Euklas *Germ.*

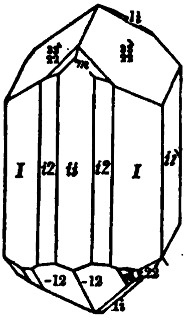
Monoclinic. $C=79°\ 44'=O \wedge$ *i-i*, $I \wedge I=115°\ 0'$, $O \wedge$ 1-ì$=146°\ 45'$; $a:b:c=1{\cdot}02943:1:1{\cdot}5446=1:0{\cdot}97135:1{\cdot}50043$. Observed planes: vertical, *I* (*s*), *i-i* (*a*), *i-ì* (*b*), *i*-2 (*I*), *i*-$\frac{10}{9}$ (α), *i*-$\frac{4}{3}$ (β), *i*-$\frac{3}{2}$ (*l*), *i*-$\frac{12}{7}$ (γ), *i*-$\frac{12}{5}$ (*h*), *i*-3 (δ), *i*-8 (ε), *i*-18, *i*-32; *i*-$\grave{\frac{3}{2}}$; clinodomes, $\frac{1}{2}$-ì (*n*), 1-ì (*o*), $\frac{3}{2}$-ì (*q*), 2-ì, 3-ì; hemidomes, $\frac{1}{4}$-*i*, $\frac{1}{3}$-*i*, 1-*i*; hemioctahedral, 1, −1 (*u*); 1-2 (*d*), −1-2 (*r*), $\frac{1}{2}$-2 (*a*); 2-$\frac{4}{3}$ (*e*), $\frac{15}{9}$-$\frac{10}{7}$ (*m*), 6-$\grave{\frac{6}{5}}$ (*y*, 6-$\grave{\frac{36}{29}}$?); −1-3 (*v*); $\frac{3}{2}$-$\grave{\frac{3}{2}}$ (*f*); 1-$\grave{2}$ (*b*), −2-$\grave{2}$ (*i*); $\frac{5}{4}$-$\grave{\frac{5}{2}}$ (*c*); $\frac{13}{8}$-$\grave{\frac{13}{4}}$ (*k*); $\frac{7}{5}$-$\grave{\frac{7}{2}}$ (*p*), $\frac{7}{6}$-$\grave{\frac{7}{2}}$ (*w*); 2-$\grave{4}$ (*x*).

i-ì ∧ *I*=122° 30′
i-ì ∧ *i*-2=107 40
i-ì ∧ *i-i*=90
i-ì ∧ $\frac{3}{2}$-$\grave{\frac{3}{2}}$=127 5
i-ì ∧ −2-$\grave{2}$=130 17
i-ì ∧ −1=112 50
i-ì ∧ −1-2=101 53
i-ì ∧ 1-ì=123 15½
i-ì ∧ 1-2=104 5
$\frac{3}{2}$-$\grave{\frac{3}{2}}$ ∧ $\frac{3}{2}$-$\grave{\frac{3}{2}}$=105 49½
−1-2 ∧ −1-2=156 14
1-2 ∧ 1-2=151 43
−1 ∧ −1, front,=134 20
2-$\frac{4}{3}$ ∧ 2-$\frac{4}{3}$=130 16
$\frac{15}{9}$-$\frac{10}{7}$ (*m*) ∧ $\frac{15}{9}$-$\frac{10}{7}$=123 22

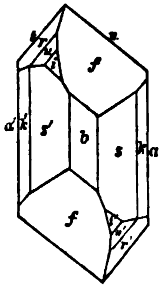
1-ì ∧ 1-ì, top,=113° 29′
$\frac{1}{2}$-ì ∧ $\frac{1}{2}$-ì, top,=143 42

O ∧ $\frac{1}{2}$-ì=161° 51′

354



354A



Cleavage: *i-ì* very perfect and brilliant; *O*, *i-i* much less distinct. Found only in crystals.

H.=7·5. G.=3·098, Haid.; 3·097, blue, from Brazil, Descl.; 3·096–

3·103, fr. Urals, Koksch. Lustre vitreous, somewhat pearly on the cleavage face. Colorless, pale mountain-green, passing into blue and white. Streak uncolored. Transparent; occasionally subtransparent. Fracture conchoidal. Very brittle. Double refraction strong; optic-axial plane *i*-ì; bisectrix acute, positive.

Comp.—O. ratio for $\dot{\mathrm{B}}\mathrm{e}$, $\ddot{\bar{\mathrm{A}}}\mathrm{l}$, $\ddot{\mathrm{S}}\mathrm{i}$, $\dot{\mathrm{H}}=2:3:4:1$, from Damour's analysis, who first found water to be a constituent; whence $(\frac{1}{6}\dot{\mathrm{H}}^3+\frac{2}{6}\dot{\mathrm{B}}\mathrm{e}^3+\frac{3}{6}\ddot{\bar{\mathrm{A}}}\mathrm{l})\ddot{\mathrm{S}}\mathrm{i}$ = Silica 41·1, alumina 35·3, glucina 17·4, water 6·2=100. Fluorine replaces a little of the oxygen. Analyses: 1, Berzelius (Schw. J., xxvii. 73); 2, Mallet (Phil. Mag., IV. v. 127); 3, Damour (C. R., xl. 942):

	$\ddot{\mathrm{S}}\mathrm{i}$	$\ddot{\bar{\mathrm{A}}}\mathrm{l}$	$\ddot{\bar{\mathrm{F}}}\mathrm{e}$	$\dot{\mathrm{F}}\mathrm{e}$	$\dot{\mathrm{B}}\mathrm{e}$	$\dot{\mathrm{C}}\mathrm{a}$	$\ddot{\mathrm{S}}\mathrm{n}$	$\dot{\mathrm{H}}$	F	
1.	43·22	30·56	2·22	—	21·78	—	0·70	—	—	=98·48 Berzelius.
2.	44·18	31·87	1·31	—	21·43	—	0·35	—	—	=99·14 Mallett.
3. (¼)	41·63	34·07	—	1·03	16·97	0·14	0·34	6·04	0·38	=100·60 Damour

Pyr., etc.—In the closed tube, when strongly ignited, B.B. gives off water (Damour). B.B. in the forceps cracks and whitens, throws out points, and fuses at 5·5 to a white enamel. Becomes electric by friction, and, when once excited, retains this property for several hours. Not acted on by acids.

Obs.—Occurs in Brazil, in the mining district of Villa Rica, with topaz in chloritic schist; in the auriferous sands of the Orenburg district, southern Ural, near the river Sanarka, with topaz, corundum, cyanite, etc. One Ural crystal measures 3 in. by ½ in.

The crystallization of this species is elaborately detailed by Schabus in the Transactions of the Royal Academy of Vienna, vol. vi., and by Kokscharof in Pogg., ciii. 348, and his Russian Mineralogy.

Euclase receives a high polish, but is useless as an ornamental stone on account of its brittleness.

Named by Haüy from εὖ, *easily*, and κλάω, *to break*. Haüy states that his name, Euclase, was published by Daubenton in an early issue of his Tableau meth. de Minéraux; but the particular edition of the Tableau (of which several were issued) the author has not been able to learn. Delametherie, after publishing, in 1792, the name and description, without crediting either to Haüy, in his *Théorie de la Terre*, in 1797, gives Haüy full credit.

First brought to Europe from S. America by Dombey, in 1785.

327. DATOLITE. Datolith (fr. Arendal) *Esmark* (undescr.); *Karsten & Klapr.*, Gehlen's J., vi. 1806, Klapr. Beitr., iv. 354, 1807; *Karst.*, Tab., 52, 1808. Datholit *Wern.*, 1808. Datholite *Brongn.*, Min., ii. 397, 1807. Chaux boratée siliceuse *H.*, Tabl., 17, 1809. Esmarkit *Hausm.*, Handb., 862, 1813. Datolite *Aikin*, Min., 1815; Jameson, ii. 257, 1816. Borate of lime; Borosilicate of lime. Humboldtite *Levy*, Ann. Phil., II. v. 130, 1823.

Botriolit *Hausm.*, v. Moll's Efem., iv. 393, 1808. Botryolith *Karst.*, Tab., 52, 1808. Chaux boratée siliceuse var. concretionnée-mammelonnée *H.*, Tabl., 17, 145, 1809. Faser-datolith *Leonh.*, Handb., 590, 1821. Botryolite.

Monoclinic. *C*=89° 54′=*O* (below) ∧ *i-i*, *I* ∧ *I*=115° 3′, *O* ∧ 1-ì=162° 27′; *a* : *b* : *c*=0·49695 : 1 : 1·5712. Observed planes: *O* (*a*); vertical, *I* (*d*), *i-i* (*c*), *i*-ì (*b*, rare), *i*-2̀ (*o*), *i*-$\grave{\frac{3}{2}}$ (*r*); clinodomes, 1-ì (*σ*), $\frac{4}{3}$-ì (*t*), 2-ì (*y*), 4-ì (*m*); hemidomes, 2-*i* (*γ*), –1-*i* (*u*), –$\frac{4}{3}$-*i* (*v*), –2-*i* (*x*), –3-*i* (*f*), –4-*i* (*ψ*), –6-*i* (*s*), –8-*i* (*ψ*); hemipyramids, $\frac{4}{5}$ (*k*), 1 (*l*), $\frac{4}{3}$ (*l* of Schröder), 2 (*e*), 4 (*ε*), –4 (*n*), –8 (*δ* of S..); –3-3, –6-3 (*ρ*); –4-2 (*θ*); –5-$\frac{5}{3}$ (*χ*); –3-$\frac{3}{2}$ (*w*); 12-$\grave{\frac{3}{2}}$ (*p*); 2-2̀ (*h*), –4-2̀ (*z*), –$\frac{8}{3}$-2̀ (*i*), 8-2̀ (*g*).

O ∧ –2-*i*=135° 13′	*O* ∧ $\frac{4}{5}$=154° 52′	*O* ∧ 6-3=108° 13′
O ∧ –1-*i*=153 35	*O* ∧ $\frac{4}{3}$=141 49	*O* ∧ 4-2̀=121 58
O ∧ –6-*i*=108 37	*O* ∧ 2=130 23	*O* ∧ 8-2̀=107 20
O ∧ 1=149 33	*O* ∧ –4=113 4	*O* ∧ *I*=90 5

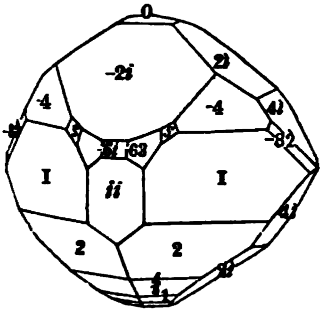
O ∧ *i*-2̀=90° 4′
O ∧ 2-ì=147 41
O ∧ 4-ì=128 19
I ∧ 2=139 32
I ∧ -4=157 1
i-*i* ∧ 1=111

i-*i* ∧ *I*=147° 32′
i-*i* ∧ *i*-2̀=128 9
i-*i* ∧ 2-ì=90 5
i-*i* ∧ 4-ì=90 4
I ∧ *I*, front,=115 3
2-ì ∧ 2-ì, ov. *O*,=115 21

i-2̀ ∧ *i*-2̀, ov. *i*-*i*,=76° 18′
4-ì ∧ 4-ì, ov. *O*,=76 38
2 ∧ 2, adj.,=131 38
-2-*i* ∧ -4=145 34
-2-*i* ∧ *i*-*i*=134 53
$\frac{4}{3}$ ∧ $\frac{4}{3}$, adj.,=141 14

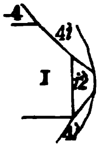
Cleavage: *O* distinct. Also botryoidal and globular, having a columnar structure; also divergent and radiating; also massive, granular to compact.

355



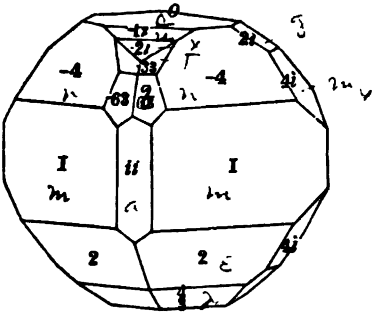
Roaring Brook.

356



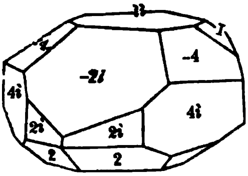
R. Brook.

357



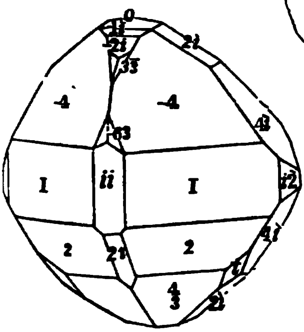
Isle Royale.

359



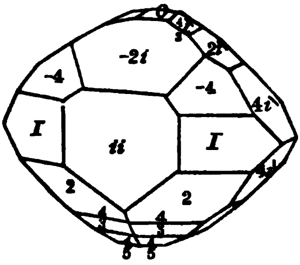
Seisser Alp.

358



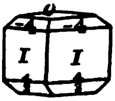
Isle Royale.

360



Toggiana.

361



Andreasberg.

H.=5—5·5. G.=2·8—3; 2·989, Arendal, Haidinger. Lustre vitreous, rarely subresinous on a surface of fracture; color white; sometimes grayish, pale green, yellow, red, or amethystine, rarely dirty olive-green or honey-yellow. Streak white. Translucent; rarely opaque white. Fracture uneven, subconchoidal. Brittle. Plane of optical axis *i*-ì; angle of divergence very obtuse; bisectrix nearly normal to *i*-*i*.

Var.—1. *Ordinary.* In crystals, glassy in aspect. Usual forms as in figures. Crystals from Bergen Hill, examined by Hessenberg (Min. Not., No. iv.), similar to fig. 355, but wanting *O*, -8-2̀, -6-3, and having *i*-ì, 6-*i*, *i*-2̀. Those of Andreasberg have the planes *O*, *i*-*i*, *I*, *i*-2̀ (these three quite small); −1-*i*, −2-*i*, −4-*i*, *i*-*i*, 2-*i*; 2-ì, 4-ì, −4, −8, 2, ⅓, ⅛, −4-2, −8-2̀, −⅓-2̀, 2-2̀, i-2̀. (Schröder, Pogg., xcviii. 34, and Dauber, ib., ciii. 116). Those of Toggiana, as in fig. 360, with also *i*-ì, *i*-⅔, −8-*i*, 1-*i*, 4, ⅓, −6-3, −5-⅘. One of Glen Farg, figured by Greg & Lettsom, has the planes of the rhombic prism *I* (*d*) very large, *i*-*i* (*P*) narrow linear, the clinodomes 2-ì, 4-ì narrow, and the octahedral planes −4 (small), ⅓ (large), 1, 2.

The plane *i*-*i* is usually made *O*, and *O*, *i*-*i*, and 4-ì, *I*; but in that case the form is not so simply presented as in the above figures. The angles of the vertical prisms *I*, *i*-2̀ are very nearly identical with those of the clinodomes 2-ì, 4-ì. The small letters added to the crystallographic symbols in the list of observed planes above, are the lettering of Brooke & Miller (Min., 408) and of Dauber. The plane *t*, of fig. 358, makes parallel intersections with ⅓ and 4-ì, but not with 2 and 2-ì. *O* ∧ *t*= 140°−142°, *i*-ì ∧ *t*= about 109½° by measurement.

2. *Compact massive.* White opaque, breaking with the surface of porcelain or Wedgewood ware. G.=2·911, Hayes; 2·983, Chandler. From the L. Superior region (anal. 8).

3. *Botryoidal; Botryolite.* Radiated columnar, having a botryoidal surface, and containing more water than the crystals. The original locality of both the crystallized and botryoidal was Arendal, Norway.

Comp.—O. ratio for $\dot{\mathrm{R}}$, $\dddot{\mathrm{R}}$, $\ddot{\mathrm{Si}}$, $\dot{\mathrm{H}}$=2 : 3 : 4 : 1; ($\dot{\mathrm{C}}\mathrm{a}^2$, $\dot{\mathrm{H}}^2$, $\dddot{\mathrm{B}}$)$\ddot{\mathrm{Si}}$, in which $\dot{\mathrm{H}}^2$: $\dot{\mathrm{C}}\mathrm{a}^3$: $\dddot{\mathrm{B}}$=1 : 2: 3=Silica 37·5, boric acid 21·9, lime 35·0, water 5·6=100. For botryolite, the ratio 2 : 3 : 4 : 2.

Analyses: 1, Stromeyer (Pogg., xii. 157); 2, Du Menil (Schw. J., lii. 364); 3, 4, Rammelsberg (Pogg., xlvii. 175); 5, Bechi (Am. J. Sci., II. xiv. 65); 6, Tschermak (Kenng. Uebers., 1860, 57); 7, Whitney (Am. J. Sci., III. xv. 435); 8, C. F. Chandler (ib., xxxviii. 13); 9, A. A. Hayes (J. N. H. S., Boston, viii. 62); 10, Rammelsberg (l. c.):

		$\ddot{\mathrm{Si}}$	$\dddot{\mathrm{B}}$	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\mathrm{H}}$
1.	*Datolite*, Andreasberg	37·36	21·26	35·67	5·71=100 Stromeyer.
2.	" "	38·51	21·34	35·59	4·60=100·14 Du Menil.
3.	" "	38·48	20·31	35·64	5·57=100 Rammelsberg.
4.	" Arendal	37·65	21·24	35·41	5·70=100 Rammelsberg.
5.	Mt. Caporciano	37·50	22·03	35·34	1·56, $\dddot{\mathrm{A}}\mathrm{l}$ 0·85, $\dot{\mathrm{M}}\mathrm{g}$ 2·12=99·41 Bechi.
6.	Toggiana	38·2	[21·2]	34·9	5·7=100 Tschermak.
7.	I. Royale, *Datolite*	37·64	[21·88]	34·68	5·80, $\dot{\mathrm{M}}\mathrm{n}$ *tr.*=100 Whitney.
8.	L. Superior, *white*	37·41	[21·40]	35·11	5·73, $\dddot{\mathrm{A}}\mathrm{l}$, $\dddot{\mathrm{F}}\mathrm{e}$ 0·35=100 Chandler.
9.	" " (½)	38·12	22·40	33·23	8·97, $\dddot{\mathrm{A}}\mathrm{l}$, $\dddot{\mathrm{F}}\mathrm{e}$ 0·52, $\dot{\mathrm{C}}\mathrm{u}$ 0·04, q'tz 1·94=99·72 H.
10.	Arendal, *Botryolite*	36·08	19·34	35·22	8·63=99·27 Rammelsberg.

Pyr., etc.—In the closed tube gives off much water. B.B. fuses at 2 with intumescence to a clear glass, coloring the flame bright green. Gelatinizes with muriatic acid.

Obs.—Datolite is found in trappean rocks; also in gneiss, dioryte, and serpentine; in metallic veins; sometimes also in beds of iron ore. Found in Scotland, in trap, at Kilpatrick Hills, Glen Farg in Perthshire, and in Salisbury Craigs; in a bed of magnetite at Arendal in Norway, and in Utö in Sweden; at Andreasberg, in veins of silver ores, in argillaceous schist, with apophyllite, etc.; at Niederkirchen and Sonthofen in Bavaria (the *humboldtite*); in granite at Baveno near Lago Maggiore, one crystal from which place measured 4½ × 3¾ × 1½ inches; at the Seisser Alp, Tyrol, and also at Theiss, near Claussen; at Mt. Catini, Tuscany, in gabbro; at Toggiana in Modena, in serpentine; in dioryte, on the Rosskopf, near Freiburg, in Brisgau.

Datolite occurs crystallized and massive at the Rocky Hill quarry, Hartford, Conn., in the north-east part of Southington, near Mr. Hamlen's, in amygdaloid, both in crystals, fibrous, and massive; also in Berlin, near Kensington; in the north-west part of Meriden and at Middlefield Falls, Conn; in better specimens at Roaring Brook, 14 miles from New Haven, where the crystals (f. 355–356) are sometimes half an inch long, and nearly pellucid; the author obtained from a transparent crystal of this locality *I* ∧ *I*=115° 12′, giving by calculation for *i*-2̀ ∧ *i*-2̀ 76° 28′; the plane *s* is not quite even, and is often unpolished; in N. Jersey, at Bergen Hill, in splendid crystals; in trappean rocks, both crystals and the opaque white compact variety (anal. 8), in the Lake Superior region, at the Minnesota, Quincy, Marquette, Ash-bed, and other mines; at the Superior mine near Ontonagon, and on Isle Royale.

Named from δατεῖσθαι, *to divide*, alluding to the granular structure of a massive variety. Werner introduced an *h* after the first *t* without reason, and most subsequent authors have followed him in this; but not Karsten, nor Leonhard who pronounced it wrong, nor Haidinger, Aikin, Jameson, and others.

Levy gave the name *humboldtite* to crystals which he found to be *monoclinic*, datolite having been made orthorhombic by Haüy. Wollaston proved their identity with datolite.

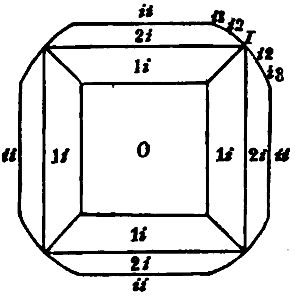
Alt.—Haytorite is datolite altered to chalcedony.

328. GUARINITE. *Guiscardi*, ZS. G., x. 14, 1858.

Tetragonal. $O \wedge 1\text{-}i = 159°\ 38'$; $a = 0{\cdot}3712$. Observed planes as in the figure. $O \wedge 2\text{-}i = 143°\ 33'$, $i\text{-}i \wedge 1\text{-}i = 110°\ 22'$, $i\text{-}i \wedge 2\text{-}i = 126°\ 27'$, $i\text{-}i \wedge i\text{-}2 = 153°\ 26'$, $i\text{-}i \wedge i\text{-}3 = 161°\ 27'$. In thin tables; fig. 362 a top view; planes *i-i* sometimes wanting; 1-*i* and 2-*i* observed in only one of the two zones. Cleavage parallel to *i-i*, rather imperfect.

H.=6. G.=3·487. Lustre of cleavage-face somewhat adamantine. Color sulphur-yellow, honey-yellow, pale or dark. Streak uncolored, or whitish-gray. Transparent to translucent.

362



Comp.—(Ċa+T̈i) S̈i, same as for titanite. Analysis by Guiscardi (l. c.): S̈i 33·64, T̈i 33·92, Ċa 28·01, Ḟe, Ṁn *tr.* The compound is consequently *dimorphous.*

Pyr., etc.—The same as in titanite.

Obs.—Found in small cavities in a grayish trachyte, on Monte Somma, along with glassy feldspar and nephelite. The mass of the trachyte is rich in glassy feldspar, hornblende, and melanite. In one case in the common rock of Somma, consisting of feldspar and nephelite, and here along with sphene.

As titanic acid itself is trimorphous, it is not strange that a compound containing it should be dimorphous.

329. TITANITE. Nouv. substance minerale (fr. Chamouni) *Pictet*, J. de Phys., xxxi. 368, 1787;=Pictite *Delameth.*, T. T., ii. 282, 1797. Titanit (fr. Passau) *Klapr.*, Beitr., i. 245, 1795; =Titane siliceo-calcaire *Daubenton*, Tabl., 1799, *H.*, Tr., iv. 1801;=Braun Mänakerz *Wern.*, Min. Syst., 1808, Leonh. Tasch., iii. 311, 1809. Schorl rayonnante en gouttière [or channelled Actinolite, the cryst. being twins with a reënt. angle] *Saussure*, Voy. Alpes, iv. 103, 1796;=Sphene *H.*, Tr., iii. 1801;=Gelb Menakerz *Wern.*, 1808, l. c.

Séméline (fr. Marone, Dauphiny) *Fl. de Bellevue*, J. de Phys., li. 443, 1800. Spinthère *H.*, Tr., iv. 1801.

Ligurite (fr. Stura, Apennines (Liguria)) *Viviani*, Mem. Acc. Sci. Genova, iii., J. de Phys., lxxvii. 236, 1813. Greenovite (fr. St. Marcel) *Duf.*, Ann. d. M., III. xvii. 529, 1840. Lederite *Shep.*, Am. J. Sci., xxxix. 357, 1840. Aspidelite *Weibye.*

Monoclinic. $C = 60°\ 17' = O \wedge i\text{-}i$; $I \wedge I = 113°\ 31'$, $O \wedge 1\text{-}\grave{i} = 159°\ 39'$; $a : b : c = 0{\cdot}56586 : 1 : 1{\cdot}3251$. Observed planes: O; vertical, $i\text{-}i$, $i\text{-}\grave{i}$, I, $i\text{-}3$; clinodomes, $2\text{-}\grave{i}$, $4\text{-}\grave{i}$, $\frac{16}{3}\text{-}\grave{i}$; hemidomes, $-\frac{1}{3}\text{-}i$ (or $\frac{11}{30}\text{-}i$), $-2\text{-}i$, $-5\text{-}i$, $\frac{4}{5}\text{-}i$, $\frac{5}{6}\text{-}i$, $1\text{-}i$, $2\text{-}i$; hemioctahedral, $\frac{1}{2}$, $\frac{2}{3}$, 1, -1, 2, -2, 4, -4; $1\text{-}2$, $2\text{-}2$, $-4\text{-}2$; $-3\text{-}3$; $\frac{5}{2}\text{-}\frac{5}{3}$; $\frac{3}{4}\text{-}\grave{\frac{3}{2}}$; $1\text{-}\grave{2}$, $-3\text{-}\grave{3}$, $6\text{-}\grave{3}$, $\frac{3}{4}\text{-}\grave{\frac{15}{8}}$, $1\text{-}\grave{\frac{7}{2}}$.

$O(y) \wedge i\text{-}i(P) = 119°\ 6[illegible]'$	$2(n) \wedge -2(t)$, ov. $I, = 108°\ 39'$
$O(y) \wedge 1\text{-}i(x) = 159$	$2(n) \wedge I(r) = 152\ 46$
$O(y) \wedge 4\text{-}\grave{i}(s) = 123\ 59$	$2(n) \wedge i\text{-}i(P) = 144\ 56$
$O(y) \wedge I(r) = 114\ 30$	$2(n) \wedge 2(n) = 136\ 12$
$O(y) \wedge 1(z) = 154\ 19$	$-1(l) \wedge -1(l) = 133\ 52$
$O(y) \wedge 2(n) = 141\ 44$	$-2(t) \wedge -2(t) = 110\ 52$
$O(y) \wedge -1(l) = 139\ 26$	$-4 \wedge -4 = 106\ 2$
$O(y) \wedge -2(t) = 109\ 37$	$2\text{-}2(e) \wedge 2\text{-}2(e) = 157\ 16$
$1(z) \wedge 1(z) = 149\ 43$	$1\text{-}2(w) \wedge 1\text{-}2(w) = 164\ 36$

$6\text{-}\grave{3}(u) \wedge i\text{-}\grave{i}(b)=140° \; 21'$

$-3\text{-}\grave{3}(m) \wedge -3\text{-}\grave{3}(m)=76 \; 7$

$-3\text{-}\grave{3}(m) \wedge i\text{-}\grave{i}\,(b)=141 \; 27$

$i\text{-}i(P) \wedge i\text{-}3(o)=167 \; 41$

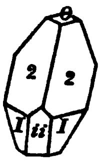
$4\text{-}\grave{i}(s) \wedge 4\text{-}\grave{i}(s)$, ov. $O,=67° \; 58'$

$I(r) \wedge i\text{-}i(P)=146 \; 45$

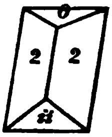
$1\text{-}i(x) \wedge i\text{-}i(P)=140 \; 43$

$i\text{-}i(P) \wedge i\text{-}\grave{i}(b)=90$

363

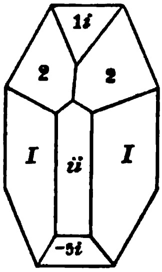


364



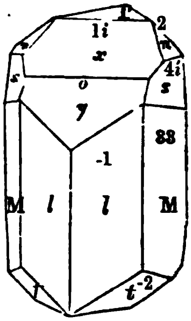
Semeline.

367

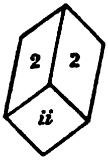


Spinthere.

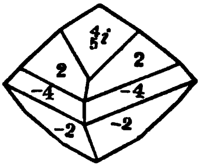
368



365

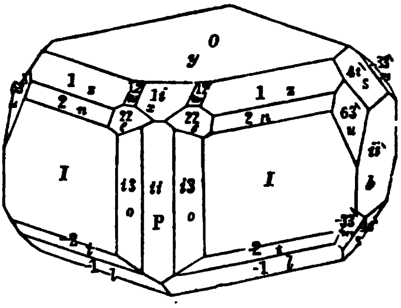


366

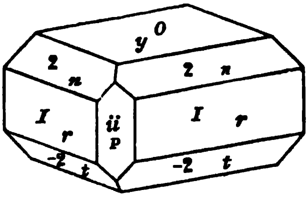


Greenovite.

370



369



Lederite.

Cleavage: *I* sometimes nearly perfect; *i-i* and -1 much less so; rarely (in greenovite) 2 easy, -2 less so; sometimes hemimorphic (f. 372). Twins: composition-face *i-i*, and twinned either (*a*) by revolution on an axis normal to *i-i*, or (*b*) on a vertical axis; the former very common, and usually producing thin tables with a reëntering angle along one side; sometimes elongated, as in f. 373; occasionally in double twins, or fours, as would be represented by two f. 373 united back to back. Sometimes massive, compact; rarely lamellar.

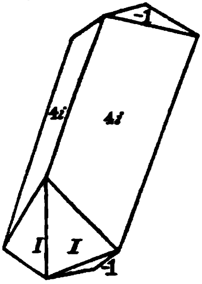
H.=5–5·5. G.=3·4–3·56. Lustre adamantine—resinous. Color brown, gray, yellow, green, and black. Streak white, slightly reddish in greenovite. Transparent—opaque. Brittle. Optic-axial plane *i-ì*; bisectrix positive, very closely normal to 1-*i* (*x*); double refraction strong: axial divergence 53°–56° for the red rays, 46°–45° for the blue; Descl.

Comp., Var.—$(\dot{C}a+\ddot{T}i)\,\ddot{S}i$, which is equivalent to $\ddot{\bar{R}}\,\ddot{S}i$ (since $R\,O+R\,O^2=R^2O^3$); it being a 3 : 2 silicate, like andalusite, but one in which titanium forms part of the base.

Var. 1. *Ordinary*. (*a*) *Titanite*; brown to black, the original being thus colored, also opaque or subtranslucent. (*b*) *Sphene* (named from *σφήν*, *a wedge*); of light shades, as yellow, greenish, etc., and often translucent; the original was yellow.

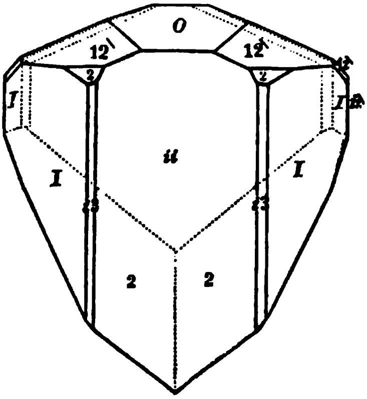
Ligurite was an apple-green sphene; *Spinthere* (or Semeline) a greenish; named *spinthere* from its lustre, and *semeline* from *semen lini*, *flax-seed*, alluding to a common form. *Lederite*, brown, opaque, or subtranslucent, of the form in f. 369.

371



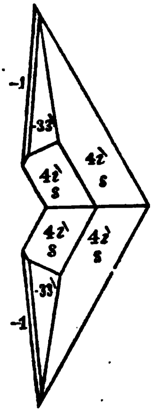
Pictite.

372



Rothenkopf.

373



Schwarzenstein.

2. *Manganesian*; *Greenovite*. Red or rose-colored, owing to the presence of a little manganese.

3. In the crystals there is a great diversity of form, arising from an elongation or not into a prism, and from the occurrence of the elongation in the direction of different diameters of the fundamental form. (*a*) Long prismatic in the direction of the prism *I*, f. 367 of *spinthere*, from Dauphiny; short prismatic, in the same direction, f. 369, *lederite*, from northern New York; (*c*) oblong prismatic in the direction of the edge 2 / 2, very common, f. 363–365; (*d*) in tho direction of the edge –1 / –1, f. 368 (from Naumann); *e* in the direction of the prism 4-ĭ, f. 371, pictite, and f. 373 twin from Schwarzenstein; (*f*) not elongated, of which f. 366 is one example among many widely different. Besides these there are (*g*) *hemimorphic* forms, as in f. 372, the planes of the opposite extremities of the crystal being unlike.

Analyses: 1, Klaproth (Beitr., i. 245); 2, 3. Rosales and Brooks (Pogg., lxii. 253); 4, Fuchs, (Ann. Ch. Pharm., xlvi. 319); 5. H. Rose (Pogg., lxii. 253); 6, Marignac (Ann. Ch. Phys., III. xiv. 47); 7, Delesse (Ann d. Mines, IV. vi. 325); 8, T. S. Hunt (Am. J. Sci., II. xv. 442); 9, Arppe (Anal. Finske Min., 34):

	S̈i	T̈i	Ċa
1. Passau, *bn.*	35	33	33 =101 Klaproth.
2. "	30·63	42·56	25·00, Ḟe 3·93=102·12 Brooks.
3. Arendal, *bn.*	31·20	40·92	22·25, Ḟe 5·06=99 43 Rosales.
4. Schwarzenstein, *yw.*	32·52	43·21	24·18=99 91 Fuchs; G =3·44.
5. Zillerthal, *ywh. gn.*	32·29	41·58	26·61, Ḟe 0·96=101·44 Rose; G.=3·535.
6 Piedmont, *Greenovite*	32·26	38·57	27·65, Ḟe 0·76, M̶n 0·76=100 Marignac.
7. " "	30·4	42·0	24·3, Ṁn 3·6=100·3 Delesse.
8. Grenville, *Lederite*	31·83	40·00	28·31, ign. 0·40=100·54 Hunt; G.=3·5.
9 Frugard, Finl., *bn.*	31·03	43·57	21·76, Ḟe 0·75, Ṁg 0·08, Ä̶l 1·05, ign. 0·38=98·62 A.

Pyr., etc.—B.B. some varieties change color, becoming yellow, and fuse at 3 with intumescence, to a yellow, brown, or black glass. With borax they afford a clear yellowish-green glass. Imperfectly soluble in heated muriatic acid; and if the solution be concentrated along with tin, it becomes of a fine violet color. With salt of phosphorus in R.F. gives a violet bead; varieties containing much iron require to be treated with the flux on charcoal with metallic tin. Completely decomposed by sulphuric and fluohydric acids.

Obs.—Titanite occurs in imbedded crystals, in granite, gneiss, mica schist, syenite, chlorite schist, and granular limestone; also in beds of iron ore, and volcanic rocks, and often associated with pyroxene, hornblende, chlorite, scapolite, zircon, etc. Found in complicated compound crystals of a pale green color and transparent, in the Grisons, Switzerland, associated with feldspar and chlorite; in mica slate at St. Gothard; also at Mont Blanc, and elsewhere, in the Alps; on crystals of calcite at Chalanches and Maromme, in Dauphiny (the *spinthère* H.); in small reddish crystals in the protogine of Pormenaz and Chamouni (*pictite* Saus.); in large, broad, yellowish or reddish-green crystals, with colorless apatite, in a talcose schist at Ala, Piedmont (*ligurite*); in pale yellowish-green transparent or translucent crystals, laceolate in form, lining fissures in titanic iron at Arendal, in Norway (*aspidelite* Weibye); at Achmatovsk, Urals; at St. Marcel, in Piedmont, with manganesian epidote and romeine (*greenovite* Duf., anal. 6, 7); at Val Maggia, Piedmont; at Schwarzenstein, Tyrol; at Felberthal in Pinzgau; at Frugard, in Finland, of a brownish-black color (anal. 9). Small crystals occur in syenite at Strontian in Argyleshire, near Criffel in Galloway; at Craig Cailleach in Perthshire; in Inverness; near Tavistock: near Tremadoc, in North Wales, with brookite; at Crow Hill, near Newry, Ireland.

Occasionally it is found among volcanic rocks, as at Lake Laach (*semeline* of F. de Bellevue), and at Andernach on the Rhine.

Occurs in *Canada* at Grenville, Elmsley, Burgess, and Grand Calumet Island, in amber-colored crystals; in the trachytes of Yamaska, Shefford, and Brome Mts. In *Maine*, in fine crystals at Sanford, also at Thurston. In *Mass.*, good crystals in gneiss, in the east part of Lee; at Bolton with pyroxene and scapolite in limestone; at Pelham. In *Conn.*, at Trumbull. In *N. York*, at Roger's Rock on Lake George, abundant in small brown crystals, along with graphite and pyroxene; at Gouverneur, in black crystals in granular limestone with scapolite; in Diana near Natural Bridge, Lewis Co., in dark brown crystals, among which is the variety *lederite* (f. 369), in which cleavage is distinct parallel to *I*; the crystals are sometimes nearly three inches square; at Rossie, St. Lawrence Co., in pale red and brown crystals with apatite, pargasite, and feldspar; in Macomb near Pleasant Lake; in Orange Co., in large crystals abundant in limestone, near Duck-cedar pond, in the town of Monroe; near Edenville, in light brown crystals, sometimes nearly two inches across, in limestone; five miles south of Warwick, in large grayish-brown crystals, with zircon, hornblende, and iron ore; also in small crystals a mile south of Amity; in Westchester Co., near Peekskill, in an aggregate of feldspar, quartz, and hornblende; also near West Farms, in small reddish-brown prisms. In *N. Jersey*, at Franklin, of a honey-yellow color. In *Penn.*, Bucks Co., three miles west of Attleboro', associated with tabular spar and graphite.

The crystallization was first clearly made out by G. Rose in 1821. For recent observations see R. & M. Min.; Descl. Min.; Hessenberg Min. Not., Nos. i. to vii; v. Rath., Pogg., cxv. 466. Breithaupt states that much sphene is triclinic (Handb., ii. 744, B. H. Ztg., xxv. 107). Fig. 370 above is ideal, being intended to exhibit the relative positions of the planes on the fundamental prism, and the letters used on the planes by authors, as well as the symbols. Fig. 368 is from Naumann, drawn after his view of the fundamental form; and fig. 373 (from Hessenberg) is similar in this respect, but a side view.

Alt.—Sphene occurs of little hardness, dull in lustre, and hydrated from alteration. Crystals of this kind, found in a decomposing feldspar, with zircon at Green River, Henderson Co., N. C., have been named by C. U. Shepard (Am. J. Sci., xxii. 96, 1856) *Xanthitane*. Color pale yellowish-white; H.=3·5; G.=2·7—3·0, and stated to contain 12·5 p. c. of water. Also occurs altered to steatite.

Artif.—Formed in crystals by heating together 3 $\ddot{\mathrm{Si}}$, 4 $\ddot{\mathrm{Ti}}$, and chlorid of calcium, the composition of them ($\frac{3}{2}$) $\ddot{\mathrm{Si}}$ 30·5, $\ddot{\mathrm{Ti}}$ 41·7, $\dot{\mathrm{Ca}}$ 27·8=100; and the manganesian (greenovite) by adding chlorid of manganese (Hautefeuille).

330. GROTHITE *Dana*. (Titanite *P. Groth*, Jahrb. Min., 1866, 44.) P. Groth has shown that the titanite-like mineral, from the syenite of Plauen Grund near Dresden, differs in composition and cleavage from ordinary sphene. The form is monoclinic in habit, being somewhat like f. 363 and 367; but there is distinct cleavage parallel to one 2, and little distinct parallel to the other. The angles are 2 ∧ 2=136°; 2 on 1-*i*=155° 19′ to 156° 20′; 1-*i* on *i-i* about 162°. H.=6·5. G.=3·52—3·60. Lustre vitreous to greasy. Color clove to blackish-brown; in thin splinters reddish-brown and translucent. The altered mineral is isabella-yellow to pale yellowish-brown.

Composition according to Groth (l. c.): ($\frac{3}{2}$) $\ddot{\mathrm{Si}}$ 30·51, $\ddot{\mathrm{Ti}}$ 31·16, $\dddot{\overline{\mathrm{Fe}}}$ 5·83, $\dddot{\overline{\mathrm{Al}}}$, $\dot{\mathrm{Y}}$ 2·44, $\dot{\mathrm{Mn}}$ 1·02, $\dot{\mathrm{Ca}}$ 31·34=102·30. It gives the O. ratio for $\dot{\mathrm{R}}$, $\dddot{\overline{\mathrm{R}}}$, $\ddot{\mathrm{Ti}}$, $\ddot{\mathrm{Si}}$, 8·95 : 3·23 : 12·16 : 16·15, or for bases ($\ddot{\mathrm{Ti}}$ included) to silica, 24·34 : 16·15=3 : 2. The general formula is therefore ($\dot{\mathrm{R}}^3$, $\ddot{\mathrm{R}}^{\frac{3}{2}}$, $\dddot{\overline{\mathrm{R}}}$) $\ddot{\mathrm{Si}}$. The analysis corresponds very nearly to 8 $\ddot{\mathrm{Si}}$, 6 $\ddot{\mathrm{Ti}}$, 1 $\dddot{\overline{\mathrm{R}}}$, 9 ($\dot{\mathrm{Ca}}$ $\dot{\mathrm{Mn}}$). It is therefore a titanite in which one-half of the bases consists of 3 $\dot{\mathrm{Ca}}^3$+1 ($\dddot{\overline{\mathrm{Fe}}}$, $\dddot{\overline{\mathrm{Al}}}$). If not a result of alteration, and the character of the cleavage is a constant one, it should rank as a distinct species.

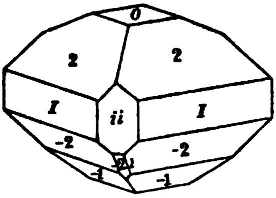
CASTELLITE. Castellit *Breith.*, B. H. Ztg., xxv 113, 1866. Monoclinic. In very small and exceedingly thin 8-sided tables, having for the angles of the rhombic prism 118° and 62°. Cleavage prismatic? H.=5·5—6. G.=3·150. Lustre vitreous, somewhat adamantine. Color wine-yellow to wax-yellow; streak colorless. Fragile.

According to Plattner it acts B.B. like titanite, giving evidence of the presence of titanic acid, lime, and silica, but with less of the first and more of the last than in sphene. Occurs in the phonolite of Holenkluk Mtn., near Proboscht, and in that of Sollodiz—a rock containing also sanidin, hornblende, augite, ilmenite, and apatite.

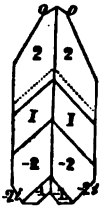
331. KEILHAUITE. Keilhauit *A. Erdmann*, Ak. H. Stockh., 355, 1844. Yttrotitanit *Scheerer*, Pogg., lxiii. 459, 1844.

Monoclinic, and near sphene in angles. $C = O \wedge i\text{-}i = 122°$, $I \wedge I = 114°$ (calc. from $I \wedge i\text{-}i$) (fig. 374); $I \wedge i\text{-}i = 147°$, $O \wedge 2 = 143°\ 30'$, $I \wedge 2 = 153°\ 30'$, $-2 \wedge -1 = 149°$, $i\text{-}i \wedge 2\text{-}i = 125°$, from measurements with the common goniometer by D. Forbes; $O \wedge I = 114°\ 26'$, and $O \wedge -1 = 140°\ 42'$, from calculations by Hansteen; faces of the crystals rather rough. Twins very common: plane of composition $i\text{-}i$ (fig. 375). Cleavage quite distinct, parallel to 2.

374



375



H.=6·5. G.=3·519 to 3·72, D. Forbes; 3·69, Scheerer; 3·716—3·733, Rammelsberg. Lustre vitreous to resinous. Brownish-black; in splinters brownish-red and translucent; also dull brown and pale grayish-brown. Streak-powder grayish-brown to pale dirty yellow.

Comp.—$(\dot{R}^3, \ddot{R}^{\frac{3}{2}}, \bar{R})\ddot{Si}$, having, like sphene, titanium among the basic metals; but containing the sesquioxyd alumina, and traces of glucina, and, besides lime, the protoxyds, yttria, protoxyd of iron, etc.

Analyses: 1, 2, Erdmann (l. c.); 3, D. Forbes (Edinb. N. Phil. J., II., i. 62, and iii.); 4, 5, Rammelsberg (Pogg., cvi. 296):

	$\ddot{Si}$	$\ddot{Ti}$	$\bar{Al}$	$\bar{Fe}$	$\bar{Mn}$	$\bar{Ce}$	$\bar{Be}$	$\dot{Ca}$	$\dot{Y}$
1.	30·00	29·01	6·09	6·35	0·67	0·32	—	18·92	9·62=100·98 Erdmann.
2.	29·45	28·14	5·90	6·48	0·86	0·63	—	18·68	9·74=99·88 Erdmann.
3.	31·33	28·04	8·08	$\dot{Fe}$ 6·87	$\dot{Mn}$ 0·28	—	0·52	19·56	4·78=99·41 D. Forbes.
4. *Massive*	29·48	26 67	5·45	6·75	*tr.*	—	—	20·29	8·16, Mg 0·94, $\dot{K}$ 0·60, ign. 0·54=98·88 Ramm.
5. *Cryst.*	28·50	27·04	6·24	5·90	*tr.*	—	—	17·15	12·08, $\dot{Mg}$ *tr.*, ign. 3·59=100·50 Ramm.

Rammelsberg's analyses afford for the oxygen ratio between silica and the other ingredients, anal. 4, 15·72 : 22·94=2 : 3, and anal. 5, 15·20 : 22·71=2 : 3; conforming to the other analyses in the fundamental ratio of the species.

Pyr., etc.—B.B. fuses with intumescence easily to a black shining glass. Yields an iron-colored glass with borax, which in the inner flame becomes blood-red. With salt of phosphorus gives an iron color and a silica skeleton, and in the inner flame a violet bead. Reaction of manganese with soda. Decomposed by muriatic acid.

Obs.—Occurs near Arendal, Norway; at Buöe, Arkeröe, Alve, and Narrestöe, in a feldspathic rock, both in crystals and massive. Crystals weighing 2½ lbs., and masses of 15 to 20 lbs., are mentioned by Forbes. A dull brown massive kind from Alve gave G.=3·72; and a pale grayish-brown 3·603; a specimen from near Narrestöe, G.=3·519. The Alve keilhauite has two cleavages inclined to one another 138° (Forbes & Dahl, Nyt. Mag. f. Nat., xiii.). Also from Snarum, Norway.

Named after Prof. Keilhau of Norway.

332. TSCHEFFKINITE. ? Mineral de Coromandel *Beud.*, Tr., ii. 652, 1832. Tschewkinit *G. Rose*, Reis. Ural, ii. 1839.

Massive, amorphous.

H.=5—5·5. G.=4·508—4·549, G. Rose; 4·5296, H. Rose; after heating, in powder, 4·615; after fusion, 4·717. Lustre vitreous. Color velvet-black. Streak dark brown. Subtranslucent to opaque.

Comp.—Essentially ($\dot{\text{R}}^3$, $\ddot{\text{R}}^{\frac{3}{2}}$, Ɍ) $\dddot{\text{Si}}$, for the Ural tscheffkinite, as in keilhauite. Analyses: 1, H. Rose (Pogg., lxii. 591); 2, Hermann (Bull. Soc. Nat. Moscou, xxxix. 57); 3, Beudant (Tr., l. c.); 4, A. Damour (Bull. G. Fr., xix. 550, 1862):

	$\dddot{\text{Si}}$	$\ddot{\text{Ti}}$	$\ddot{\text{Th}}$	$\dot{\text{U}}$	$\dot{\text{Fe}}$	$\dot{\text{Mn}}$	$\dot{\text{Y}}$	$\dot{\text{Ce}}$,$\dot{\text{La}}$,$\dot{\text{Di}}$	Mg	$\dot{\text{Ca}}$	$\dot{\text{K}}$,$\dot{\text{Na}}$	$\dot{\text{H}}$	
1. Ural ($\frac{4}{6}$)	21·04	20·17	——	——	11·21	0·53	——	45·09	0·22	3·50	0·12	——	=101·88 R.
2. "	20·68	16·07	20·91	2·50	9·17	0·75	3·45	22·80	——	3·25	——	0·42	=100 Herm.
3. Africa	19·0	8·0	——	——	$\bar{\text{F}}$19·0	$\bar{\text{M}}$1·2	——	36·0	——	8·0	——	11·0	=102·2 Beud.
4. "	19·03	20·86	——	——	7·96	0·38	——	38·38	0·27	4·40	——	1·30	=100·30 D.

Hermann showed that the mineral contained thoria, and that Rose had included it in his titanic acid and oxyd of cerium; his O. ratio for $\dot{\text{R}}$ (including the thoria), $\ddot{\text{Ti}}$, $\dddot{\text{Si}}$ is 10·44 : 6·38 : 10·92 = 15 : 9 : 16, and hence for $\dot{\text{R}}+\ddot{\text{R}}$, $\dddot{\text{Si}}$, 3 : 2, whence the above formula. Rose's analysis corresponds to the same general formula.

a. The Coromandel mineral, referred here by Damour, affords, according to him, the O. ratio for $\dot{\text{R}}+\text{Ɍ}+\ddot{\text{R}}$, $\dddot{\text{Si}}=2:1$; and for $\dot{\text{R}}$, Ɍ, $\ddot{\text{R}}=2:1:2$; whence the formula $(\frac{2}{5}\dot{\text{R}}^3+\frac{1}{5}\text{Ɍ}+\frac{2}{5}\ddot{\text{R}}^{\frac{3}{2}})^4\dddot{\text{Si}}^3$. The alumina is left out of consideration as an impurity. But including it, the O. ratio for bases and silica is 20·65 to 10·14, sustaining still better the ratio 2 : 1. Damour has made a new examination of the mineral, and directly ascertained the *absence of thorium* (letter to the author of April 24, 1867); he further observes that a little $\dot{\text{Di}}$ and $\dot{\text{La}}$ are probably present with the $\dot{\text{Ce}}$. Descloizeaux states that the mineral is not homogeneous, it consisting of a brown material not acting on polarized light, and small colorless grains which are strongly doubly refracting. The mineral has H.=5·5–6; G.=4·26; lustre vitreous, inclining to resinous; color brownish-black; subtranslucent.

Pyr., etc.—B.B. glows, then intumesces strongly, becomes brown, and fuses to a black glass. Gives with the fluxes reactions for iron, manganese, and titanic acid. Gelatinizes with muriatic acid. The Coromandel mineral in a closed tube yields a little water. B.B. fuses with intumescence to a black scoria, feebly magnetic. With salt of phosphorus it gives in R.F. a pale brown glass, opaline, which becomes milky in the O.F. With borax it affords a hyacinth-brown glass, transparent in the R.F. and pale brown and opaque in the O.F. Attacked readily by nitric acid, especially if heated, depositing gelatinous silica mixed with titanic acid and black grains of titanic iron.

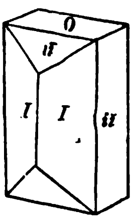
Obs.—From the Ilmen Mountains in the Urals; only a few specimens have been found. The tscheffkinite in collections is mostly *uralorthite*, which it much resembles. Also from the coast of Coromandel, whence it was long since brought by Leschenault.

Named after the Russian general, Tschevkin.

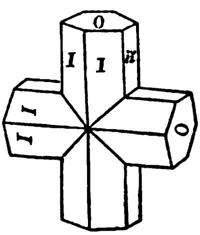
333. STAUROLITE. Pierres de croix *de Robien*, N. idées sur la format. d. Foss., 109, 1751 (with figs.). Basaltes crystallisatus pt. *Cronst.* (the specimen a cross of two brown 6-sided crystals, worn as an amulet at baptisms in Basel, and called *Lapis crucifer*, and *Basler Taufstein*), Min., 70, 1758. Schorl cruciforme pt., Pierres de croix, *de Lisle*, Crist., 1772, 1783 (with figs.). Staurolite *Delameth.*, Sciagr., i. 298, 1792. Grenatite (fr. St. Gothard), *Saussure*, Voy. Alpes, § 1900, 1796. Granatite. Staurolith *Karst.*, Tab., 22, 1800. Staurotide *H.*, Tr., iii 1801.

Orthorhombic. $I \wedge I=129°\ 20'$, $O \wedge 1\text{-}\bar{\imath}=124°\ 46'$; $a:b:c=1{\cdot}4406:1:2{\cdot}11233$. Observed planes: O; vertical, I, $i\text{-}\breve{\imath}$; dome, $1\text{-}\bar{\imath}$.

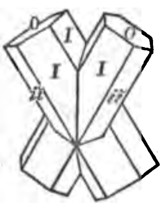
376



377



378



$O \wedge 1\text{-}\bar{\imath}=124°\ 46'$
$O \wedge I=90$
$O \wedge i\text{-}\breve{\imath}=90$
$I \wedge i\text{-}\breve{\imath}=115\ 17$
$O \wedge \frac{3}{2}\text{-}\breve{\imath}$, comp.-face, $=134\ 21$
$O \wedge \frac{3}{2}\text{-}\breve{\frac{3}{2}}$ " $=119\ 23$
$I \wedge I$, meas., $128\ 30\text{–}129\ 30$

Cleavage: $i\text{-}\breve{\imath}$ distinct, but interrupted; I in traces.

Twins cruciform: 1, composition-face $\frac{3}{2}\text{-}\breve{\imath}$ (f. 377); 2, composition-face $\frac{3}{2}\text{-}\breve{\frac{3}{2}}$

(f. 378). [Making $\frac{3}{2}$-$\breve{i}$ and $\frac{3}{2}$-$\breve{\frac{3}{2}}$ the planes 1-$\breve{i}$ and 1, on the ground that twinning usually takes place parallel to the fundamental or diagonal planes of crystals, then *I* above is i-$\frac{3}{2}$, and the true $I \wedge I = 109° \ 14'$, whence $a' : b' : c' = 1·4406 : 1 : 1·4082$ ($=\frac{2}{3} c$).] Crystals often with rough surfaces. Massive forms unobserved.

H.=7—7·5. G.=3·4—3·8. Subvitreous, inclining to resinous. Color dark reddish-brown to brownish-black, and yellowish-brown. Streak uncolored to grayish. Translucent—nearly or quite opaque. Fracture conchoidal. Optic-axial plane i-$\bar{i}$; bisectrix positive, normal to *O*.

Comp., Var.—O. ratio for $\dot{R}(+\dot{H})$, $\ddot{\bar{R}}$, $\ddot{Si} = 1 : 4 : 2\frac{1}{2}$; for bases and silica 2 : 1; whence $(\frac{1}{3}\dot{R}^3 + \frac{2}{3}\ddot{\bar{A}}l)^4 \ddot{Si}^3 =$ (if $3\dot{R} = \frac{2}{4}\dot{H} + \frac{2}{4}\dot{Mg} + \frac{1}{4}\dot{Fe}$) Silica 28·3, alumina 51·7, protoxyd of iron 15·8, magnesia 2·5, water 1·7=100. Excluding the water, the formula may be $(\dot{Fe}^3, \ddot{\bar{A}}l)^4 \ddot{Si}^3 + \frac{1}{4}\dot{R}^2\ddot{Si}$, equivalent to a 2 : 1 silicate containing a little $(\dot{Mg}, \dot{Fe})^2\ddot{Si}$ (chrysolite); or $(\dot{Fe}^3, \ddot{\bar{A}}l)^4 \ddot{Si}^3 + \frac{2}{13}(\dot{R}^3, \ddot{\bar{A}}l)\ddot{Si}$, that is, the same 2 : 1 silicate with a little gehlenite.

The early analysts made the iron all sesquioxyd. Mitscherlich has pronounced it (J. pr. Ch., lxxxvi. 1) *all* protoxyd in the staurolite of St. Gothard, Airolo, and Brittany. Rammelsberg found a variety of ratios in his analyses of the mineral from other localities, the silica varying from 27 to over 50 per cent. But G. Lechartier has ascertained that staurolite contains, uniformly, some water, separable only at a high heat; and that the variations are due to *impurities*, the powder under the microscope being distinctly a mixture of two or more minerals, and the action of fluohydric acid on some crystals making them cellular, or even spongy and fragile. After purifying the staurolite, the proportion of silica was nearly constant, and the specific gravity was 3·70—3·76. (See below.)

Var. 1. *Ordinary*. 2. *Zinc-Staurolite* (anal. 27); found at Canton, Ga., in slender crystals, ½ in. long and a line or less thick, having a yellowish-brown to cinnamon-brown color; G.=3·792. The crystals have the planes *I*, *O*, i-$\bar{i}$. 3. *Manganese-Staurolite*, *Nordmarkite* (anal. 28); from dolomite in Nordmark, Sweden, of chocolate-brown color, with H.=6·5, G.=3·54, and presenting the usual crystalline form. Its easy fusibility is reason for here giving this variety the distinctive name *Nordmarkite*.

Analyses: 1, Klaproth (Beitr., v. 80); 2, Lohmeyer (Pogg., lxii. 419); 3, Marignac (Ann. Ch. Phys., III. xiv. 49); 4–7, Jacobson (Pogg., lxii. 419); 8, 9, 12, Rammelsberg (ib., cxiii. 599); 10, 11, Wislicenus (J. pr. Ch., xciii. 260); 13, 14, Jacobson (Pogg., lxviii. 414); 15, Rammelsberg (l. c.); 16, Vauquelin (J. d. M., viii. 354); 17, 18, Jacobson (l. c.); 19, 20. Rammelsberg (l. c.); 21, 22, Jacobson (l. c.); 23–26, Rammelsberg (l. c.); 27, Genth (Am. J. Sci., II. xxxiii. 198); 28, Paykull (Efv. Ak. H. Stockh., 1866):

		$\ddot{Si}$	$\ddot{\bar{A}}l$	$\ddot{\bar{F}}e$	$\ddot{\bar{M}}n$	$\dot{Fe}$	$\dot{Mg}$	ign.	
1. St. Gothard, *red*		27·00	52·25	18·50	0·25	——	——	——	=98·00 Klaproth.
2. "	*dark r.*	27·02	49·96	20·07	0·28	——	——	——	=97·33 Lohmeyer.
3. "		28·47	53·34	17·41	0·31	——	0·72	——	=100·25 Marignac.
4. "		30·31	46·80	18·08	——	——	2·16	——, $\dot{Ca}$ 0·13	=97·48 Jacobson
5. "		30·91	48·68	15·37	$\dot{M}$ 1·19	——	1·33	——	=99·48 Jacobson.
6. "		29·72	54·72	15·69	——	——	1·85	——	=101·98 Jacobson.
7. "		29·13	52·01	[17·58]	——	——	1·28	——	=100 Jacobson.
8. "	*brown*	29·60	48·53	4·25	$\dot{M}$ 0·96	11·50	3·12	0·76	=98·72 Ramm.
9 "		35·05	44·18	5·21	" *tr.*	11·48	2·86	0·95	=99·73 Ramm.
10. "		27·95	54·26	4·58	——	9·91	2·80	——	=99·50 Wislicenus.
11. "		27·90	54·42	4·90	——	9·96	2·97	——	=100·15 Wislicenus.
12. Massachusetts, *bk.*		28·86	49·19	3·20	$\dot{M}$ 1·28	13·32	2·24	0·43	=98·52 Ramm.
13. Airolo, *black*		33·45	47·23	16·51	——	——	1·99	——	=99·18 Jacobson.
14. "		32·99	47·92	16·65	——	——	1·66	——	=99·22 Jacobson.
15. "		43·26	40·45	2·40	——	10·92	2·09	0·45	=99·57 Ramm.
16. Brittany		33·00	44·00	13·00	1·0	——	——	——, $\dot{Ca}$ 3·84	=94·84 Vauq.
17. "		39·19	44·87	15·09	0·17	——	0·32	——	=99·64 Jacobson.
18. "		40·35	44·22	15·77	0·10	——	——	——	=100·44 Jacobson.
19. "		50·75	34·86	2·86	*tr.*	10·45	1·80	0·38	=101·10 Ramm.
20. Pitkaranta		51·32	34·30	——	$\dot{M}$ 0·42	11·01	2·32	0·59	=99·96 Ramm.
21. Polevskoi, Ural		38·68	47·43	15·06	——	——	2·44	——	=103·61 Jacobson.
22. "		38·33	45·97	14·60	——	——	2·47	——	=101·37 Jacobson.
23. Goldenstein, *bn.*		35·15	44·02	0·88	$\dot{M}$ 1·41	12·16	3·06	1·27	=97·95 Ramm.

	$\ddot{S}i$	$\bar{A}l$	$\bar{F}e$	$\dot{M}n$	$\dot{F}e$	$\dot{M}g$	ign.
24. Franconia, *bn.*	35·36	48·67	2·27	*tr.*	13·05	2·19	0·27=101·80 Ramm.
25. Litchfield, Ct., *bk.*	36·92	42·92	1·85	0·70	12·80	2·93	1·00=98·82 Ramm.
26. Lisbon, N. H.	49·10	37·70	——	*tr.*	10·69	1·64	0·68=99·81 Ramm.
27. Canton, Ga.	(⅓) 28·82	49·21	9·51	0·15	——	3·22	1·47, $\dot{Z}n$ 7·13, $\ddot{T}i$ 0·84, Cu Ag *tr.*=100·35 Genth
28. Nordmark, Sweden	36·05	35·18	13·73	$\bar{M}n$ 11·61	——	——	2·51=99·08 Paykull.

In No. 2, G.=3·737—3·744; 4–7, G.=3·797 in pieces, 3·744 in powder; 12, G.=3·772; 13, 14, G.=3·66—3·73; 17, 18, G.=3·528; 20, G.=3·265; 21, 22, G.=3·549, 3·588; 23, G.=3·66; 24, G.=3·764; 25, G.=3·622; 26, G.=3·413; 27, zinc-staurolite, G.=3·792.

Lechartier obtained (Bull. Soc. Ch., II. iii. 375) the following results after purification:

	1, 2. St. Gothard.		3, 4. Brittany.		5. Quimper.	6. Bolivia.
Silica	28·21	28·48	28·16	28·98	29·15	29·07
Ign.	1·50	1·50	1·55	1·43	1·49	1·30
Sp. Gr.	3·75	3·74	3·75	3·70	3·76	

Before purification the silica obtained by him was for 2, 36·30; 3, 46·21—54·15; 4, 49·39; 5, 41·36 p. c. Nos. 3, 4, 5, 6 were large opaque crystals. He observes that all staurolite contains titanic acid, and that some magnesia is present.

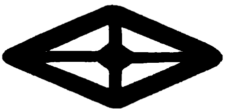
Pyr., etc.—B.B. infusible, excepting the manganesian variety (anal. 28), which fuses easily to a black magnetic glass. With the fluxes gives reactions for iron, and sometimes for manganese. Imperfectly decomposed by sulphuric acid.

Obs.—Usually found in mica schist, argillaceous schist, and gneiss; often associated with garnet, cyanite, and tourmaline.

Occurs with cyanite in *paragonite* schist, at Mt. Campione, Switzerland, in polished, brown, translucent crystals; at the Greiner mountain, Tyrol, in simple crystals associated with cyanite, and sometimes appearing as a continuation of its crystals, parallel with them; near Lake Como; in the Tyrol; at Goldenstein in Moravia, brown and translucent; in large twin crystals in Brittany; at Tornduff and near Killiney in Ireland; at Oporto, St. Jago de Compostella, and at other localities mentioned above.

Abundant throughout the mica slate of New England. In *Maine*, at Windham, near the bridge, the mica slate is filled with large crystals; also at Mt. Abraham, Hartwell, and Winthrop. In *N. Hamp.*, brown and large cryst. at Franconia; at Lisbon, abundant in mica slate; on the shores of Mink Pond, loose in the soil; at Grantham, 2 m. from Meriden, of a gray color. In *Vermont*, at Cabot. In *Mass.*, at Chesterfield, in fine crystals. In *Conn.*, at Bolton, Vernon, Litchfield, Stafford, and Tolland. In *New York*, small crystals at the Foss ore bed in Dover, Duchess Co.; also three and a half miles from New York city, on the Hudson. In *Penn.*, reddish-brown cryst. abundant on the Wissahiccon 8 m. from Philadelphia. In *Georgia*, at the lead mine, Canton, in quartzose mica schist, the gangue of the lead ore.

379



Dr. C. T. Jackson has described a variety of staurolite in tesselated crystals like chiastolite, from Charlestown, N. H., as represented in the accompanying figure. He states that the staurolite macles pass by insensible shades into andalusite macles, where the mica slate passes into argillaceous slate.

Named from σταυρός, *a cross.* Haüy's change of *staurolite* to *staurotide* was neither necessary nor reasonable.

Alt.—Occurs altered to steatite.

334. SCHORLOMITE. *Shepard*, Am. J. Sci., II. ii. 251, 1846. Ferrotitanite *Whitney*, J. Nat Hist., Boston, vi. 46, 1849. ? Iwaarit *Kutorga*, 1851, *N. Nord.*, Verz. Finl. Min. 1852.

Massive, without cleavage.

H.=7—7·5. G.=3·862, Shepard; 3·807, Whitney; 3·783, in coarse powder, Rammelsberg; 3·745, fr. Kaiserstuhl, Claus. Color black, sometimes tarnished blue, and with pavonine tints; streak grayish-black. Lustre vitreous. Fracture conchoidal.

Comp.—O. ratio for $\dot{R}+\bar{R}+\ddot{R}$ (bases), and silica=2 : 1 nearly, and for $\dot{R}$, $\ddot{R}$, $\bar{R}$=4 : 4 : 3 whence $(\frac{1}{4}\dot{C}a^3+\frac{1}{4}\bar{F}e+\frac{1}{4}\ddot{T}i^{\frac{3}{2}})^4\ddot{S}i^3$, and approaching closely the Coromandel tscheffkinite, bu containing no cerium, and sesquioxyd of iron in place of alumina. Whitney deduced $\dot{\mathrm{C}}\mathrm{a}^3\dddot{\mathrm{S}}\mathrm{i}+\ddot{\bar{\mathrm{F}}}\mathrm{e}\dddot{\mathrm{S}}\mathrm{i}+\dot{\mathrm{C}}\mathrm{a}\ddot{\mathrm{T}}\mathrm{i}^2$=Silica 24·9, oxyd of iron, 21·9, lime 30·7, titanic acid 22·5=100. In Rammelsberg's second analysis, the silica was determined only by the loss, and in two of the other analyses there was titanic acid remaining with the silica.

Analyses: 1, 2, Whitney (l. c.); 3, 4, Rammelsberg (Pogg., lxxvii. lxxxv., and Min. Ch., 886, former analysis revised); 5, Crossley (This Min., 3d edit., 692); 6, Claus (Ann. Ch. Pharm., cxxix. 213):

	$\dddot{\mathrm{S}}\mathrm{i}$	$\ddot{\mathrm{T}}\mathrm{i}$	$\ddot{\bar{\mathrm{F}}}\mathrm{e}$	$\dot{\mathrm{M}}\mathrm{g}$	$\dot{\mathrm{C}}\mathrm{a}$
1. Arkansas	25·66	22·10	21·58	——	29·78=99·12 Whitney.
2. "	27·89ᵃ	20·43	21·90	——	30·05=100·27 Whitney.
3. "	26·09	17·36	25·36ᵃ	1·55	31·12=101·48 Ramm.
4. "	[26·24]	21·34	20·11	1·36	29·38, $\dot{\mathrm{F}}\mathrm{e}$ 1·57=100 Ramm.
5. "	26·36ᵃ	21·56	22·00	1·25	30·72, $\ddot{\bar{\mathrm{M}}}\mathrm{n}$ *tr.*=101·89 Crossley.
6. Kaiserstuhl	29·55	21·18	18·08	1·22	25·13, $\dot{\mathrm{K}}$, $\dot{\mathrm{N}}\mathrm{a}$ 4·22=99·38 Claus.

ᵃ With some titanic acid.

The mineral was first correctly described and analyzed by Whitney. Shepard made it a hydrous silicate of sesquioxyd of iron, yttria, and perhaps thoria.

Pyr., etc.—B.B. fuses quietly at 3 to a black glass. Reactions for iron with the fluxes. Fused with salt of phosphorus on charcoal, with tin, in the inner flame, gives a violet bead. Gelatinizes with muriatic acid, the solution becoming violet when boiled with metallic tin.

Obs.—In small masses with elæolite and brookite in the Ozark Mts., Magnet Cove, Arkansas. The dodecahedral crystals reported by Shepard are black garnets, which occur with it. Found also in the Kaiserstuhl, in the vicinity of Oberschaffhausen, in phonolite.

Named from a resemblance to schorl (black tourmaline).

IVAARITE. As described by Nordenskiöld (Beskr. Finl. Min., 1855, 101), it has the characters of schorlomite, and like it is found with elæolite. It occurs, he states, both massive and in garnet-like crystals, is lustrous black and opaque, with the lustre adamantine; has H.=6·0, and G.=3·67—3·69. The mineral is stated to consist of 6 $\dddot{\mathrm{S}}\mathrm{i}$, 3 $\ddot{\mathrm{T}}\mathrm{i}$, 2 $\ddot{\bar{\mathrm{F}}}\mathrm{e}$, 6 $\dot{\mathrm{C}}\mathrm{a}$, which corresponds to the O. ratio for bases and silica 3 : 2, instead of 2 : 1, the schorlomite ratio. B.B. fuses to a black glass. From Ivaara, Finland.

335. SAPPHIRINE. Sapphirin (fr. Greenland) *Giesecke*, Stromeyer's Unters., i. 391. Sapphirine. Sapphirin pt. [rest blue Spinel] *Hausm.*, Handb., 427, 1847.

Orthorhombic ? In disseminated grains, or aggregations of grains.

H.=7—8. G.=3·42—3·48 ; 3·473, Damour. Lustre vitreous. Color pale blue or green. Translucent. Optically biaxial ; and dichroic.

Comp.—O. ratio for $\dot{\mathrm{R}}$, $\ddot{\bar{\mathrm{R}}}$, $\dddot{\mathrm{S}}\mathrm{i}$=1 : 4 : 1; for bases and silica=5 : 1; constituents, 3 $\dot{\mathrm{M}}\mathrm{g}$+4 $\ddot{\bar{\mathrm{A}}}\mathrm{l}$+1½ $\dddot{\mathrm{S}}\mathrm{i}$=Silica 14·5, alumina 66·2, magnesia 19·3=100. The biaxial polarization shows that it is not impure corundum or spinel. Perhaps $(\tfrac{1}{2}\dot{\mathrm{M}}\mathrm{g}^3+\tfrac{1}{2}\ddot{\bar{\mathrm{A}}}\mathrm{l})^4\dddot{\mathrm{S}}\mathrm{i}^3+6\ddot{\bar{\mathrm{A}}}\mathrm{l}$, or a staurolite with corundum as an accessory. Possibly a 5 : 1 subsilicate. Analyses: 1 Stromeyer (Unters., i. 391); 2, 3, Damour (Bull. G. Soc., II. vi. 317, 1849):

	$\dddot{\mathrm{S}}\mathrm{i}$	$\ddot{\bar{\mathrm{A}}}\mathrm{l}$	$\dot{\mathrm{M}}\mathrm{g}$	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\mathrm{F}}\mathrm{e}$
1.	14·51	63·11	16·85	0·38	3·92, $\ddot{\bar{\mathrm{M}}}\mathrm{n}$ 0·53, ign. 0·49=99·78 Stromeyer.
2.	14·88	63·31	19·06	——	2·09=99·34 Damour.
3.	14·84	63·20	19·50	——	1·90=99·44 Damour.

Pyr., etc.—B.B. alone and with borax infusible, unaltered.

Obs.—Associated with mica and anthophyllite at Fiskenaes in Greenland.

The name alludes to the sapphire color.

APPENDIX TO ANHYDROUS SILICATES.

336. EULYTITE. Arsenik-Wismuth *Wern.*, *Breith.*, Lotzt. Min. Syst., 23, 62, Hoffm. Min., IV. a, 65, 1817. Wismutblende, Eulytin, *Breith.*, Pogg., ix. 275, 1827; Handb., 303. Wismutisches Blende-Erz *Breith.*, Uib., 66, 1830, Char., 239, 1832. Kieselwismuth *Kersten*, Pogg., xxvii. 81, 1833. Silicate of Bismuth.

Isometric: tetrahedral. Usually in minute crystals, and edges often rounded, figs. 34, 35. Observed planes: 1, *O*, 2-2. Cleavage: dodecahedral, very imperfect. Twins: plane of composition parallel to a dodecahedral face. Crystals often in groups. Sometimes globular, and columnar, lamellar, or granular.

H.=4·5. G.=5·912—6·006. Lustre resinous or adamantine. Color dark hair-brown, yellowish-gray, grayish-white, and straw-yellow. Streak yellowish-gray or uncolored. Subtransparent—opaque. Fracture uneven. Rather brittle.

Comp.—Probably $\dddot{\overline{\mathrm{Bi}}}^4\,\dddot{\mathrm{Si}}^9$, with some phosphate and fluorid of iron, Frankenheim. Analysis by Kersten (Pogg., xxvii. 81):

$\dddot{\mathrm{Si}}$ 22·23 $\dddot{\overline{\mathrm{Bi}}}$ 69·38 $\overset{.....}{\overline{\mathrm{P}}}$ 3·31 $\dddot{\overline{\mathrm{Fe}}}$ 2·40 $\dddot{\overline{\mathrm{Mn}}}$ 0 30 HF, $\dot{\mathrm{H}}$, and loss 2·38=100.

Pyr., etc.—In a matrass decrepitates and affords a trace of water. B.B. fuses to a dark-yellow mass, and gives out inodorous fumes. Fuses and froths on charcoal, staining it yellowish-brown, sometimes with a tinge of green. Fuses readily with soda to a button, at first greenish-yellow and then reddish-yellow, and finally affords metallic bismuth. With salt of phosphorus it fuses to a yellow globule, with a silica skeleton, which becomes colorless on cooling.

Obs.—Found with native bismuth near Schneeberg, Saxony, in quartz, and at Bräunsdorf, near Freiberg.

Named from εὔλυτος, *easily dissolved*, or *fusible.*

337. ATELESTITE. *Breith.*, Char., 306, 1832.

Occurs in small monoclinic crystals, at Schneeberg, with eulytite: they have a sulphur-yellow color, adamantine lustre, H. about 5, and are transparent to translucent. Descloizeaux observes that some of the crystals, having the form of a rhombic octahedron, polarize light strongly.

Contains bismuth, but exact composition not ascertained.

338. HYPOCHLORITE. Sogenannter Grüneisenerde von Schneeberg, Hypochlorit, *Schüler*, Schw. J., lxvi. 41, 1832, Dissert. de Ferro ochr., etc., *Jenæ*, 1832.

Minute crystalline; also earthy. H.=6. G.=2·9—3·04. Lustre vitreous, feeble. Color green. Streak light green. Brittle; fracture even to flat conchoidal.

Comp.—Analysis by Schüler (l. c.):

$\dddot{\mathrm{Si}}$ 50·24 $\dddot{\overline{\mathrm{Al}}}$ 14·65 $\dddot{\overline{\mathrm{Bi}}}$ 13·03 $\dddot{\overline{\mathrm{Fe}}}$ 10·54 $\overset{.....}{\overline{\mathrm{P}}}$ 9·62 Mn *tr.*

Perhaps a mixture of a silicate of bismuth and iron, and a phosphate of alumina.

B.B. grows dark, but infusible; a yellow deposit on the coal. Insoluble in acids.

In minute crystals and grains, or massive and earthy, with native bismuth and cobalt ores, at Schneeberg, Johanngeorgenstadt, and Bräunsdorf, in Saxony. Also reported from Ullersreuth, Voigtland, in a bed of limonite.

Named from ὑπόχλωρος, on account of its green chlorite-like color.

338A. ISOPYRE. *Turner*, Ed. New Phil. J., iii. 263, 1827.

In compact masses, with cleavage.

H.=6—6·5. G.=2·9—3. Lustre vitreous. Streak light greenish-gray. Color grayish or velvet-black, occasionally spotted red, like heliotrope. Opaque—subtranslucent. Fracture flat conchoidal. Brittle. Acts slightly on the magnetic needle.

Comp.—O. ratio for $\dot{\mathrm{R}}$, $\dddot{\overline{\mathrm{R}}}$, $\dddot{\mathrm{Si}}$, 1 : 3 : 6, as in labradorite. Analysis by Turner (l. c.):

$\dddot{\mathrm{Si}}$ 47·09 $\dddot{\overline{\mathrm{Al}}}$ 13·91 $\dddot{\overline{\mathrm{Fe}}}$ 20·07 $\dot{\mathrm{Ca}}$ 15·43 $\dot{\mathrm{Cu}}$ 1·94=98·44.

Part of the iron is supposed to be protoxyd, judging from the color of the mineral.

B.B. fuses easily to a magnetic bead, and colors the flame green. A silica skeleton with salt of phosphorus. With the acids decomposed with difficulty and imperfectly.

From St. Just, near Penzance, in a quartzose granite with tourmaline and tin ore, in pieces two inches in diameter. Also in breccia on the Calton Hill, Edinburgh, with limonite.

B. HYDROUS SILICATES.

Arrangement of the Species.

I. THE GENERAL SECTION OF HYDROUS SILICATES. Includes all Hydrous Silicates, excepting the Zeolites and the Margarophyllites.

1. Bisilicates.
2. Unisilicates.
3. Subsilicates.

II. ZEOLITE SECTION. Feldspar-like in constituents and oxygen ratio; the bases being alumina, and the alkalies and alkaline earths (K, $\dot{N}a$, $\dot{C}a$, $\dot{B}a$, $\dot{S}r$), to the almost total exclusion of magnesia and iron; and the oxygen ratio between the protoxyd and sesquioxyd bases being 1 : 3.

III. MARGAROPHYLLITE SECTION. Micaceous or thin foliated when crystallized; and plane angle of base of prism 120°.

On account of the uncertainties with respect to the relations of the water in hydrous silicates, the basis for a true classification of them is to a large extent wanting. From the dominance among anhydrous silicates of the grand subdivisions of Bisilicates, Unisilicates, and Subsilicates, the same groups might be reasonably looked for among the hydrous. But the formulas of very many of the species may be written according to either of these types, by making more, or less, or none, of the water basic; and consequently all attempts to define the limits of the groups must be at present unsatisfactory. Crystallographic and other relations to anhydrous species give help, but not always sure guidance.

The following examples elucidate some of the reasons for referring species to the section of Bisilicates rather than that of Unisilicates, or the reverse:

Laumontite (No. 342, beyond) has a close approximation in crystalline form to pyroxene, and this suggests a relation to the Bisilicates; moreover, its formula is wholly pyroxene-like, if the water is *not* basic. It is to be noted that part of the water escapes on heating to 100° C. There is the same relation in form between *pectolite* and pyroxene, as long since shown by Frankenheim; and the same formula also, if the water, here a more stable constituent, *is* basic. *Okenite* is very near hornblende, or another anhydrous bisilicate, in its crystallization; and it is also like it in formula, if *half* the water is basic. In each of these cases crystallography appears to show whether any of the water, and how much, is basic. Again, *dioptase* has the angles nearly, and the bisilicate ratio, of beryl, if the water be *not* basic.

Prehnite has an affinity in its crystallization to chrysolite; and, if the water is *all* basic, the oxygen ratio for the bases and silica is 1 : 1, or that of a Unisilicate, as in chrysolite. Calamine is approximately isomorphous with prehnite, and, moreover, both are pyroelectric; and the oxygen ratio is 1 : 1, if the water is *not* basic. *Fahlunite*, a result of the alteration of iolite, is equivalent to iolite *plus* water. Iolite is a $\frac{5}{4}$ silicate, there being a deficiency of base for a true unisilicate; but the added water just fills up the deficiency, so that, if the water is basic, the species is strictly a Unisilicate, the O. ratio for $\dot{R}$, $\bar{R}$, $\dddot{Si}$, $\dot{H}$ being 1 : 3 : 5 : 1, or for the bases $\dot{R}+\bar{R}+\dot{H}$ and silica, 5 : 5 = 1 : 1. There seems to be no reason for questioning this basic relation of the water; it is probable that the deficiency of base may lead to the easy absorption of water so characteristic of iolite. In other alterations of iolite still more water is taken up, so that the O. ratio is 1 : 3 : 5 : 2; the compound is apparently the same, but with twice the proportion of water, only one-half of it in this case being basic. The same remarks are applicable to margarodite and other hydrous micas in their relations to muscovite and the anhydrous micas.

Apophyllite crystallizes in tetragonal forms—forms that are common among anhydrous Unisil cates, and are unknown among Bisilicates. The species is therefore arranged beyond as a Un silicate, but as a representative of the Scapolite group of anhydrous silicates. *Trilomite* and *Thori* are *isometric* species, and related to helvite and garnet; and they are Unisilicates, like garnet, i the water be *not* basic.

From these examples it is apparent that the facts give only probable conclusions. It is to l hoped that chemistry will soon furnish principles that are encumbered with less of doubt.

The group of *Zeolites* includes species that are feldspar-like in having among them the oxyge ratios for the protoxyds, alumina, and silica 1 : 3 : 4, 1 : 3 : 6, 1 : 3 : 8, 1 : 3 : 9, 1 : 3 : 12, wit the only difference that water is present in addition. They are therefore sometimes spoken of a representatives among hydrous silicates of the anhydrous feldspars. But this inference, thoug apparently sustained by the oxygen ratios, is far from right. It assumes that the water is not basi If it be basic, then the species may be ordinary Bisilicates or Unisilicates, quite remote from th feldspars. Looking to the crystallization, it is found that there is, in fact, nothing whatever to sustain the relation to the feldspars. The species of the Feldspar group are almost identical in angle and physical characters; while the zeolites are exceedingly diverse in both respects, and none hav the feldspar form or angles. Nearly all the systems of crystallization are represented among them and with a very wide range in angles. The feldspars have the prismatic angle near 120°; whil the zeolites that approach the feldspars most nearly—that is, the *Stilbite* group, in which the oxygen ratio is 1 : 3 : 12, and the crystallization is in part oblique—have the prismatic angle near 90 in one species, and from 130° to 136° in others. The hexagonal species, chabazite, levynite, an gmelinite, usually made a subgroup among the zeolites, have widely different rhombohedral angles

While, then, there is seeming unity in the group of zeolites, there is actually the widest diversity; and, when fully understood, they will probably have their places among the Unisilicates an Bisilicates of the first section. Analcite, which is included among the zeolites, is related in form to the feldspars, and in both form and formula (the water being excluded) to the anhydrous sili cate, leucite.

The *Margarophyllites* appear to constitute a strictly natural group, although under a very vari ous chemical constitution. They are foliated in structure like the micas, and, like them, have the plane angle of the base of the prism 120°, the crystallization being either hexagonal or prismatic, with the angles of base 120° and 60°. They include talc and pyrophyllite, margarodite and other hydrous micas, chlorite, margarite, etc.; with also kaolinite and serpentine, which have the same crystallization; and to these are added some species not yet known in the crystallized state, which appear to be chemically allied to the margarophyllites. The true margarophyllites are below 5 in hardness; greasy to the feel, at least when finely powdered; and not sparry in appearance when massive, unless through pseudomorphism, in which case this sparry character is that of the original mineral altered to make them.

I. GENERAL SECTION OF HYDROUS SILICATES.

ARRANGEMENT OF THE SPECIES.

The oxygen ratios of the species are given after the tables of formulas; the 1st column, the O. ratio for $\dot{\mathrm{R}}$, $\dddot{\bar{\mathrm{R}}}$, $\ddot{\mathrm{Si}}$, $\dot{\mathrm{H}}$; 2d column for $\dot{\mathrm{R}}+\dddot{\bar{\mathrm{R}}}$ (or bases), $\ddot{\mathrm{Si}}$, $\dot{\mathrm{H}}$. After the $\dot{\mathrm{H}}$ in the latter column, a fraction is added, giving the proportion of the water that is required to be added to the bases to make the ratio that of the formula. In *pectolite*, for example, all the water is to be added to the bases; this making the ratio of bases to silica 5 + 1 : 12 = 1 : 2.

I. BISILICATES.

I. PECTOLITE OR PYROXENOID GROUP. Monoclinic, and isomorphous with the Amphi bole group (p. 207).

339. PECTOLITE	$(\frac{5}{6}(\dot{\mathrm{C}}\mathrm{a}, \dot{\mathrm{N}}\mathrm{a})+\frac{1}{6}\dot{\mathrm{H}})\ddot{\mathrm{Si}}$	$\mathrm{Si}\,\Theta\|\Theta_2\|(\frac{1}{6}\mathrm{H}_2+\frac{5}{6}(\mathrm{Na}_2,\mathrm{Ca}))$
340. XONALTITE	$\dot{\mathrm{C}}\mathrm{a}\,\ddot{\mathrm{Si}}+\frac{1}{4}\dot{\mathrm{H}}$	$\mathrm{Si}\,\Theta\|\Theta_2\|\mathrm{Ca}+\frac{1}{4}\,\mathrm{aq}$

341. **Okenite**	$(\frac{1}{2}\dot{Ca}+\frac{1}{2}\dot{H})\ddot{Si}+\frac{1}{2}\dot{H}$	$Si\,\Theta\|\Theta_2\|(\frac{1}{2}H_2+\frac{1}{2}Ca)+\frac{1}{2}aq$
342. **Gyrolite**	$(\frac{2}{3}\dot{Ca}+\frac{1}{3}\dot{H})\ddot{Si}+\dot{H}$	$Si\,\Theta\|\Theta_2\|(\frac{1}{3}H_2+\frac{2}{3}Ca)+aq$
343. **Laumontite**	$(\frac{1}{4}\dot{Ca}^3+\frac{3}{4}\dddot{Al})\ddot{Si}^2+3\dot{H}$	$Si\,\Theta\|\Theta_2\|(\frac{1}{4}Ca+\frac{3}{4}\beta Al)+aq$
343A. **Leonhardite**		

II. DIOPTASE (OR BERYLLOID) GROUP. Hexagonal.

344. **Catapleiite**	$(\frac{1}{3}(\dot{Na},\dot{Ca})^3+\frac{2}{3}\ddot{Zr})\ddot{Si}^3+1\frac{1}{3}\dot{H}$	$Si\,\Theta\|\Theta_2\|(\frac{1}{3}(Na_2,Ca)+\frac{2}{3}\gamma\ddot{Zr})+aq$
345. **Dioptase**	$\dot{Cu}\ddot{Si}+\dot{H}$	$Si\,\Theta\|\Theta_2\|Cu$
346. **Chrysocolla**	$\dot{Cu}\ddot{Si}+2\dot{H}$	$Si\,\Theta\|\Theta_2\|Cu+2aq$
347. **Alipite**	$(\frac{2}{3}(\dot{Ni},\dot{Mg})+\frac{1}{3}\dot{H})\ddot{Si}$	$Si\,\Theta\|\Theta_2\|(\frac{1}{3}H_2+\frac{2}{3}(Ni,Mg))$
348. **Conarite**		

III. PICROSMINE GROUP.

349. **Picrosmine**	$\dot{Mg}\ddot{Si}+\frac{1}{2}\dot{H}$	$Si\,\Theta\|\Theta_2\|Mg+\frac{1}{2}aq$
350. **Spadaite**	$(\frac{5}{6}\dot{Mg}+\frac{1}{6}\dot{H})\ddot{Si}+\frac{1}{3}\dot{H}$	$Si\,\Theta\|\Theta_2\|(\frac{1}{6}H_2+\frac{5}{6}Mg)+\frac{1}{3}aq$

Appendix.—351—356, **Pyrallolite, Picrophyll, Traversellite, Pitkarandite, Strakonitzite, Monradite**; 357, **Neolite**, 9 $\dot{Mg}$, $\dddot{Al}$, 9 $\ddot{Si}$, $4\frac{1}{2}$ $\dot{H}$; 358, **Paligorskite**, 6 $\dot{Mg}$, 5 $\dddot{Al}$, 24 $\ddot{Si}$, 18 $\dot{H}$; 359, **Xylotile**, $\dot{Mg}$, $\dot{Fe}$, $\dddot{Fe}$, $\ddot{Si}$; 360, **Anthosiderite**, $\dddot{Fe}$, $\ddot{Si}$, $\dot{H}$.

	$\dot{R}$	$\dddot{R}$	$\ddot{Si}$	$\dot{H}$	$\dot{R}\dddot{R}$	$\ddot{Si}$	$\dot{H}$		$\dot{R}$	$\dddot{R}$	$\ddot{Si}$	$\dot{H}$	$\dot{R}\dddot{R}$	$\ddot{Si}$	$\dot{H}$
Pectolite	5		12	1	5	12	1 ($\frac{1}{6}$)	Catapleiite	1	2	6	2	1	2	$\frac{2}{3}$
Xonaltite	4		8	1	4	8	1	Dioptase	1		2	1	1	2	1
Okenite	1		4	2	1	4	2 ($\frac{1}{2}$)	Chrysocolla	1		2	2	1	2	2
Laumontite	1	3	8	4	1	2	1	Picrosmine	1		2	$\frac{1}{2}$	1	2	$\frac{1}{2}$
Leonhardite (?)								Spadaite	5		12	4	5	12	4 ($\frac{1}{3}$)

II. UNISILICATES.

I. CALAMINE (OR CHRYSOLITHOID) GROUP. Orthorhombic. Approximately isomorphous with chrysolite.

361. **Calamine**	$\dot{Zn}^2\ddot{Si}+\dot{H}$	$Si\|\Theta_4\|(Zn_2+aq$
362. **Villarsite**	$(\dot{Mg},\dot{Fe})^2\ddot{Si}+\frac{1}{2}\dot{H}$	$Si\|\Theta_4\|(Mg,Fe)_2+\frac{1}{2}aq$
363. **Prehnite**	$(\frac{1}{6}\dot{H}^3+\frac{2}{3}\dot{Ca}^3+\frac{2}{3}\dddot{Al})^2\ddot{Si}^3$	$Si\|\Theta_4\|(\frac{1}{6}H_2+\frac{2}{3}Ca+\frac{2}{3}\beta Al)_2$
364. **Chlorastrolite**	$(\frac{1}{3}(\dot{Ca},\dot{Na})^3+\frac{2}{3}(\dddot{Al},\dddot{Fe}))^2\ddot{Si}^3+2\dot{H}$	$Si\|\Theta_4\|(\frac{1}{3}(Na_2,Ca)+\frac{2}{3}\beta(Al,Fe))_2+\frac{2}{3}aq$

II. THORITE (OR HELVITOID) GROUP. Isometric.

365. **Tritomite**	$\ddot{Si}$, $\dot{Ce}$, $\dot{La}$, $\dot{Di}$, $\dot{H}$, etc.	
366. **Thorite**	$\ddot{Th}\ddot{Si}+1\frac{1}{2}\dot{H}$	$Si\|\Theta_4\|\ Th_2+1\frac{1}{2}aq$
367. **Cerite**	$(\dot{Ce},\dot{La},\dot{Di})^2\ddot{Si}+\dot{H}$	$Si\|\Theta_4\|(Ce,La,Di)_2+aq$
368. **Erdmannite**		

III. PYROSMALITE GROUP. Hexagonal.

369. **Pyrosmalite**	$(\frac{1}{3}\dot{H}+\frac{2}{3}(\dot{Fe},Mn.\,FeCl))^2\ddot{Si}$	$Si\|(\Theta,Cl_2)_4\|(\frac{1}{3}H_2+\frac{2}{3}(Fe,Mn))_2$

IV. APOPHYLLITE GROUP. Tetragonal, with perfect basal cleavage.

370. APOPHYLLITE	$(\dot{\mathrm{H}}, \dot{\mathrm{C}}\mathrm{a}, \dot{\mathrm{K}})^2 \ddot{\mathrm{S}}\mathrm{i} + \dot{\mathrm{H}} \ddot{\mathrm{S}}\mathrm{i}$	$\mathrm{Si}\|\Theta_4\|(\frac{1}{2}\mathrm{H}_2+\frac{1}{2}(\mathrm{K}_2,\mathrm{Ca}))_2+\mathrm{H}_2\mathrm{Si}\Theta$

V. GISMONDITE GROUP. Tetragonal and hemihedral, or orthorhombic; lateral cleavage in short and small crystals.

371. EDINGTONITE	$?(\frac{1}{7}\dot{\mathrm{H}}+\frac{6}{7}\dot{\mathrm{B}}\mathrm{a})^2\ddot{\mathrm{S}}\mathrm{i}+\frac{4}{7}\dot{\mathrm{H}}$	$\mathrm{Si}\|\Theta_4\|(\frac{1}{7}\mathrm{H}_2+\frac{6}{7}\mathrm{Ba})_2+\frac{4}{7}\,\mathrm{aq}$
372. GISMONDITE	$(\frac{2}{3}\dot{\mathrm{C}}\mathrm{a}+\frac{1}{3}\dot{\mathrm{K}})+\ddot{\bar{\mathrm{A}}}\mathrm{l}, 2\frac{1}{4}\ddot{\mathrm{S}}\mathrm{i}, 4\frac{1}{2}\dot{\mathrm{H}}$	

VI. CARPHOLITE GROUP.

373. CARPHOLITE	$(\ddot{\bar{\mathrm{A}}}\mathrm{l}, \ddot{\bar{\mathrm{M}}}\mathrm{n}, \ddot{\bar{\mathrm{F}}}\mathrm{e})^2\ddot{\mathrm{S}}\mathrm{i}^3+3\dot{\mathrm{H}}$	$\mathrm{Si}\|\Theta_4\|\beta(\bar{\mathrm{A}}\mathrm{l}, \bar{\mathrm{M}}\mathrm{n}, \bar{\mathrm{F}}\mathrm{e})_2+\mathrm{aq}$

	$\dot{\mathrm{R}}$	$\ddot{\bar{\mathrm{R}}}$	$\ddot{\mathrm{S}}\mathrm{i}$	$\dot{\mathrm{H}}$	$\dot{\mathrm{R}}\ddot{\bar{\mathrm{R}}}$	$\ddot{\mathrm{S}}\mathrm{i}$	$\dot{\mathrm{H}}$		$\dot{\mathrm{R}}$	$\ddot{\bar{\mathrm{R}}}$	$\ddot{\mathrm{S}}\mathrm{i}$	$\dot{\mathrm{H}}$	$\dot{\mathrm{R}}\ddot{\bar{\mathrm{R}}}$	$\ddot{\mathrm{S}}\mathrm{i}$	$\dot{\mathrm{H}}$
Calamine	1		1	½	1	1	½	Pyrosmalite	2		3	1	2	3	1
Villarsite	1		1	¼	1	1	¼	Apophyllite	1		4	2			
Prehnite	2	3	6	1	5	6	1 (⅙)	? Edingtonite	1	4	7	4	5	7	4 (½)
? Chlorastrolite	1	2	3	1	1	1	⅓	Gismondite	1	3	4½	4½	4	4½	4½
Thorite	1		1	⅔	1	1	⅔	Carpholite		1	1	½	1	1	½
? Cerite	1		1	½	1	1	½								

III. SUBSILICATES.

374. ALLOPHANE	$\ddot{\bar{\mathrm{A}}}\mathrm{l}\ddot{\mathrm{S}}\mathrm{i}+6\dot{\mathrm{H}}$ (or $5\dot{\mathrm{H}}$)	$\beta\bar{\mathrm{A}}\mathrm{l}_2\Theta\|\Theta_4\|\mathrm{Si}+n\,\mathrm{aq}$
375. COLLYRITE	$\ddot{\bar{\mathrm{A}}}\mathrm{l}^2\ddot{\mathrm{S}}\mathrm{i}+9\dot{\mathrm{H}}$	=1 Allophane+1 Gibbsite
376. SCHRÖTTERITE	$\ddot{\bar{\mathrm{A}}}\mathrm{l}^8\ddot{\mathrm{S}}\mathrm{i}^3+30\dot{\mathrm{H}}$	=3 Allophane+5 Gibbsite

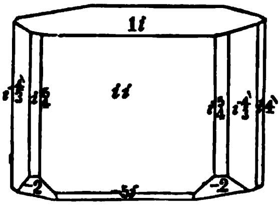
The O. ratio for $\ddot{\bar{\mathrm{R}}}$, $\ddot{\mathrm{S}}\mathrm{i}$, $\dot{\mathrm{H}}$ in Allophane is 3 : 2 : 6; in Collyrite 6 : 2 : 9; in Schrötterite 4 : 1 : 5. The species Euclase (p. 379) and Datolite (p. 380) are true hydrous Subsilicates. The reason for placing them with the anhydrous species is stated on page 204.

I. BISILICATES.

339. PECTOLITE. Pektolith *v. Kobell*, Kastner's Arch., xiii. 385, 1828, xiv. 341. Photolith *Breith.*, Char., 181, 1832. Wollastonite, Stellite, *Thomson*, Min., i. 180, 313. Ratholite *some collectors.* Osmelith *Breith.*, Pogg., ix. 133, 1827.

Monoclinic, isomorphous with wollastonite. Observed planes: *O*; vertical, i-i, i-$\frac{5}{4}$, i-$\grave{3}$, i-$\grave{4}$; hemidomes, 1-i, −5-i; hemioctahedral, −2. Angles measured by Greg:

380



Ratho.

i-$i \wedge 1$-i=95° 23′
i-i, back, $\wedge 1$-i=84 37
i-$i \wedge i$-$\frac{5}{4}$=139 30
i-$i \wedge i$-$\grave{3}$=125° 55′
i-$i \wedge i$-$\grave{4}$=102 30
i-$i \wedge -2$=132 54

Cleavage: i-i (orthod.) perfect. Twins: composition-face i-i. In close aggregations of acicular crystals. Fibrous massive, radiated to stellate.

H.=5. G.=2·68—2·78. Lustre of the surface of fracture silky or subvitreous. Color whitish or grayish. Subtranslucent to opaque. Tough. For

Bergen mineral optic-axial plane parallel to orthodiagonal, and very nearly normal to *i-i*; acute bisectrix positive, parallel to orthodiagonal, and obtuse bisectrix nearly normal to cleavage-plane or *i-i*; axial angle in oil, through cleavage plates, 143°—145°; Descl.

Var.—Almost always columnar or fibrous, and divergent, the fibres often 2 or 3 inches long, and sometimes, as in Ayrshire, Scotland, a yard. Resembles in aspect fibrous varieties of natrolite, okenite, thomsonite, tremolite, and wollastonite. *Osmelite*, from Niederkirchen, near Wolfstein, Bavaria, is columnar and radiated; G.=2·799—2·833, Breith.; color grayish-white, yellowish, gray.

Comp.—O. ratio for $\dot{R}, \ddot{Si}, \dot{H}=5:12:1$; whence, if the water is basic, $(\frac{4}{6}\dot{C}a+\frac{1}{6}\dot{N}a+\frac{1}{6}\dot{H})\ddot{Si}$ =Silica 54·2, lime 33·8, soda 9·3, water 2·7=100. Analyses: 1. v. Kobell (Kastner's Arch. Nat., xiii. 385); 2, 3, J. D. Whitney (Jour. Soc. N. H. Bost., 1849, p. 86, and Am. J. Sci., II. vii. 434); 4, J. S. Kendall (ib.); 5, G. J. Dickinson (ib.); 6, J. D. Whitney (Am. J. Sci., II. xxix. 205); 7, A. J. Scott (Ed. N. Phil. J., liii. 277); 8, Heddle (Phil. Mag., IV. ix. 248); 9, Thomson (Min., i. 131); 10, Walker (Heddle, l. c.); 11, Kennedy (ib.); 12–16, Heddle (l. c.); 17, Adams (Millon, etc., Ann. d. Ch., 1848, 166); 18, v. Kobell (Ber. Ak. München 1866, i. 296, J. pr. Ch., xcvii. 493); 19, Igelström (J. pr. Ch., lxxxi. 396):

		$\ddot{Si}$	$\ddot{\bar{Al}}$	$\ddot{\bar{Fe}}$	$\dot{Mg}$	$\dot{C}a$	$\dot{N}a$	$\dot{K}$	$\dot{H}$
1.	M. Baldo	51·30	0·90		—	33·77	8·26	1·57	3·89=99·69 Kobell.
2.	I. Royale	53·45	4·94	—	—	31·21	7·37	*tr.*	2·72=99·69 Whitney.
3.	"	55·66	1·45	—	—	32·86	7·31	—	2·72=100 Whitney.
4.	Bergen Hill	54·00	1·90	—	—	32·10	8·89	*tr.*	2·96=99·85 Kendall.
5.	" "	55·00	1·10	—	—	32·53	9·72	—	2·75=101·10 Dickinson.
6.	" "	(⅓) 54·62	—	$\dot{F}e$ $1·11^{a}$	—	32·94	8·96	—	[2·37]=100 Whitney.
7.	Talisker, Skye	52·01	1·82	—	0·39	32·85	7·67	—	5·06=99·80 Scott.
8.	" "	53·82	2·73			29·88	9·55	—	3·76=99·74 Heddle.
9.	Kilsyth, *Wollast.*	52·74	0·67	$1·20^{b}$	1·52	31·68	9·60	—	2·00=99·42 Thomson.
10.	Costorphine Hill	54·00	—	—	2·59	30·79	5·55	—	5·43=98·36 Walker.
11.	Castle Rock, *Woll.*	51·5	1·0	—	—	32·0	8·5	—	5·0=98·0 Kennedy.
12.	" " "	53·06	0·75	—	—	33·48	9·98	—	3·13=100·40 Heddle.
13.	Ratho, *fibrous*	52·53	0·88	—	—	32·79	$9·75^{c}$	—	3·04=98·99 Heddle.
14.	" *crystalline*	52·58	1·46	—	—	33·75	9·26	—	2·80=98·84 Heddle.
15.	Knockdolian Hill	53·24	1·00	—	—	32·22	9·57	—	3·60=99·63 Heddle.
16.	Girvan	53·48	0·41	—	—	34·39	9·88	—	3·26=101·42 Heddle.
17.	Bavaria, *Osmelite*	52·91	0·86	—	—	32·96	6·10	2·79	4·01=99·63 Adam.
18.	" "	52·63	—	$0·37^{b}$	—	34·47	$8·28^{a}$	*tr.*	2·94, $\dot{M}n$ 1·75=100·44 K.
19.	Wermland	52·24	—	$1·75^{c}$	—	33·83	[8·48]		3·70=100 Igelström.

a With some Mn O. b The iron protoxyd. c With some K O.

Berzelius obtained a fluorine reaction with the Monzoni mineral. The analysis by Adam (No. 17) makes the *osmelite* identical with pectolite. Riegel obtained a very different result (Jahrb. f. pr. Pharm., xiii. 1); but v. Kobell has confirmed Adam's result, and shown that Riegel must have had in hand another mineral.

Pyr., etc.—In the closed tube yields water. B.B. fuses at 2 to a white enamel. Gelatinizes with muriatic acid. Often gives out light when broken in the dark.

Obs.—Occurs mostly in trap and related rocks, in cavities or seams; occasionally in metamorphic rocks. Found in Scotland at Ratho Quarry, and Castle Rock, near Edinburgh; at Kilsyth, Costorphine Hill, Loch End, Girvan, and Knockdolian Hill, in Ayrshire; and at Taliver, etc., I. Skye. Also at Mt. Baldo and Mt. Monzoni in the Tyrol, where first obtained; at an iron mine in Wermland, associated with chlorite and calcite.

Occurs also at Bergen Hill, N. J., in large and beautiful radiations; compact at Isle Royale, L. Superior.

Descloizeaux obtained from Bergen crystals, *i-i* ∧ 1-*i*=95° 30′ and 84° 30′. Wollastonite gives *i-i* ∧ 1-*i*=95° 23′, *i-i* ∧ -5-*i*=159° 32′, *i-i* ∧ *i*-½=140° 5′, *i-i* ∧ -2=93° 52′.

340. XONALTITE. Xonaltit *Rammelsberg*, ZS. G., xviii. 33, 1866.

Massive. Very hard. G.=2·71, white; 2·718, gray. Color white to bluish-gray. Tough. Fracture splintery.

O. ratio for $\dot{\mathrm{Ca}}$, $\ddot{\mathrm{Si}}$, $\dot{\mathrm{H}}$=4 : 8 : 1; whence 4 $\dot{\mathrm{Ca}}\,\ddot{\mathrm{Si}}+\dot{\mathrm{H}}$=Silica 49·80, lime 46·47, water 3·73=100. Analyses: 1, 2, Rammelsberg (l. c.):

	$\ddot{\mathrm{Si}}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Mn}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{H}}$
1. *White*	49·58	1·31	1·79	——	43·56	3·70=99·94 Rammelsberg.
2. *Gray*	50·25	2·28		0·19	43·92	4·07=100·71 Rammelsberg.

Yields water. Infusible [?]. Decomposed by muriatic acid (Ramm.). Occurs at Tetela – Xonalta, Mexico, in concentric layers, with apophyllite and bustamite.

341. OKENITE. Okenit *v. Kobell*, Kastner's Arch., xiv. 333, 1828. Dysclasite *Connel*, Ed. Phil. J., xvi. 198, 1834. Bordite *Adam*, Dufr. Miu., iv. 697, 1859.

Orthorhombic? $I \wedge I$=122° 19′, Breith. Composed of a congeries of minute acicular crystals; commonly fibrous; also compact.

H.=4·5–5. G.=2·28–2·37; 2·362 of dysclasite, Connel; 2·28 of okenite, v. Kobell. Lustre subpearly. Color white, with a shade of yellow or blue; often yellow by reflected light, and blue by transmitted. Frequently opalescent. Subtransparent—subtranslucent. Very tough.

Var.—*Bordite*, from Bordöe, one of the Faröe islands, is only a very fine fibrous milk-white okenite, firm in texture and very tough, and having H.=3·5, G.=2·33.

Comp.—O. ratio for $\dot{\mathrm{R}}$, $\ddot{\mathrm{Si}}$, $\dot{\mathrm{H}}$=1 : 4 : 2; whence, if half of the water is basic, 2 : 4 : 1; and the formula $(\frac{1}{2}\dot{\mathrm{H}}+\frac{1}{2}\dot{\mathrm{Ca}})\,\ddot{\mathrm{Si}}+\frac{1}{2}\dot{\mathrm{H}}$=Silica 56·6, lime 26·4, water 17·0=100. It has the prismatic angle nearly of amphibole, to which it is related in composition. Analyses: 1, 2, v. Kobell (l. c.); 3, Connel (l. c.); 4, Würth (Pogg., lv. 113); 5, v. Hauer (Jahrb. G. Reichs., 1854, 190); 6, Schmid (Pogg., cxxvi. 143); 7, Adam (l. c.):

	$\ddot{\mathrm{Si}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{H}}$
1. Greenland	55·64	26·59	17·00, $\ddot{\mathrm{Al}}$ and $\ddot{\mathrm{Fe}}$ 0·53, $\dot{\mathrm{K}}$ *tr.*=99·76 Kobell.
2. "	56·99	26·35	16·65=99·99 Kobell.
3. Faröe	57·69	26·83	14·71, $\dot{\mathrm{Mn}}$ 0·22, $\ddot{\mathrm{Fe}}$ 0·32, $\dot{\mathrm{K}}$ 0·23, $\dot{\mathrm{Na}}$ 0·44=100·44 Connel.
4. Disko	54·88	26·15	17·94, $\ddot{\mathrm{Al}}$ 0·46, $\dot{\mathrm{Na}}$ 1·02=100·45 Würth.
5. " $(\frac{3}{2})$	54·81	27·23	18·04, $\dot{\mathrm{Mg}}$ *tr.*=100·08 Hauer.
6. Stromöe	57·85	26·09	13·97, $\dot{\mathrm{Mg}}$ 1·58, $\dot{\mathrm{Na}}$ 0·23=99·72 Schmid. G.=2·324.
7. *Bordite*	56·92	25·14	14·19, $\ddot{\mathrm{Al}}$ 0·67, $\dot{\mathrm{Na}}$ 1·04=97·94 Adam.

Pyr., etc.—In a matrass yields water. B.B. alone becomes opaque and white, and fuses to a glass. Effervesces with soda, and fuses to a subtransparent glass, which is milk-white on cooling; with borax forms a transparent colorless glass. Gelatinizes readily in muriatic acid.

Obs.—Occurs in trap or related eruptive rocks. Found at the Faröe Islands; in Iceland; on the island of Disko, Greenland.

342. GYROLITE. Gurolite *Anderson*, Phil. Mag., IV. i. 101, 1851. Gyrolite.

In concretions, lamellar-radiate in structure.

H.=3–4. Lustre vitreous to pearly. Color white. Translucent, becoming opaque.

Comp.—$(\frac{2}{3}\dot{\mathrm{Ca}}+\frac{1}{3}\dot{\mathrm{H}})\,\ddot{\mathrm{Si}}+\dot{\mathrm{H}}$. Analyses: 1, Anderson (l. c.); 2, How (Am. J. Sci., II. xxxii. 13):

	$\ddot{\mathrm{Si}}$	$\ddot{\mathrm{Al}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{K}}$	$\dot{\mathrm{H}}$
1. Skye	50·70	1·48	0·18	33·24	——	14·18=99·85.
2. N. Scotia	51·90	1·27	0·08	29·95	1·60	15·05=99·78.

Pyr., etc.—In a closed tube yields water, intumesces, and separates into thin scales. B.B. swells up and fuses with difficulty to an opaque enamel.

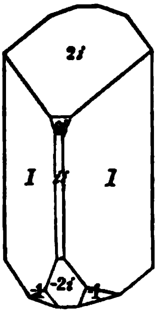
Obs.—From the Isle of Skye, with stilbite, laumontite, etc.; also N. Scotia, 25 m. S.W. of C. Blomidon, between Margaretville and Port George, on apophyllite. Reported also from Faröe and Greenland.

343. LAUMONTITE. Zeolithe efflorescente *H.*, Tr., iv. 1801. Laumonite *H.*, Tabl. Comp., 1808. Lomonit *Wern.*, *Karst.* Tab., 1808. Schneiderite *Meneghini*, Am. J. Sci., II. xiv. 64.

Monoclinic. $C=68° 40'$, $I \wedge I=86° 16'$, $O \wedge 1\text{-}\grave{\imath}=151° 9'$; $a : b : c = 0{\cdot}516 : 1 : 0{\cdot}8727$. Observed planes as in the annexed figures. Prism I, with the very oblique terminal plane $2\text{-}i$, the most common form. Cleavage: $i\text{-}\grave{\imath}$ and I perfect; $i\text{-}i$ imperfect.

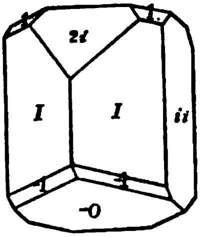
$O \wedge I=104° 20'$
$O \wedge i\text{-}i=101\ 20$
$O \wedge 2\text{-}i$, adj.,$=122\ 59$
$O \wedge -1=148\ 22$
$O \wedge 1=138\ 3$
$i\text{-}\grave{\imath} \wedge -1=113\ 16$
$i\text{-}\grave{\imath} \wedge 1=120\ 14$
$-1 \wedge -1$, front,$=133\ 28$
$1 \wedge 1$, front,$=119\ 32$
$i\text{-}i \wedge 2\text{-}i=125\ 41$
$I \wedge -1=135\ 58$
$I \wedge 1=117\ 37$
$I \wedge 2\text{-}i=113\ 30$
$I \wedge i\text{-}i=133\ 8$
$I \wedge i\text{-}\grave{\imath}=136\ 52$

381



Mt. Catini.

382



Huelgoet.

Twins: composition-face $i\text{-}i$. Also columnar, radiating or divergent.

H.$=3{\cdot}5-4$. G.$=2{\cdot}25-2{\cdot}36$. Lustre vitreous, inclining to pearly upon the faces of cleavage. Color white, passing into yellow or gray, sometimes red. Streak uncolored. Transparent—translucent; becoming opaque and usually pulverulent on exposure. Fracture scarcely observable, uneven. Not very brittle. Double refraction weak; optic-axial plane $i\text{-}\grave{\imath}$; divergence 52° 24′ for the red rays; bisectrix negative, making an angle of 20° to 25° with a normal to $i\text{-}i$; Descl.

Var.—Laumontite of Huelgoet has G.$=2{\cdot}29$; of Sarnthal, Tyrol, 2·28 (Gericke); of Plauenscher Grund (Gericke) and Helsingfors (Arppe) 2·31; of the red, from I. Skye, 2·252 (J. W. Mallet). *Caporcianite* occurs in pearly monoclinic crystals, of a flesh-red color, having G.$=2{\cdot}47$, and H.$=3{\cdot}5$.

Comp.—O. ratio for $\dot{\mathrm{R}}$, $\not{\mathrm{R}}$, $\ddot{\mathrm{Si}}$, $\dot{\mathrm{H}}=1 : 3 : 8 : 4$; and for $\dot{\mathrm{R}}+\not{\mathrm{R}}$, $\ddot{\mathrm{Si}}$, $\dot{\mathrm{H}}=1 : 2 : 1$; whence the formula $(\frac{1}{4}\,\dot{\mathrm{C}}\mathrm{a}^3+\frac{3}{4}\,\not{\mathrm{A}}\mathrm{l})\,\ddot{\mathrm{Si}}^2+3\,\dot{\mathrm{H}}$=Silica 50·9, alumina 21·9, lime 11·9, water 15·3=100. Both in formula and crystallization it is related to pyroxene.

Analyses: 1, 2, Dufrénoy (Ann. d. Mines, III. viii. 503); 3, Connel (Ed. N. Phil. J., 1829, 282); 4, 5, Babo and Delffs (Pogg., lix. 339); 6, Malaguti and Durocher (Ann. d. Mines, IV. ix. 325); 7, Sjögren (Pogg., lxxviii. 415); 8, Scott (Ed. N. Phil. J., 1852, liii. 284); 9, 10, Gericke (Ann. Ch. Pharm., xcix. 110); 11, Arppe (An. Finsk. Min., 22); 12, J. W. Mallett (Am J. Sci., II. xxii. 179); 13, How (ib., xxvi. 30):

	$\ddot{\mathrm{Si}}$	$\not{\mathrm{A}}\mathrm{l}$	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\mathrm{H}}$
1. Phipsburg, Me.	51·98	21·12	11·71	15·05=99·86 Dufrénoy.
2. Cormayeur	50·38	21·48	11·14	16·15=99·10 Dufrénoy.
3. Skye	52·04	21·14	10·62	14·92=98·72 Connel.
4. ———?	52·30	22·30	12·00	14·2=100·8 Babo.
5. ———?	51·17	21·23	12·43	15·17 (loss)=100 Delffs.
6. Huelgoet	52·47	22·56	9·41	15·56=100 M. & D.
7. Upsala, *red*	51·61	19·06	12·53	14·02, $\not{\mathrm{F}}\mathrm{e}$ 2·96=100·18 Sjögren.
8. I. Storr	53 05	22·94	9·67	14·64=100·80 Scott.

		S̈i	Äl	Ċa	Ḣ
9.	Sarnthal	(⅔) 51·58	20·63	11·50	15·10, F̈e 0·26, Ṅa 1·57=100·64 Gericke.
10.	Plauen Grund	51·33	21·98	9·01	14·93, F̈e 0·14, Ṅa 3·20=100·59 Gericke.
11.	Helsingfors, *red*	50·44	18·90	9·60	14·51, F̈e 2·88, Ṅa, K̇ 2·06, Ṁg 1·04=99·43 A
12.	Skye, *red*	53·95	20·13	12·86	12·42, K̇, Ṅa 0·87, Ṁg *tr.*=100·23 Mallet.
13.	Port George, N. S.	51·43	21·64	12·07	15·26=100·44 How.

An impure Swiss laumontite has been analyzed by Fellenberg (Mitth. Berne, 54, 1865).

The Ædelforsite of Retzius, or the *Red Zeolite of Ædelfors*, is referred here by N. J. Berlin, who considers it impure from mixed silica (quartz), and related to the red zeolite of Upsala analyzed by him. It afforded Retzius S̈i 60·28, Äl 15·42, Ċa 8·18, F̈e 4·16, Ṁg and Ṁn 0·42, Ḣ 11·07=99·53. A similar mineral from Fahlun yielded Hisinger S̈i 60·00, Äl 15·6, F̈e 1·8, Ċa 8·0, Ḣ 11·6=97·0; while he obtained for the Ædelfors zeolite S̈i 53·76, Äl 18·47, F̈e 4·02, Ċa 10·90, Ḣ 11·23=98·38, which is near the composition of laumontite. Bischof has analyzed a pseudomorph of laumontite after orthoclase (see ORTHOCLASE).

Pyr., etc.—In a vacuum, Huelgoet laumontite crystals, according to Malaguti & Durocher, lose in weight 2·26 p. c., and, over sulphuric acid, 3·85 p. c.; and regain the same in water or moist air. Heated up to 100° C., they lose 3·17 p. c.; to 200°, 6·08 p. c.; to 300°, 7·28; and the remainder of the water only at a red heat. B.B. swells up and fuses at 2·7—3 to a white enamel. Gelatinizes with muriatic acid.

Obs.—Laumontite occurs in the cavities of trap or amygdaloid; also in porphyry and syenite, and occasionally in veins traversing clay slate with calcite. It was first observed in 1785, in the lead mines of Huelgoet in Brittany, by Gillet Laumont, after whom it is named.

Its principal localities are at the Faröe Islands; Disko in Greenland; in Bohemia, at Eule in clay slate; St. Gothard in Switzerland; the Fassathal, in large masses exhibiting a radiated structure; Sarnthal, near Botzen, Tyrol; Plauenscher Grund, near Dresden; Hartfield Moss in Renfrewshire, accompanying analcite; the amygdaloidal rocks in the Kilpatrick hills, near Glasgow; and in several trap rocks of the Hebrides, and the north of Ireland.

Peter's Point, Nova Scotia, affords fine specimens of this species. It is there associated with apophyllite, thomsonite, and other species of this family; also at Port George, N. S., in veins sometimes 3 in. thick, and at Margaretville, colored green by copper; also at Digby Neck and Long Point. Also found in good specimens at Phipsburg, Maine; also sparingly at Bradleysville, Litchfield Co., Conn., near a paper-mill, in narrow seams in gneiss; and at Southbury, Conn., a little east of the village, on the land of Mr. Stiles. Abundant in many places in the copper veins of Lake Superior in trap, and on I. Royale; on north shore of Lake Superior, between Pigeon Bay and Fond du Lac. Found also at Bergen Hill, N. J., in greenstone, with datolite, apophyllite, etc.; sparingly at Phillipstown, N. Y., in feldspar with stilbite, and at Columbia bridge, near Philadelphia.

Alt.—Most varieties become opaque and crumble at the touch after exposure to the ordinary atmosphere, losing 1 to 2 p. c. of water. Specimens in cabinets can be best preserved from alteration by keeping them in moist air.

Schneiderite (l. c.) is laumontite from the serpentine of Monte Catini, Italy, which has undergone alteration through the action of magnesian solutions. It is described by Meneghini as laminate-radiate in structure, with H.=3. Fig. 381 represents a crystal from Mt. Catini (one received by Prof. G. J. Brush from Prof. Bechi); it gave the author the approximate angles $I \wedge I=$ [illegible]—86° 30′, $i\text{-}i \wedge 2\text{-}i=126°$, $-2\text{-}i \wedge i\text{-}i=148° 15′$, $I \wedge -1=135°$, $-1 \wedge -1$, front, $=133°$, $2\text{-}i \wedge 6\text{-}i=$ [illegible]. The planes had little lustre, and that strongly pearly. Bechi obtained in an analysis (l. c.):

S̈i 47·79 Äl 19·38 Ṁg 11·03 Ċa 16·77 Ṅa, K̇ 1·63 Ḣ 3·41=100.

It fuses B.B. with intumescence, and gelatinizes in cold acids. Occurs with sloanite in the gabbro rosso of Tuscany. Named after Sign. Schneider, director of the mine of Mount Catini

CAPORCIANITE *Savi* (Mem. cost fis. Toscana, ii. 53). Has been referred to laumontite. [illegible] described by Meneghini as resembling heulandite and near it in its angles, affording (see f. [illegible], p. 444) $2\text{-}i \wedge -2\text{-}i=131°$, $2\text{-}i \wedge I=150°$, with cleavage parallel to *i-i* very easy, and also parallel to 2-*i*; easy parallel to −2-*i*; faces 2-*i* minutely striated; also in twins; also imperfectly radiated foliaceous. H.=2·5; G.=2·470; color flesh-red; lustre pearly.

COMP.—Ċa³ S̈i³+3 Äl S̈i³+9 Ḣ, Ramm., and near laumontite=Silica 53·0, alumina 22·7, lime 12·4, water 11·9=100. Analyses: 1, Anderson (Ed. Phil. J., 1842, 21); 2, Bechi (Am. J. Sci., II. xiv. 62):

	S̈i	Äl	F̈e	Ċa	Ṁg	Ṅa	K̇	Ḣ
1.	52·8	21·7	0·1	11·3	0·4	0·2	1·1	13·1=100·7 Anderson.
2.	52·02	22·83	—	9·68	1·11	0·25	1·11	13·17=100·17 Bechi.

B.B. fuses to a white enamel without intumescence. Dissolves easily in acids, and forms a jelly even in the cold. Occurs in geodes with calcite in the gabbro rosso of Monte de Caporciano at l'Impruneta, and other places in Tuscany. It is sometimes accompanied by native copper.

343A. **LEONHARDITE** *Blum* (Pogg., lix. 336, 1843). Near laumontite and probably that species. Monoclinic $I \wedge I = 83°\ 30'$, and $96°\ 30'$; $O \wedge I = 114°$. Cleavage parallel with I very perfect, basal imperfect. Also columnar and granular.

H.=3–3·5. G.=2·25. Lustre of cleavage-face pearly, elsewhere vitreous. White, sometimes yellowish, seldom brownish. Subtranslucent. Usually whitens on exposure like laumontite.

Analyses: 1, Delffs (Pogg., lix. 336, 339); 2, Babo (ib.); 3, 4, G. O. Barnes (Am. J. Sci., II. xv. 440):

		$\ddot{\mathrm{Si}}$	$\dddot{\mathrm{\bar{A}l}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{H}}$
1.	Schemnitz	56·128	22·980	9·251	11·641=100 Delffs.
2.	"	55·00	24·36	10·50	12·30=102·16 Babo.
3.	Copper Falls	55·96	21·04	10·49	11·93=99·42 Barnes.
4.	" "	55·04	22·34	10·64	11·93=99·95 Barnes.

These results afford the following O. ratios for $\dot{\mathrm{R}}$, $\dddot{\mathrm{\bar{R}}}$, $\ddot{\mathrm{Si}}$, $\dot{\mathrm{H}}$: (1) 1 : 4 : 11⅓ : 4⅓; (2) 1 : 4 : 10 : 3⅓; (3, 4) 1 : 3½ : 10 : 3½. Delffs' analysis was made after drying the mineral at 100° C.; dried at the ordinary temperature it gave 13·547–13·807 water, which corresponds to the above formula. B.B. exfoliates, froths, and easily melts to an enamel. Dissolves in acids.

From a trachytic rock at Schemnitz in Hungary; at Plitsch in an earthy chlorite, and near Predazzo in the Fleims Valley, Tyrol, in a melaphyre. Also at Copper Falls, Lake Superior region, a variety which alters but little on exposure.

Lewinstein has analyzed two altered specimens from the copper mines of Lake Superior (ZS. Ch. u. Pharm. 1860, 11), one (A) containing 76 p. c. of the mineral, the other (B) 81·61 p. c., the rest impurity; A, of a brownish-red color, and B, greenish, afforded, impurity excluded:

	$\ddot{\mathrm{Si}}$	$\dddot{\mathrm{\bar{A}l}}$	$\dddot{\mathrm{\bar{F}e}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Na}}$	$\dot{\mathrm{K}}$	$\dot{\mathrm{H}}$
A.	57·92	10·19	1·19	1·13	4·59	1·14	2·58	21·26=100.
B.	55·21	22·58	2·55	1·31	0·98	3·45	3·41	10·51=100.

A gives nearly the O. ratio 1 : 2 : 12 : 8; and B, 1 : 5 : 13 : 4·3.

344. **CATAPLEIITE.** Katapleiit *Weibye & Sjögren*, Pogg., lxxix. 299, 1850.

Hexagonal. In thin tabular hexagonal prisms, with the basal edges replaced by the planes 1, 2, 4; $O \wedge 1 = 142°\ 4'$, $O \wedge 2 = 122°\ 40'$, $O \wedge 4 = 107°\ 47'$. Cleavage: lateral (I) perfect; 2, distinct. Also massive.

H. near 6. G.=2·8. Lustre nearly dull, weak vitreous on surface of fracture. Color light yellowish-brown. Streak isabella-yellow. Opaque.

Comp.—O. ratio for $\dot{\mathrm{R}}$, $\dddot{\mathrm{\bar{R}}}$, $\ddot{\mathrm{Si}}$, $\dot{\mathrm{H}}=1:2:6:2$; for $\dot{\mathrm{R}}+\dddot{\mathrm{\bar{R}}}$, $\ddot{\mathrm{Si}}$, $\dot{\mathrm{H}}=1:2:\frac{2}{3}$; whence the formula $(\frac{1}{3}\dot{\mathrm{R}}^3+\frac{2}{3}\ddot{\mathrm{Zr}})\ddot{\mathrm{Si}}^2+1\frac{1}{3}\dot{\mathrm{H}}$. Analyses by Sjögren (l. c.):

	$\ddot{\mathrm{Si}}$	$\ddot{\mathrm{Zr}}$	$\dddot{\mathrm{\bar{A}l}}$	$\dot{\mathrm{Na}}$	$\dot{\mathrm{Ca}}$	$\dddot{\mathrm{\bar{F}e}}$	$\dot{\mathrm{H}}$
1.	46·83	29·81	0·45	10·83	3·61	0·68	8·66=101·02.
2.	46·52	29·33	1·40	10·06	4·66	0·49	9·05=101·51.

Pyr., etc.—In the closed tube yields water. B.B. in the platinum forceps fuses at 3 to a white enamel; with borax a clear colorless glass. Easily soluble in muriatic acid without gelatinizing; the dilute acid solution colors turmeric paper orange-yellow (reaction for zirconia).

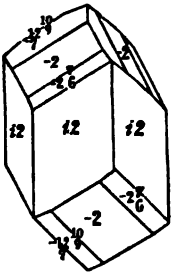
Obs.—From the island Lamöe near Brevig, Norway, along with zircon, leucophanite, mosandrite, and tritomite.

On the crystallization see H. Dauber, Pogg., xcii. 239.

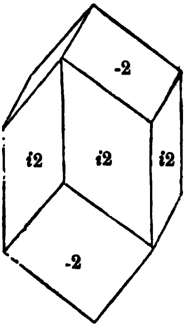
345. **DIOPTASE.** Achirit *B. F. J. Hermann*, 1788, N. Act. Petrop., xiii. 339, 1802. Emeraudine *Delameth.*, T. T., ii. 230, 1797. Kupfer-Schmaragd *Wern.*, 1800, Ludwig, i. 53, 238, 1803. Dioptase *H.*, Tr., iii. 1801. Emerald-Copper *Jameson*. Smaragdo-Chalcit *Mohs.*, Grundr., 1824.

Rhombohedral. $R \wedge R=126°\ 24'$; $O \wedge R=148°\ 38'$; $a=0·5281$. Observed planes: rhombohedral, 1 (R), 2, −2; hemi-scalenohedral on three alternate edges, as in the figure, with also 2^{s}; also 1^{s}; prismatic, i-2, i-$\frac{3}{2}$, i-$\frac{4}{3}$, i-$\frac{4}{7}$, the last three hemihedral.

383



384



$O \wedge 2=129°\ 21'$	$i\text{-}\frac{4}{3} \wedge i\text{-}2=165°\ 44'$
$i\text{-}2 \wedge i\text{-}2=120$	$i\text{-}\frac{3}{2} \wedge i\text{-}2=169\ 6$
$2 \wedge 2=95\ 54$	$1^{s} \wedge i\text{-}2=146\ 36$
$2 \wedge i\text{-}2=132\ 3$	$-2 \wedge R=137\ 57$
$2^{s} \wedge i\text{-}2=151$	$i\text{-}2 \wedge R=126\ 48$

Cleavage: R perfect. Twins: composition-face R. Also massive.

H.=5. G.=3·278—3·348. Lustre vitreous. Color emerald-green. Streak green. Transparent—subtranslucent. Fracture conchoidal, uneven. Brittle. Double refraction strong, positive.

Comp.—O. ratio for $\dot{C}u$, $\ddot{S}i$, $\dot{H}=1:2:1$; $\dot{C}u\ddot{S}i+\dot{H}$=Silica 38·2, oxyd of copper 50·4, water 11·4=100. Analyses: 1, 2, Hess (Pogg., xvi. 360); 3, 4, Damour (Ann. Ch. Phys., III. x. 485);

	$\ddot{S}i$	$\dot{C}u$	$\dot{H}$
1.	36·60	48·89	12·29, $\dot{F}e$ 2·00=99·78 Hess.
2.	36·85	45·10	11·52, $\dddot{A}l$ 2·36, $\dot{C}a$ 3·38, $\dot{M}g$ 0·22=99·43 Hess.
3.	36·47	50·10	11·40, $\dot{F}e$ 0·42, $\dot{C}a\ddot{C}$ 0·35=98·74 Damour.
4.	38·93	49·51	11·27=99·71 Damour.

Pyr., **etc.**—Like chrysocolla, but gelatinizes with muriatic acid.

Obs.—Dioptase occurs disposed in well defined crystals and amorphous on quartz, occupying seams in a compact limestone west of the hill of Altyn-Tübeh in the Kirghese Steppes. Also reported as found in the Duchy of Nassau, between Oberlahnstein and Braubach.

Breithaupt found for the angle $R \wedge R$ 125° 55′; and Kokscharof, after careful measurement, adopts this value (Bull. Ac. St. Pet., ix. 240).

Named by Haüy *dioplase*, from *διά*, *through*, and *ὄπτομαι*, *to see*, because the cleavage directions were distinguishable on looking through the crystal.

Named *Achirite* after Achir Mahmed, a Bucharian merchant, living at the fortress of Semipalatna on the Irtish, who had procured it in the region where it occurred, and who furnished the specimens that were taken in 1785 by Mr. Bogdanof to St. Petersburg. Although first named by Hermann, his description was not given to the St. Petersburg Academy before 1800, and the volume containing it was not published until 1802, a year after the appearance of Haüy's work.

346. CHRYSOCOLLA. Chrysocolla pt. *Theophr.*, *Diosc.*, *Plin.* Chrysocolla pt., Cæruleum pt. *Germ.* Berggrün, *Agric.*, Foss., 1546. Cæruleum montanum pt. *Wall.*, Min., 280, 1747; C. montanum, Viride montanum pt., *Cronst.*, Min., 172, 1758. Mountain Blue and Mountain Green pt. Bleu de Montagne, Vert de Montagne, Bleu do Cuivre, Vert de Cuivre, *Fr.* Kupfergrün *Wern.*, Bergm. J., 382, 1789; *Karst.*, Tab., 46, 1800, 62, 1808. Cuivre carbonaté vert pulverulent, *H.*, Tr., 1801; Tabl., 1809. Kieselkupfer *Klapr.*, Beitr., iv. 86, 1807. Vert de Cuivre, Chrysocolle, *Brochant*, Min., ii. 208, 1808. Kieselmalachit *Hausm.*, Handb., 1813. Kieselkupfer *Leonh.*, Handb., 1821. C. hydrosiliceux *H.* Cuivre hydraté silicifère, Hydrophane cuivreux, *Fr.* Somervillite (fr. N. J.) *Dufr*, Min., iii. 147, 1847. Dillenburgite. Kupferpecherz pt. Hoffm. Min., iii. b, 103, 1816; Hepatinerz *Breith.*, Char, 224, 1832; Pechkupfer *Hausm.*, Handb., 372, 1847. Llanca *Chilian Miners.* Demidovit *N. Nordensk*, Bull. Soc. Nat. Moscou, xxix. 128, 1856. Asperolite *Herm.*, ib., xxxix. 68, 1866.

Cryptocrystalline; often opal-like or enamel-like in texture; earthy. Incrusting, or filling seams. Sometimes botryoidal.

H.=2–4. G.=2–2·238. Lustre vitreous, shining, earthy. Color mountain-green, bluish-green, passing into sky-blue and turquois-blue; brown to black when impure. Streak, when pure, white. Translucent—opaque. Fracture conchoidal. Rather sectile; translucent varieties brittle.

Comp.—Composition varies much through impurities, as with other amorphous substances, resulting from the alteration. As the silica has been derived from the decomposition of other silicates, it is natural that an excess should appear in many analyses.

True chrysocolla appears to correspond to the O. ratio for Ċu, S̈i, Ḣ, 1 : 2 : 2=Ċu S̈i+2 Ḣ =Silica 34·2, oxyd of copper 45·3, water 20·5=100, the water being double that of dioptase. But some analyses afford 1 : 2 : 3=Ċu S̈i+3 Ḣ (anal. 13), and 1 : 2 : 4=Ċu S̈i+Ḣ (anal. 11).

Impure chrysocolla may contain, besides free silica, black oxyd of copper, oxyd of iron (or limonite), and oxyd of manganese; and consequently vary in color from bluish-green to brown and black, the last especially when oxyd of manganese or of copper is present. Other kinds are impure with carbonate or sulphate of copper; and others with oxyds of lead, antimony, arsenic, etc.

Analyses: 1, v. Kobell (Pogg., xviii. 254); 2–4, Berthier (l. c.); 5, Bowen (Am. J. Sci., viii. 18); 6, Beck (Am. J. Sci., xxxvi. 111); 7, Scheerer (Pogg., lxv. 289); 8, C. T. Jackson (This Min., 520, 1850); 9, Joy (Ann. Lyc. N. Y., viii. 120); 10, Rammelsberg (J. pr. Ch., lv. 488, Pogg., lxxxv. 300); 11, Nordenskiöld (Ramm. Min. Ch., 552); 12, J. L. Smith (Gilliss's Exped., ii. 92); 13, F. Field (Phil. Mag., IV. xxii. 361); 14, Kittredge (Pogg., lxxxv. 300); 15, Domeyko (Min., 145, 1845):

		S̈i	Ċu	Ḣ	F̈e
1.	Bogoslovsk	36·54	40·00	20·20	1·00, gangue 2·10=99·84 Kobell.
2.	"	35·0	39·9	21·0	3·0, " 1·1=100 Berthier.
3.	Canaveilles, Pyr.	26·0	41·8	23·5	2·5, " 2·5, C̈ 3·7=100 Berthier.
4.	Somerville, N. J.	35·4	35·1	28·5	——, " 1·0=100 Berthier
5.	"	37·25	45·17	17·00	——=99·42 Bowen.
6.	Franklin, N. J.	40·00	42·60	16·00[a]	1·40=100 Beck.
7.	Arendal, Norway	35·14	48·07	20·36	——, F̈e, A⃛l, Ċa, K̇ 1·09=99·66 Scheerer.
8.	Copper Harbor	37·85	27·97	20·00	8·90, A⃛l 4·8=99·55 C. T. Jackson.
9.	" "	32·00	32·75	26·50	7·75[b]=99·00 Joy.
10.	Lake Superior	32·55	42·32	20·68	1·63[b], Ċa 1·76, Ṁg 1·06=100 Ramm.
11.	Nischne Tagilsk	31·45	37·31	31·18	0·40=100·34 Nordenskiöld.
12.	Chili	31·35	42·51	21·62	1·97, A⃛l 2·88=100·28 Smith.
13.	Coquimbo	28·21	39·50	24·52	2·80, A⃛l 4·97=100 Field.
14.	Chili	40·09	27·97	24·73	Ḟ 4·94, Ċa 1·49, Ṁg 0·78=100 Kittredge.
15.	" *bh.-gn.*	52·2	29·5	16·7	1·2=99·6 Domeyko.

[a] Loss included. [b] With some $Al^2 O^3$.

The mineral from Somerville, N. J., as described by Berthier (Ann. Ch. Phys., li. 395), is of three varieties: (1) a thin, green, transparent incrustration; (2) a bluish-green earthy mineral, very tender and light, becoming transparent, like hydrophane, in water; and (3) a pale greenish-blue massive material, hard enough to scratch glass, and to be polished for jewelry; and he observes that the chrysocolla is nearly pure in the first, but is mixed with opal-silica in much of the second kind, and with opal-silica and ordinary silica in the last. Berthier's analysis (No. 4 above) was made on a specimen of the second kind, and according to him probably contained 8 p. c. of opal-silica in a state of mixture. Berthier, allowing for 8 p. c. of free silica in this analysis, suggests that the composition may be Ċu S̈i+4 Ḣ, while Bowen's earlier analysis (5) gives Ċu S̈i+2 Ḣ. Berthier's mineral has been named (without sufficient reason) *Somervillite*, and the analysis has generally been taken as expressing directly his view of the composition. Berthier gives an analysis also of the hard chrysocolla of Somerville (*third* kind) to show that there is in these ores free silica. He obtained (l. c.) Silica 28·9, oxyd of copper 6·1, water 6·7, oxyd of iron 0·4, *silica soluble in the alkalies* 57·9=100.

The specimen for No. 13 had a fine turquois-blue color, and was from Tambillos near Coquimbo.

Demidoffite occurs at Tagilsk, Urals, in mammillated crusts of a sky-blue color, and afforded N. Nordenskiöld (l. c.) S̈i 31·55, A⃛l 0·53, Ċu 33·14, Ṁg 3·15, Ḣ 23·03, P̈ [10·22]=100.

Hermann has given (l. c.) the name *Asperolite* to an amorphous mineral from Tagilsk, Russia. It occurs in reniform masses of the size of the fist, of a bluish-green color, conchoidal fracture, smooth and lustrous. Brittle. H.=2·5; G.=2·306. Analysis afforded him S̈i 31·94, Ċu 40·81, Ḣ 27·25=100. O. ratio for Ṙ, S̈i, Ḣ=1 : 2 : 3. He considers it one of a series of silicates of copper, consisting of dioptase, chrysocolla, asperolite, and a mineral described by Nordenskiöld, containing respectively 1, 2, 3, and 4 eq. Ḣ. Named *asperolite* on account of its great brittleness.

The following are analyses of other impure varieties; 1, Ullmann (Syst. tab. Uebers., 275); 2 Klaproth (Beitr., iv. 34); 3, Thomson (Min., i. 1836); 4, v. Kobell (J. pr. Ch., xxxix. 209); 5, Damour (Ann. d. M., III. xii.); 6, Rammelsberg (Min. Ch., 552); 7, Berthier (Ann. d. M., III. xix 698); 8, Domeyko (Min., 1860, 139); 9, F. Field (Phil. Mag., IV. xxii. 361); 10, 11, Domeyko (l. c.)

	$\ddot{S}i$	$\dot{C}u$	$\dot{H}$	$\overset{\dots}{\bar{F}}e$
1. Dillenburg	40	40	12	——, $\ddot{C}$ 8=100 Ullmann.
2. Turjinsk, *green*	26	50	17	——, $\ddot{C}$ 7=100 Klaproth.
3. ?	25·31	54·46	5·25	——, $\ddot{C}$ 14·98=100 Thomson.
4. Turjinsk, *brown*	9·66	13·00	18·00	59·00=99·66 Kobell.
5. " "	17·95	12·12	20·55	50·85=101·47 Damour.
6. Mexico	27·74	36·07	16·70	17·46, $\dot{C}a$, $\dot{M}g$ 0·40=98·37 Rammelsberg.
7. Chili	7·1	46·8	15·0	1·5, $\dddot{S}$ 10·1, gangue 18·5=99 Berthier.
8. " *black*	15·00	26·33	15·02	3·05, $\ddot{M}n$ 39·80=99·20 Domeyko.
9. " "	18·90	24·71	15·52	0·28, $\ddot{M}n$ 40·28=99·64 Field.
10. " "	18·3	61·2	17·1	2·9=99·5 Domeyko.
11. " "	10·33	75·55	12·13	1·26, $\dot{C}a$ 0·40, $\dot{M}g$ 0·33=100 Domeyko.

Nos. 1 to 3 contain some carbonate of copper; and 1 has been named *Dillenburgite.* Nos. 4 to 6 are *Kupferpecherz* (or *Hepatinerz*), a brown variety containing much limonite as impurity; No. 7 contains 25 p. c. of sulphate of copper; Nos. 8, 9 contain oxyd of manganese, and are black in color; Nos. 10, 11 include black oxyd of copper. Nos. 7 to 11 are all from the vicinity of Coquimbo. The cupreous variety abounds especially at the Higuera mines; and 10 is from the Cortadere mine; 11 from the Brillador.

The chrysocolla of Rochlitz, in the Riesengebirge, afforded Herter & Porth (Jahrb. G. Reichs., x. 10) $\ddot{S}i$ 42·93—43·43, $\dot{C}u$ 16·11—29·37, $\dot{P}b$ 1·73—5·05, $\dot{Z}n$ 7·43—0·50. $\dot{C}a$ 2·00—1·54, $\dot{M}g$ 4·46—0·33, $\dddot{A}l$ 5·56—8·85, $\overset{\dots}{\bar{F}}e$ 10·07—2·08, $\dot{H}$ 9·23—8·61, and 32 p. c. of antimonic and arsenic acids.

Delesse finds some recent stalactitic formations of a bluish-white color, occurring in the galleries of a copper mine in Tuscany (Ann. d. M., IV. ix. 593), to consist of Silica 21·08, alumina 17·83, oxyd of copper 28·37, water 32·72=100.

Pyr., etc.—In the closed tube blackens and yields water. B.B. decrepitates, colors the flame emerald-green, but is infusible. With the fluxes gives the reactions for copper. With soda and charcoal a globule of metallic copper. Decomposed by acids without gelatinization.

Obs.—Accompanies other copper ores, occurring especially in the upper part of veins.

Bischof observes (Lehrb., ii. 1885) that silicate of copper may be formed through the action of an alkaline-, lime-, or magnesia-silicate on sulphate or nitrate of copper in solution. He also shows that this silicate is decomposed by carbonated waters, producing carbonate of copper. The alkaline silicates are furnished by the decomposing granite, and the sulphate of copper by altered pyritous copper. But L. Sæmann communicates to the author that he has seen specimens of chrysocolla from Chili, which have in the interior the fibrous structure and composition of pure malachite, showing that the whole was once malachite. The chrysocolla analyzed by Scheerer (anal. 7) occurs with feldspar, and is supposed to have resulted from the action of sulphate of copper on the feldspar. Some specimens of the chrysocolla are translucent and brittle on one part, and earthy, like decomposed feldspar, on the opposite.

Found in most copper mines in Cornwall; at Libethen in Hungary; at Falkenstein and Schwatz in the Tyrol; in Siberia; the Bannat; Thuringia; Schneeberg, Saxony; Kupferberg, Bavaria; South Australia; Chili, etc.

In Somerville and Schuyler's mines, New Jersey, at Morgantown, Pa., and at Wolcottville, Conn., chrysocolla occurs associated with red copper ore, native copper, and green malachite; in Pennsylvania, near Morgantown, Berks Co.; at Perkiomen; at Cornwall, Lebanon Co.; also with similar associated minerals, and with brown iron ore, in Nova Scotia, at the Basin of Mines; also in Wisconsin and Michigan, mixed with carbonate of copper.

Chrysocolla is from *χρυσός, gold,* and *κόλλα, glue,* and was the name of a material used in soldering gold. The name is often applied now to borax, which is so employed. But much of the ancient *chrysocolla* was a green stone containing copper as the coloring ingredient, and the best, as Dioscorides says, was that which was *κατακόρως πρασίζουσα,* or of a fine leek-green or prase color; and the island of Cyprus, which was named from its copper mines, was a prominent locality. Pliny says the mineral was named after the real *chrysocolla,* because it looked like it. It may have included carbonate of copper, as was true to some extent of the *chrysocolla* and *mountain-green* of the 16th, 17th, and 18th centuries. The *cæruleum montanum* of Wallerius included both chrysocolla and an earthy variety of the carbonate.

347. ALIPITE. Pimelit *Schmidt,* Pogg., lxi. 388, 1844. Alipit *Glock.,* 1845.

Massive; earthy.

H.=2·5. G.=1·44—1·46, Schmidt. Color apple-green. Not unctuous. Adheres to the tongue.

Comp.—O. ratio for $\dot{R}$, $\ddot{S}i$, $\dot{H}$, 1 : 3 : ¼, nearly; whence $(\frac{1}{4}\dot{H}+\frac{3}{4}(\dot{N}i, \dot{M}g))\ddot{S}i$, if the water be basic; according to Schmidt (l. c.), $\ddot{S}i$ 54·63, $\ddot{\bar{A}}l$ 0·30, $\dot{N}i$ 32·66, $\dot{F}e$ 1·13, $\dot{M}g$ 5·89, $\dot{C}a$ 0·16, $\dot{H}$ 5·23 =100.

From Silesia.

Named from the Greek ἀλιπής, *not greasy.*

348. CONARITE. Konarit *Breith.*, B. H. Ztg., xviii. 1, 1859.

Monoclinic? In small grains and crystals, with perfect brachydiagonal cleavage, and supposed to be like vivianite in crystallization.

H.=2·5—3. G.=2·459—2·619. Color yellowish, pistachio- and siskin-green, olive-green. Streak siskin-green. In thin lamellæ translucent. Fragile.

Comp.—O. ratio for $\dot{N}i$, $\ddot{S}i$, $\dot{H}$=1 : 3 : 1½, nearly; whence $(\frac{1}{3}\dot{H}+\frac{2}{3}\dot{N}i)\ddot{S}i+\frac{2}{3}\dot{H}$, if a third of the water be basic. Analysis by Winkler (B. H. Ztg., xxiv. 335):

$\ddot{S}i$	$\ddot{\bar{A}}l$	$\ddot{\bar{F}}e$	$\dot{N}i$	$\dot{C}o$	$\dot{H}$	$\ddot{\bar{P}}$	$\ddot{\bar{A}}s$	$\dddot{S}$
43·6	4·6	0·8	35·8	0·6	11·1	2·7	0·8	*tr.*=100.

Obs.—Occurs at the Hanns George mine, at Röttis, in Saxon Voigtland, with röttisite.

Named from κόναρος, *evergreen.*

349. PICROSMINE. Pikrosmin *Haid.*, Min. Mohs., iii. 157, 1825.

Orthorhombic. Cleavable massive. Also columnar or fibrous. Cleavage: in traces, parallel to a prism of 117° 49′; perfect parallel to *i-ĭ*, less so parallel to *i-ī*.

H.=2·5—3. G.=2·66, cleavable massive; 2·596, columnar. Lustre of cleavage-face pearly, elsewhere vitreous. Color greenish-white; also dark green, gray. Streak white. Subtranslucent—opaque. Odor bitter argillaceous when moistened. Double refraction strong; optical axes in the columnar variety in a longitudinal plane; bisectrix negative, normal to the sides of the columns.

Comp.—O. ratio for $\dot{R}$, $\ddot{S}i$, $\dot{H}$=1 : 2 : ½; $\dot{M}g\ddot{S}i+\frac{1}{2}\dot{H}$=Silica 55·1, magnesia 36·7, water 8·2=100. Analysis by Magnus (Pogg., vi. 53):

$\ddot{S}i$ 54·89 $\ddot{\bar{A}}l$ 0·79 $\ddot{\bar{F}}e$ 1·40 $\dot{M}n$ 0·42 $\dot{M}g$ 34·35 $\dot{H}$ 7·30=98·15.

Pyr., etc.—In the closed tube some ammonia given off with the water; the assay blackens and has a burnt smell. B.B. on charcoal whitens without fusing. With borax slowly dissolves to a transparent glass; affords a glass with little soda, and an infusible slag if the soda be increased. A pale and indistinct red with cobalt solution.

Obs.—Associated with magnetic iron ore at the iron mine of Engelsberg, near Pressnitz in Bohemia. The fibrous variety resembles asbestus.

Named from πικρός, *bitter*, and ὀσμή, *odor.*

Haidinger instituted the species on the physical characters and cleavage of the massive and fibrous mineral, without a knowledge of the chemical composition; and he suggests that much of common asbestus may belong to it.

The talcose or chloritic schist of Greiner in Tyrol, and the limestone of the vicinity of Waldheim, Saxony, are reported as other localities. Descloizeaux obtained the above optical characters from the Pressnitz mineral, and also from another from Zermatt.

350. SPADAITE. *V. Kobell*, Gel. Anz., München, xvii. 945, 1843, J. pr. Ch., xxx. 467.

Massive, amorphous.

H.=2·5. Lustre a little pearly or greasy. Translucent. Color reddish, approaching flesh-red. Fracture imperfect conchoidal and splintery.

Comp.—O. ratio for $\dot{R}$, $\ddot{\mathrm{Si}}$, $\dot{\mathrm{H}}$=5 : 12 : 4; whence, if a fourth of the water is basic, $(\frac{5}{6}\dot{\mathrm{Mg}}+\frac{1}{6}\dot{\mathrm{H}})\ddot{\mathrm{Si}}+\frac{1}{2}\dot{\mathrm{H}}$. Analysis by v. Kobell:

$\ddot{\mathrm{Si}}$ 56·00 $\dddot{\bar{\mathrm{A}}}\mathrm{l}$ 0·66 $\dot{\mathrm{Fe}}$ 0·66 $\dot{\mathrm{Mg}}$ 30·67 $\dot{\mathrm{H}}$ 11·34=99·33.

Pyr., etc.—In the closed tube yields much water and becomes gray. B.B. melts to a glassy enamel. Dissolves in concentrated muriatic acid, the silica easily gelatinizing.

Obs.—From Capo di Bove, near Rome, filling the spaces among crystals of wollastonite, in leucitic lava.

Named after Sign. Medici Spada.

QUINCITE.—The *quincite* of Berthier is in light carmine-red particles disseminated through a limestone deposit.

Comp.—Silica 54, magnesia 19, protoxyd of iron 8, water 17=98. From near the village of Quincy, France. Strong concentrated acids dissolve the magnesia and iron, and leave the silica in a gelatinous state. The color is attributed to organic matter.

351. PYRALLOLITE pt. 352. PICROPHYLL. 353. TRAVERSELLITE. 354. PITKARANDITE. 355. STRAKONITZITE. 356. MONRADITE.

These are names of pyroxene in different stages of alteration, between true pyroxene and either serpentine or steatite. For analyses and descriptions, see under that species (p. 221).

357. NEOLITE. Neolit *Scheerer*, Pogg., lxxi. 285, 1847.

In silky fibres stellately grouped; also massive.

H.=1–2. G.=2·77, after drying. Color green. Lustre silky or earthy.

Comp.—O. ratio for $\dot{R}$, $\dddot{\bar{R}}$, $\ddot{\mathrm{Si}}$, $\dot{\mathrm{H}}$ about 3 : 1 : 6 : 1½; whence the formula $\dot{\mathrm{Mg}}\ddot{\mathrm{Si}}+\frac{1}{2}\dot{\mathrm{H}}\,[+\frac{1}{9}\dddot{\bar{\mathrm{A}}}\mathrm{l}\,\dot{\mathrm{H}}^3]$. Perhaps $(\dot{R}^3, \dddot{\bar{R}}, \dot{\mathrm{H}}^3)\ddot{\mathrm{Si}}^3$. As the mineral is formed through the agency of infiltrating waters through rocks containing magnesia, it is not safe to assume that there are no impurities present. Analyses: 1–3, Scheerer (Pogg., lxxxiv. 373); 4, Richter (ib.):

	$\ddot{\mathrm{Si}}$	$\dddot{\bar{\mathrm{A}}}\mathrm{l}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Mn}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{H}}$
1. Arendal	52·28	7·33	3·79	0·89	31·24	0·28	4·04=99·85.
2. "	47·35	10·27	7·92	2·64	24·73	—	6·28=99·19.
3. Eisenach	51·35	9·02	0·79	—	30·19	1·93	6·50=99·78.
4. "	51·44	8·79	$\dddot{\bar{\mathrm{F}}}\mathrm{e}$0·88	—	31·11	2·00	6·50=100·72

Obs.—Occurs in the iron mines of Arendal, and in cavities in basalt near Eisenach. Also compact massive and earthy in fissures at Rochlitz in the Riesengebirge, Bohemia, of a pistachio-green color, or brownish; G.=2·625 to 2·837. Herter & Porth (Jahrb. G. Reichs, x. 19) observe that this variety contains oxyd of zinc, oxyd of iron, lime, alumina, and copper, as impurities.

Named from νέος, *new*, and λίθος, *stone*.

358. PALIGORSKITE. Paligorskit *T. v. Ssaftschenkof*, Verh. Min. St. Pet., 1862, 102.

Fibrous. Soft, but tough, and hence with great difficulty pulverized. G.=2·217. Color white.

COMP.—O. ratio for $\dot{R}$, $\dddot{\bar{R}}$, $\ddot{\mathrm{Si}}$, $\dot{\mathrm{H}}$, after excluding 8½ p. c. of what is called hygroscopic water, 1 : 2·5 : 8 : 3.

Analysis by Ssaftschenkof (l. c.): $\ddot{\mathrm{Si}}$ 52·18, $\dddot{\bar{\mathrm{A}}}\mathrm{l}$ 18·32, $\dot{\mathrm{Mg}}$ 8·19, $\dot{\mathrm{Ca}}$ 0·59, $\dot{\mathrm{H}}$ 12·04, hygrosc. water 8·46=99·84. B.B. infusible. Not acted on by the acids.

From the Permian mining district of the Ural, "in der Paligorischen Distanz" of the second mine on the river Popovka. Probably an altered asbestus.

359. XYLOTILE *Glocker*, Synopsis, 97, 1847 (*Bergholz*, of Sterzing, and *Holzasbest*), approaches the above in constitution, but is probably only an altered asbestus. It occurs delicately fibrous; glimmering in lustre; wood-brown, light or dark, and also green in color; with G.=2·4—2·45 for

the brown, and 2·56 for the greenish, Kenngott. Thaulow obtained (Pogg., xli. 635) $\ddot{\mathrm{Si}}$ 55·58, $\ddot{\bar{\mathrm{A}}}\mathrm{l}$ 0·04, $\bar{\mathrm{F}}\mathrm{e}$ 19·44, $\dot{\mathrm{M}}\mathrm{g}$ 15·50, $\dot{\mathrm{C}}\mathrm{a}$ 0·10, $\dot{\mathrm{H}}$ 10 27=79·93. Von Hauer finds (Sitz. Wien. Akad., xi. 388):

	$\ddot{\mathrm{Si}}$	$\bar{\mathrm{F}}\mathrm{e}$	$\dot{\mathrm{F}}\mathrm{e}$	$\dot{\mathrm{M}}\mathrm{g}$	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\mathrm{H}}$
1.	44·31	17·74	8·73	8·90	·2·27	21·57
2.	45·53	18·03	3·36	11·08	*tr.*	22·01
3.	47·96	16·05	1·87	12·37	*tr.*	21 64

Of the water in the analyses, 9·20, 7·90, and 8·13 p. c. passed off at 100° C.; and, excluding the mean of these determinations, reduces the mean of the above results to $\ddot{\mathrm{Si}}$ 50·43, $\bar{\mathrm{F}}\mathrm{e}$ 18·97, $\dot{\mathrm{F}}\mathrm{e}$ 3·23, $\dot{\mathrm{M}}\mathrm{g}$ 11·82, $\dot{\mathrm{C}}\mathrm{a}$ 0·85, $\dot{\mathrm{H}}$ 14·63=99·98.

Kenngott considers it as probably altered chrysotile.

Xylite of Hermann is also probably only a hydrous asbestus. It has a brown color and asbestiform structure. Hermann obtained (J. pr. Ch., xxxiv. 180, 1845), $\ddot{\mathrm{Si}}$ 44·06, $\bar{\mathrm{F}}\mathrm{e}$ 37·84, $\dot{\mathrm{C}}\mathrm{a}$ 6·58, $\dot{\mathrm{M}}\mathrm{g}$ 5·42, $\dot{\mathrm{C}}\mathrm{u}$ 1·36, $\dot{\mathrm{H}}$ 4·70=99·96. H.=3. G.=2·935.

360. ANTHOSIDERITE. *Hausm.*, Gel. Anz. Gött., 281, 1841.

In tufts of a fibrous structure, and sometimes collected into feathery flowers. Resembles cacoxene.

H.=6·5. G.=3. Lustre silky, a little chatoyant on a fresh fracture. Color ochre-yellow and yellowish-brown, somewhat grayish, rarely white. Powder brown to colorless. Opaque or slightly subtranslucent. Gives sparks with a steel. Tough.

Comp.—$\bar{\mathrm{F}}\mathrm{e}^2\ddot{\mathrm{Si}}^9+2\dot{\mathrm{H}}$=Silica 60·3, sesquioxyd of iron 35·7, water 4·0=100. Analysis by Schnedermann (l. c., and Pogg., lii. 292) of the yellow variety (mean of two results): $\ddot{\mathrm{Si}}$ 60·08, $\bar{\mathrm{F}}\mathrm{e}$ 34·99, $\dot{\mathrm{H}}$ 3·59=98·66. If the water is basic, the O. ratio is 1 : 2½.

Pyr., etc.—B.B. becomes reddish-brown, then black, and fuses with difficulty to a black magnetic slag. Decomposed by muriatic acid.

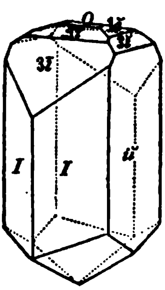
Obs.—From Antonio Pereira, in the province Minas Geraes, Brazil, where it is intimately associated with magnetic iron. Named from ἄνθος, *flower*, and σίδηρος, *iron*.

II. UNISILICATES.

361. CALAMINE. Cadmia pt. *Plin.*, xxxiv. 2; *Agric.* Foss., 255, 1546. Lapis calaminaris, *Germ.* Galmei pt. *Agric.*, Interpr., 1546. Gallmeja pt., Lapis calaminaris pt., Cadmia officin. pt., *Wall.*, Min., 247, 1747; Zincum naturale calciforme pt., Galmeja, Lapis calaminaris pt., Cronst., 197, 1758. Calamine pt *Fr. Trl.* Wall., i. 447, 1753. Zincum spatosum cinereum compactum electricum, ib. flavescens drusicum (fr. Carinthia), *v. Born*, Lithoph., i. 132, 1772. Calamine pt., Mine de Zinc vitriforme (with figs.) *de Lisle*, Crist., 829, 1772, iii. 81, 1783; Kieselerde, Zinkoxyd (fr. Derbyshire), *Klapr.*, Crell's Ann., i. 391, 1788. Galmei pt. *Karst.*, Tab., 24, 1791. Zinc oxydé pt. *H.*, Tr., iv. 1801. Electric Calamine, Silicate of Zinc, *Smithson*, Phil. Trans., 1803. Zinc Calamine *Brongn.*, Min., ii. 136, 1807. Zinkglaserz *Karst.*, Tab., 70, 100, 1808. Zinkkieselerz, Kieselzinkerz, Kieselzinkspath, Kieselgalmey, *Germ.* Siliceous Oxyd of Zinc. Zinc oxydé silicifère *H.* Calamine *Beud.*, Min., ii, 190, 1832. Smithsonite *B. & M.*, Min., 1852 [not Smithsonite *Beud.*]. Hemimorphit *Kenng.*, Min., 67, 1853. Wagit *Radoszkovski*, C. R., liii. 107, 1862.

Orthorhombic; hemimorphic-hemihedral. $I \wedge I$=104° 13′, $O \wedge 1\text{-}\bar{\imath}$= 148° 31′; $a : b : c$=0·6124 : 1 : 1·2850. Observed planes: O; vertical, I, $i\text{-}\breve{\imath}$, $i\text{-}\bar{\imath}$, $i\text{-}\breve{\tfrac{3}{2}}$, $i\text{-}\breve{2}$, $i\text{-}\breve{3}$, $i\text{-}\breve{5}$; domes, $\tfrac{1}{2}\text{-}\breve{\imath}$, $1\text{-}\breve{\imath}$, $\tfrac{3}{2}\text{-}\breve{\imath}$, $\tfrac{5}{3}\text{-}\breve{\imath}$, $2\text{-}\breve{\imath}$, $3\text{-}\breve{\imath}$, $5\text{-}\breve{\imath}$, $7\text{-}\breve{\imath}$; $\tfrac{1}{6}\text{-}\bar{\imath}$, $\tfrac{1}{3}\text{-}\bar{\imath}$, $\tfrac{1}{2}\text{-}\bar{\imath}$, $1\text{-}\bar{\imath}$, $2\text{-}\bar{\imath}$, $3\text{-}\bar{\imath}$; octahedral, $\tfrac{1}{2}$, $\tfrac{3}{2}$, 1; $3\text{-}\breve{\tfrac{3}{2}}$, $2\text{-}\breve{2}$, $4\text{-}\breve{4}$, $\tfrac{3}{2}\text{-}\breve{3}$, $\tfrac{4}{3}\text{-}\breve{4}$, $2\text{-}\breve{6}$, $\tfrac{7}{2}\text{-}\breve{7}$, $\tfrac{7}{4}\text{-}\breve{7}$; $2\text{-}\bar{2}$, $3\text{-}\bar{\tfrac{3}{2}}$, $4\text{-}\bar{\tfrac{4}{3}}$.

384



$O \wedge 2\text{-}\bar{i}=129^\circ\ 14'$
$O \wedge 3\text{-}\bar{i}=118\ 34$
$O \wedge \tfrac{1}{2}\text{-}\bar{i}=162\ 59$
$O \wedge \tfrac{1}{2}\text{-}\breve{i}=166\ 36$
$O \wedge 1\text{-}\breve{i}=154\ 31$
$O \wedge 3\text{-}\breve{i}=124\ 58$
$O \wedge 1=142^\circ\ 11'$
$i\text{-}\bar{i} \wedge 2\text{-}\breve{2}=129\ 7$
$i\text{-}\breve{2} \wedge i\text{-}\breve{2}$, ov. $i\text{-}\breve{i}$, $=114\ 50$
$I \wedge i\text{-}\breve{i}=127\ 54$
$i\text{-}\breve{2} \wedge i\text{-}\breve{i}=147\ 17$
$i\text{-}\breve{3} \wedge i\text{-}\breve{i}=156\ 49$

Twins. Cleavage: *I*, perfect; *O*, in traces. Also stalactitic, mammillated, botryoidal, and fibrous forms; also massive and granular.

H.=4·5—5, the latter when crystallized. G.=3·16—3·9, 3·43—3·49, from Altenberg. Lustre vitreous, *O* subpearly, sometimes adamantine. Color white; sometimes with a delicate bluish or greenish shade; also yellowish to brown. Streak white. Transparent—translucent. Fracture uneven. Brittle. Pyroelectric. Double refraction strong; optic-axial plane $i\text{-}\bar{i}$; divergence 81°—82½° for the red rays; bisectrix positive, normal to *O*.

Var.—1. *Ordinary.* (*a*) In crystals. Measured angles: $I \wedge i\text{-}\breve{i}=128^\circ\ 4'$, Schrauf, giving $I \wedge I=103^\circ\ 52'$; $I \wedge i\text{-}\breve{3}=151^\circ\ 12'$, Schrauf; $i\text{-}\breve{2} \wedge i\text{-}\breve{i}=147^\circ\ 25'$, Hessenberg; $O \wedge 1\text{-}\bar{i}=148^\circ\ 31'$, Dauber, 148° 39′, Schr.; $O \wedge 3\text{-}\bar{i}=118^\circ\ 39'$, Dauber, 118° 40′ Schr.; $O \wedge 1\text{-}\breve{i}=154^\circ\ 31$, Daub., 154° 27′, Schr. (*b*) Mammillary or stalactitic. (*c*) Massive; often cellular. *Wagite* is a concretionary light-blue to green calamine from Nijni Jagurt in the Ural; G.=2·707.

2. *Carbonated.* Sullivan has described (Dublin Q. J. Sci., 1862, ii. 150) a variety of calamine from the Dolores mine in the province of Santander, Spain, occurring in concentric pisolitic masses, frequently containing a semitranslucent, opal-like nucleus. This mineral, produced from the hydrous carbonate by the action of silicated waters, contains from 12 to 20 per cent. of carbonate of zinc; G.=2·88—3·69. Sullivan's paper is one of much interest.

3. *Argillaceous.* Another calamine from Spain, analyzed by Schönichen (B. H. Ztg., xxii. 163), contains 20 to 26 p. c. of alumina, with 31·5 p. c. of silica, 21 to 28·5 p. c. of oxyd of zinc, and 18 to 20 of water; and is apparently calamine mixed with clay. It occurs massive; color at first white, changing in the air to violet, brown, and finally black; transparent on the edges; feel soapy.

Comp.—O. ratio for $\dot{R}$, $\ddot{S}i$, $\dot{H}=1:1:\tfrac{1}{2}$; $\dot{Z}n^2\ddot{S}i+\dot{H}$=Silica 25·0, oxyd of zinc 67·5, water 7·5 =100. Perhaps in some, or all cases, one-third more water, or $\dot{Z}n^2\ddot{S}i+1\tfrac{1}{3}\dot{H}$=Silica 24·4, oxyd of zinc 65·9, water 9·7=100.

Analyses: 1, Smithson (Nicholson's Journ., vi. 78); 2, 3, Monheim (J. pr. Ch., xlix. 319); 4, Berzelius (Ak. H. Stockh., 1819, 141); 5, Berthier (J. d. M., xxviii. 341); 6, Thomson (Phil. Mag., 1840); 7, 8, Hermann (J. pr. Ch., xxxiii. 98); 9, E. Schmidt (J. pr. Ch., li. 257); 10, C, Schnabel (Pogg., cv. 144); 11, Radoszkovski (l. c.):

		$\ddot{S}i$	$\dot{Z}n$	$\dot{H}$
1. Retzbanya		25·0	68·3	4·4=97·7 Smithson.
2. "		25·34	67·02	7·58, $\ddot{\bar{F}}e$ 0·68, $\ddot{C}$ 0·35=100·97 Monheim.
3. Altenberg	(⅔)	24·85	66 40	7·49, $\ddot{\bar{F}}e$ 0·22, $\ddot{C}$ 0·31=99·27 Monheim.
4. Limburg		26·23	66·37	7·40=100 Berzelius.
5. Brisgau		25·5	64·5	10·0 =100 Berthier.
6. Leadhills; G.=3·164		23·2	66·8	10·8 =100·8 Thomson.
7. Nertschinsk; G.=3·871		25·38	62·85	9·07, $\dot{P}b$ 2 70=100 Hermann.
8. " G.=3·435		25·96	65 66	8·38=100 Hermann.
9. Moresnet		24·44	66·48	7·02 $\ddot{\bar{F}}e$ 0·72, $\ddot{C}$ 1·02=99·68 Schmidt.
10. Santander; G.=3·42		23·74	66·25	8·34, $\ddot{\bar{A}}l$, $\ddot{\bar{F}}e$ 1·08, $\dddot{\bar{P}}$ *tr.*=99·41 Schnabel.
11. Ural, *Wagite*		26·00	66·90	4·70, $\dot{C}a$ 1·55, $\dot{C}u$, $\dot{F}e$ *tr.*=99·15 Radosz.

The *wagite* gives the O. ratio 1 : 1 : ⅓.

Pyr., etc.—In the closed tube decrepitates, whitens, and gives off water. B.B. almost infusible (F.=6); moistened with cobalt solution gives a green color when heated. On charcoal with soda gives a coating which is yellow while hot, and white on cooling. Moistened with cobalt solution, and heated in O.F., this coating assumes a bright green color. Gelatinizes with acids even when previously ignited. Decomposed by acetic acid with gelatinization. Soluble in a strong solution of caustic potash.

Obs.—Calamine and smithsonite are usually found associated in veins or beds in stratified calcareous rocks accompanying ores of blende, iron, and lead, as at Aix la Chapelle; Raibel and Bleiberg, in Carinthia, in the upper Triassic; Moresnet in Belgium, Fribourg in Brisgau, Iserlohn, Tarnowitz, Olkucz, Miedzanagora, Retzbanya, Schemnitz. At Roughten Gill, in Cumberland, in acicular crystals and mammillary crusts, sky-blue and fine green; at Alston Moor, white; at the Rutland mine, near Mattock, in Derbyshire, in brilliant crystals, and grayish-white, and yellow, and mammillated: at Castleton, in crystals; on the Mendip Hills, mostly brownish-yellow, and in part stalactitic; in Flintshire, etc., Wales; Leadhills, Scotland. Large crystals have been found at Nertschinsk.

In the United States occurs with smithsonite in Jefferson county, Missouri. In Pennsylvania, at the Perkiomen and Phenixville lead mines; in a lower Silurian rock two miles from Bethlehem, at Friedensville, in Saucon valley, abundant and extensively worked; on the Susquehanna, opposite Selinsgrove. Abundant in Virginia, at Austin's mines in Wythe Co. A pale yellow, fusible zinciferous clay occurs in considerable abundance with calamine at the Ueberroth mine, Friedensville. Analysis of this by John M. Blake gave $\ddot{\text{Si}}$ 41·36, $\ddot{\text{Al}}$ 8·04, $\dot{\text{Fe}}$ 9·55, $\dot{\text{Zn}}$ 32·24, $\dot{\text{Mg}}$ 1·02, $\dot{\text{K}}$ *tr.*, $\dot{\text{H}}$ 7·76. Other specimens examined by W. T. Roepper gave a variable amount of zinc, showing that the substance is not homogeneous (priv. contrib.).

On cryst. see G. Rose, Pogg., lix; Dauber, Pogg., xcii. 245 (whose measurements are above adopted); Hessenberg, Senk. Nat. Ges. Frankfurt a M., ii. 260; Schrauf, Ber. Ak. Wien, xxxviii. 789; Descl. Min., i. 117.

The name *Calamine* (with *Galmei* of the Germans) is commonly supposed to be a corruption of *Cadmia*. Agricola says it is from *calamus*, a *reed*, in allusion to the slender forms (stalactitic) common in the *cadmia fornacum*.

The *cadmia* of Pliny and of other ancient authors included both the native silicate and carbonate, and the oxyd from the chimneys of furnaces (cadmia fornacum). The two native ores continued to be confounded under the name *lapis calaminaris*, *calamine* or *galmei*, until investigated chemically by Smithson in 1803. Earlier analyses had made out chemical differences, and some authors, before 1790, had rightly suggested a division of the species: Bergmann having found 28 p. c. carbonic acid in a Holywell specimen (J. de Phys., xvi. 17, 1780); and Pelletier, in a kind from Fribourg in Brisgau, which had been called *Zeolite of Brisgau* because it gelatinized with acids, 52 p. c. silica, with 36 oxyd of zinc, and 12 water (J. de Phys., xx. 420, 1782); and Klaproth, in another, similarly gelatinizing, 66 oxyd of zinc and 33 silica. But Smithson was the first to make known the true composition, and clear away all doubts.

De Lisle noticed the crystalline forms of the two species, describing one kind as prismatic with dihedral summits, and the other as scalenohedral like dogtooth spar, yet did not fully appreciate the importance of the observation; while Haüy, 14 years later, in his *Traité*, describes only the crystals of the *silicate*, and takes the ground that the *zinc carbonatée* was only an impure calcareous "zinc oxydé."

In 1807 Brongniart called the silicate *calamine*, leaving for the other ore the chemical name *zinc carbonatée*. In 1832, Beudant followed Brongniart in the former name, and designated the latter *Smithsonite*, after SMITHSON, who had analyzed in 1803 the carbonate as well as silicate. Thus the two species were at last, not only distinguished, but mineralogically named.

Unfortunately, Brooke & Miller, in 1852, reversed Beudant's use of these names, with no good reason; and in 1853, Kenngott, on account of the confusion of names, as he says, introduced for the silicate the new name *Hemimorphite*, and so added to the confusion. These innovations should have no favor.

361A. **MORESNETITE** *Risse* (Verh. nat Ver. Bonn, 1865, Ber. 98). A mineral from Altenberg, near Aachen, occurring with calamine. Two varieties are found, one dark to leek-green and opaque; the other light emerald-green, transparent. The latter is the purest; it has H.=2·5, conchoidal fracture, streak white. It afforded on analysis $\ddot{\text{Si}}$ 30·31, $\ddot{\text{Al}}$ 13·68, $\dot{\text{Fe}}$ 0·27, $\dot{\text{Ni}}$ 1·14, $\dot{\text{Zn}}$ 43·41, $\dot{\text{Mg}}$ *tr.*, $\dot{\text{Ca}}$ *tr.*, $\dot{\text{H}}$ 11·37=100·18. B.B. on charcoal gives with cobalt solution a pale green mass. Difficultly soluble in acids.

362. VILLARSITE. *Dufrenoy*, C. R., 1842, Ann. d. M., IV. i. 387, 1842. Serpentin aus d. Malenkerthal *Fellenberg*, J. pr. Ch., ci. 38, 1867.

Orthorhombic. $I \wedge I=120°\ 8'$, Descl. Observed planes: O, $1\text{-}\bar{\imath}$, 1; crystals all compound, consisting of three intersecting individuals; composition-face $\breve{\imath}\text{-}\breve{3}$. $O \wedge 1\text{-}\bar{\imath}=140°\ 36'$, $O \wedge 1=136°\ 32'$. (Crystallization perhaps pseudomorphic.) Mostly in rounded grains. Also massive.

H.=4—5. G.=2·978, from Traversella; 2·99, fr. Malenkerthal. Color yellowish-green to olive-green; also dark green to blackish. Streak uncolored. Translucent; transparent in thin plates. Double refraction strong; optic-axial plane, *i*-ī; bisectrix normal to *O*, positive; Descl.

Comp.—O. ratio for $\dot{R}$, $\ddot{Si}$, $\dot{H}=1:1:\frac{1}{4}$; $(\frac{11}{12}\dot{Mg}+\frac{1}{12}\dot{Fe})^2\ddot{Si}+\frac{1}{2}\dot{H}$=Silica 38·9, magnesia 47·5, protoxyd of iron 7·8, water 5·8=100. Appears to be a hydrous forsterite or boltonite in composition, and to resemble much the latter. G. Rose pointed out the approximation in angle to chrysolite, and regarded it as an altered variety. Its occurrence in twins of three intersecting crystals, as made known by Descloizeaux (Min., 95, 1862), is an important characteristic not thus far observed in forsterite, or any other species of the chrysolite group. The crystals have the planes shining, but not quite even. Analyses: 1, 2, Dufrenoy (l. c., and Dufr. Min., 2d. ed., iv. 343); 3, Fellenberg (l. c.):

	$\ddot{Si}$	$\dot{Fe}$	$\dot{Mn}$	$\dot{Mg}$	$\dot{Ca}$	$\dot{K}$	$\dot{H}$
1. Traversella	39·61	3·59	2·42	47·37	0·53	0·46	5·80=99·78 Dufrenoy.
2. Forez	40·52	6·25	—	43·75	1·70	0·72	6·21=99·15 Dufrenoy.
3. Malenkerthal (⅔)	41·72	7·97	—	42·15	—	—	5·55, $\dot{Cr}$, $\dot{Ni}$ 0·75, $\ddot{\ddot{Al}}$ 3·19=101·33 F.

Anal. 1 is of the original villarsite; 2, of grains from the granite of Forez and Morvan, France.

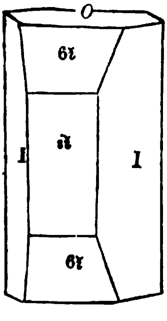
Pyr., etc.—B.B. infusible. With borax a green enamel. Attacked by concentrated acids.

Obs.—At Traversella it is associated with mica, quartz, and dodecahedral magnetite. Much boltonite is hydrous, and in composition belongs here. Grains in the interior of the serpentine pseudomorphs of Snarum have sometimes a similar composition The mineral from Pirlo in Malenkerthal, of the Grisons, constitutes the base of a serpentine-like rock, which is slightly crystalline in texture, somewhat slaty, feeble lustre, and between blackish-gray and dark green in color. Supposing the alumina present as a mixed silicate, the formula is that of the Traversella mineral. The rock looks like a mixture of several minerals.

363. PREHNITE. Chrysolite *Sage*, Min., i. 232, 1777. Chrysolite du Cap (a kind of Schorl) *de Lisle*, ii. 275, 1783. Zeolithe verdâtre *v. Born*, Cat. de Raab, i. 203, 1790. Prehnit *Wern.*, Bergm. J., 1790, i. 110; anal. by *Klapr.*, Schrift Ges. nat. Berlin, viii. 217, 1788. Koupholite (fr. Barèges), *Picot la Peyrouse*, *Delameth.*, T. T., ii. 547, 1797. Ædelite (Edelite) *Walmstedt*, Jahresb., v. 217, 1825. Jacksonite *Whitney*, J. Nat. H. Soc. Boston, v. 487, 1847.

Orthorhombic. $I \wedge I=99°\ 56'$, $O \wedge 1\text{-}\bar{i}=146°\ 11\frac{1}{2}'$; $a:b:c=0{\cdot}66963:1:1{\cdot}19035$. Observed planes: *O*; vertical, *I*, *i*-ĭ, *i*-ī; domes, $\frac{3}{4}\text{-}\bar{i}$, $\frac{3}{2}\text{-}\bar{i}$, 6-ĭ; octahedral, 2, 6. $O \wedge \frac{3}{4}\text{-}\bar{i}=153°\ 20'$, $O \wedge \frac{3}{2}\text{-}\bar{i}=134°\ 52\frac{1}{2}'$, $O \wedge 2=119°\ 45'$, $O \wedge 6=100°\ 47'$ $O \wedge 6\text{-}\breve{i}=106°\ 30'$, $I \wedge i\text{-}i=130°\ 2'$. Cleavage: basal, distinct. Tabular crystals often united by *O*, making broken forms, often barrel-shaped. Reniform, globular, and stalactitic with a crystalline surface. Structure imperfectly columnar or lamellar, strongly coherent; also compact granular or impalpable.

385



H.=6–6·5. G.=2·8–2·953. Lustre vitreous; *O* weak pearly. Color light green, oil-green, passing into white and gray; often fading on exposure. Subtransparent—translucent; streak uncolored. Fracture uneven. Somewhat brittle. Pyroelectric, with polarity central, the analogue poles at the centre of the base and the antilogue at the extremities of the brachydiagonal, Riess & Rose. Double refraction strong; optic-axial plane usually *i*-ī; bisectrix positive, normal to *O*; axial angle 122°—130°, for crystals from Dauphiny and Pyrenees, but in others much less; divergence very slightly diminished by heating; Descl.

Var.—Usual in firm and hard incrusting masses, externally globular or mammillary, the surface made up often of grouped crystals more or less imperfect, but sometimes smooth.

Coupholite is in cavernous masses, made of small, thin, fragile laminæ or scales; the original was from the peak of Ereslids, near Barèges, in the Pyrenees; also reported from the Col du Bonhomme, at the foot of Mt. Blanc. Named from κοῦφος, *tender*.

Edelite (or *Ædelite*) is nothing but prehnite from Ædelfors, Sweden.

Jacksonite (or *anhydrous prehnite*) of Whitney is ordinary prehnite, from Keweenaw Pt. and Isle Royale.

Crystals from Farmington, Ct., have for the optic-axial plane *i-ī*; and the divergence for the red rays in the outer parts of a plate of a crystal, 48°—50°; in an interior wedge-shaped part of the same plate, 17°, Descl. The dispersion is very strong in these crystals, while in those of Dauphiny it is hardly perceptible.

Comp.—O. ratio for $\dot{\mathrm{R}}$, $\dddot{\bar{\mathrm{R}}}$, $\ddot{\mathrm{Si}}$, $\dot{\mathrm{H}}$=2 : 3 : 6 : 1, whence, if the water is basic, for bases and silica, 1 : 1; and formula $(\frac{1}{6}\dot{\mathrm{H}}^3+\frac{2}{6}\dot{\mathrm{Ca}}+\frac{3}{6}\dddot{\bar{\mathrm{Al}}})^2\ddot{\mathrm{Si}}^3$=Silica 43·6, alumina 24·9, lime 27·1, water 4·4=100. Analyses: 1, 2, Gehlen (Schw. J., iii. 171); 3–5, Walmstedt (Jahresb., v. 217); 6, 7, Thomson & Lehunt (Min., i. 275); 8, Regnault (Ann. d. M., III. xiv. 154); 9, Amelung (Ramm. 2d Suppl., 118, Pogg., lxviii. 312); 10, 11, Leonhard (Pogg., liv. 579); 12, Domeyko (Ann. d. M., IV. ix. 3); 13, P. Kützing (B. H. Ztg., xx. 267); 14, C. W. Paykull (Œfv. Ak. Stock., 1866, 85):

	$\ddot{\mathrm{Si}}$	$\dddot{\bar{\mathrm{Al}}}$	$\dddot{\bar{\mathrm{Fe}}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{H}}$
1. Tyrol	43·00	23·25	2·00	26·00	4·00, $\dddot{\bar{\mathrm{Mn}}}$ 0·25=98 50 Gehlen.
2. Tyrol, Fassa	42·88	21·50	3·00	26·50	4·62, $\dddot{\bar{\mathrm{Mn}}}$ 0·25=98·75 Gehlen.
3 Mt. Blanc, *Couph.*	44·71	23·99	—	25·41	4·45, $\dddot{\bar{\mathrm{Mn}}}$ 0·19, $\dot{\mathrm{Fe}}$ 1·25=100 Walmstedt.
4. Dumbarton	44 10	24·26	—	26·43	4·18, $\dot{\mathrm{Fe}}$ 0·74=99·71 Walmstedt.
5. Ædelfors, *Edelite*	43·03	19·30	6·81	26·28	4·43, $\dddot{\bar{\mathrm{Mn}}}$ 0·15=100·20 Walmstedt.
6. Glasgow, *green*	43·60	23·00	2·00	22·33	6·40=97·33 Thomson.
7. " *white*	43·05	23·84	0·66	26·16	4·60, $\dot{\mathrm{Mn}}$ 0·42, $\dot{\mathrm{K}}$, $\dot{\mathrm{Na}}$ 1·03 Lehunt.
8. Bourg d'Oisans	44·50	23·44	4·61	23·47	4·44=100·46 Regnault.
9. Radauthal, Harz	44·74	18·06	7·38	27 06	4·13, $\dot{\mathrm{Na}}$ 1·03=102·40 Amelung.
10. Niederkirchen,	42·50	30·50	0·04	22·57	5·00, $\dot{\mathrm{K}}$ 0·02=100·63 Leonhard.
11. pseudomorphs	44·00	28·50	0·04	22·29	6·00, $\dot{\mathrm{K}}$ 0·01=100·84 Leonhard.
12. Chili	43·6	21·6	4·6	25·0	5·3=100·1 Domeyko.
13. Tyrol	44·42	24·09	0·92	26·41	4·26=100·10 Kützing.
14. Upsala	44·11	22·99	3·22	25·83	4·26=100·41 Paykull.

No. 10 is a pseudomorph after analcite, and 11 after leonhardite. The *jacksonite*, or *anhydrous prehnite*, of Whitney (l. c.), contains, according to Jackson and Brush, 4·7, 4·15 (J.), and 4·85 (B.) p. c. of water. The specimen analyzed by Whitney may possibly have been calcined, as in some localities on Lake Superior it is customary to burn the copper ore to free it from adhering rock. He obtained (l. c.) $\ddot{\mathrm{Si}}$ 46·12, $\dddot{\mathrm{Al}}$ 25·91, $\dot{\mathrm{Ca}}$ 27·03, $\dot{\mathrm{Na}}$ 0·85=99·91.

Pyr., etc.—In the closed tube yields water. B.B. fuses at 2 with intumescence to a blebby enamel-like glass. Decomposed by muriatic acid without gelatinizing. *Coupholite*, which often contains dust or vegetable matter, blackens and emits a burnt odor.

Obs.—Occurs in granite, gneiss, syenite, dioryte, and trappean rocks, especially the last.

At St. Christophe and l'Armentières, near Bourg d'Oisans in Isère, associated with axinite and epidote; at Ratschinges, Fassa valley, and near Campitello, Tyrol; in Salzburg; Ala in Piedmont; the Sau-Alp in Carinthia; Joachimsthal in Bohemia; in Nassau, at Oberscheld and Uckersdorf: near Freiburg in Brisgau on the Rosskopf; in the Harz, near Andreasberg, with datolite; Arendal, Norway; Ædelfors in Sweden (*edelite*); Upsala, Sweden, in rifts in hornblendic granite, the decomposition of the hornblende having afforded the lime, and of the mica, the alumina (Paykull); at Friskie Hall and Campsie in Dumbartonshire, and at Hartfield Moss; in Renfrewshire, in veins traversing trap, associated with analcite and thomsonite; also at Corstorphine Hill, the Castle and Salisbury Crag, near Edinburgh; Mourne Mts., Ireland.

In the United States, finely crystallized at Farmington, Woodbury, and Middletown, Conn., and West Springfield, Mass., and Patterson and Bergen Hill, N. J.; in small quantities in gneiss, at Bellows Falls, Vt.; in syenite, at Charlestown, Mass; Milk Row quarry, often in minute tabular crystals, with chabazite; also at Palmer (Three Rivers) and Turner's Falls, Mass., on the Connecticut, in trap, and at Perry, above Loring's Cove, Maine; at Westport, Essex Co., N. Y. (*chiltonite* Emmons), on a quartzose rock; on north shore of Lake Superior, between Pigeon Bay and Fond du Lac; in large veins in the Lake Superior copper region, often occurring as the veinstone of the native copper, sometimes including strings or leaves of copper; and at times in radiated nodules disseminated through the copper.

Handsome polished slabs of this mineral have been cut from masses from China.

The formula $(\frac{1}{2}\dot{\mathrm{R}}^3+\frac{1}{2}\dddot{\mathrm{Al}})^2\ddot{\mathrm{Si}}^3$ is analogous to that of chrysolite in the ratio 1 : 1, and the two species appear to be homœomorphous, 2-ī ∧ 2-ī in chrysolite=99° 7′.

Alt.—Prehnite occurs altered to green earth and feldspar.

Named by Werner in 1790 after Col. Prehn, who first found the mineral at the Cape of Good

Hope. Sage had called it (1777) *chrysolite*, and Romé de Lisle had referred it (1783, to the group of *schorl*.

363A. **Uigite** *Heddle* (Ed. N. Phil. J., II. iv. 162, 1856). In radiated sheafy clusters of plates, in nests in the amygdaloid of Uig. Isle of Skye, along with analcite and faroelite. H. =5·5; G.=2·284; lustre pearly; color white, slightly yellowish. Composition, according to Heddle (loc. cit.), $\ddot{Si}$ 45·98, $\ddot{\bar{Al}}$ 21·98, $\dot{Ca}$ 16·15, $\dot{Na}$ 4·7, $\dot{H}$ 11·25. The O. ratio for $\dot{R}$, $\ddot{\bar{R}}$, $\ddot{Si}$ corresponding is near 1 : 2 : 4. B.B. fuses readily and quietly to an opaque enamel, which is not frothy; gives a strong soda reaction.

It appears to be near prehnite in structure, and needs further investigation.

364. CHLORASTROLITE. *C. T. Jackson; J. D. Whitney*, J. Nat. Hist. Bost., v. 488.

Massive. Finely radiated or stellate in structure.

H.=5·5—6. G.=3·180. Lustre pearly. Color light bluish-green Slightly chatoyant on the rounded sides.

Comp.—O. ratio 1 : 2 : 3 : 1; $(\dot{Ca}^3, \dot{Na}^3)^2\ddot{Si}^3 + 2(\ddot{\bar{Al}}, \ddot{\bar{Fe}})^2\ddot{Si}^3 + 6\dot{H} = (\frac{1}{3}\dot{R}^3 + \frac{2}{3}\ddot{\bar{R}})^2\ddot{Si}^3 + 2\dot{H}$ = Silica 37·6, alumina 24·6, sesquioxyd of iron 6·4, lime 18·7, soda 5·2, water 7·5=100. Analyses by Whitney (Rep. G. Lake Sup., 1851, ii. 97):

	$\ddot{Si}$	$\ddot{\bar{Al}}$	$\ddot{\bar{Fe}}$, little $\dot{Fe}$	$\dot{Ca}$	$\dot{Na}$	$\dot{K}$	$\dot{H}$
1.	36·99	25·49	6·48	19·90	3·70	0·40	7·22=100·18.
2.	37·41	24·25	6·26	21·68	4·88		5·77=100·25.

Rammelsberg observes that it has some relation in composition to a hydrous epidote. It also approaches carpholite.

Pyr., etc.—In the closed tube yields water and becomes white. B.B. fuses easily with intumescence to a grayish blebby glass. Forms a transparent glass readily with borax, tinged with iron. Soluble in muriatic acid, the silica separating as a flocky precipitate (Whitney).

Obs.—Occurs on the shores of Isle Royale, Lake Superior, in small rounded pebbles, which have come from the trap, and are waterworn; it receives a fine polish.

Named from χλωρός, *green*, ἄστρον, *star*, λίθος, *stone*.

365. TRITOMITE. Tritomit *Weibye & Berlin*, Pogg., lxxix. 299, 1850.

Isometric; tetrahedral, f. 31. Cleavage indistinct.

H.=5·5. G.=3·9—4·66; 3·908, Forbes; 4·16—4·66, W. & B.; 4·26, Möller. Lustre submetallic, vitreous. Color dull brown. Streak dirty yellowish-gray. Subtranslucent.

Comp.—$(\dot{R}^3, \dot{R}^{\frac{3}{2}}, \ddot{\bar{R}})^2\ddot{Si}^3 + 4\dot{H}$? Analyses: 1, approximate, N. J. Berlin (l. c.); 2, D. Forbes (Ed. N. Phil. J., II. iii. 1856):

	$\ddot{Si}$	$\dddot{W}$	$\ddot{\bar{Al}}$	$\dot{Ce}$	$\dot{La}$	$\dot{Fe}$	$\dot{Mn}$	$\dot{Y}$	$\dot{Mg}$	$\dot{Ca}$	$\dot{Na}$	$\dot{H}$	
1.	20·13	4·62[a]	2·24	40·36	15·11	1·88	—	0·46	0·22	5·15	1·46	7·86=99·44	Berlin.
2.	21·16	3·95[b]	2·86	37·64	12·41	2·68	1·10	4·64	0·09	4·04	0·33	8·68=99·58	Forbes.

[a] With Mn O, Cu O, Sn O^2. [b] With Sn O^2.

F. P. Möller has obtained a very different composition in, apparently, a careful analysis, in which the state of oxydation of the bases was ascertained (Ann. Ch. Pharm., cxx. 241):

$\ddot{Si}$	$\ddot{Sn}$	$\ddot{\bar{Ta}}$	$\ddot{Zr}$?	$\ddot{\bar{Ce}}$	$\ddot{\bar{Al}}$	$\ddot{\bar{Fe}}$	$\ddot{\bar{Mn}}$	$\dot{Ce}$	$\dot{La}$, $\dot{Di}$	$\dot{Y}$	$\dot{Mg}$	$\dot{Ca}$	$\dot{Ba}$	$\dot{Sr}$	$\dot{Na}$	$\dot{K}$	$\dot{H}$
15·38	0·74	8·63	4·48	1·61	2·27	0·49	10·66	44·05	0·42	0·16	6·41	0·19	0·71	0·36	2·10	5·63=99·49	

From Berlin and Forbes, the formula $\ddot{\bar{R}}^2\ddot{Si}^3 + 4\dot{H}$ has been deduced. Möller obtains the O. ratio for $\dot{R}$, $\ddot{\bar{R}}$, $\ddot{Si}$, $\dot{H}$ 4 : 1 : 4 : 2. But if the $\ddot{Sn}$, $\ddot{\bar{Ta}}$, $\ddot{Zr}$ are added to the bases instead of the silica, the oxygen ratio for all the bases to the silica and water is very nearly 2 : 1 : ⅓.

Forbes questions whether the crystals observed are not thorite.

Pyr., etc.—Yields water and gives a weak fluorine reaction; with borax a reddish-yellow glass, which is colorless on cooling. With muriatic acid in powder yields chlorine, and gelatinizes.

Obs.—From the island Lamö, near Brevig, Norway, with leucophanite and mosandrite in a coarse syenite.

Named from τρίς, *three-fold*, and τέμνειν, *to cut*, alluding to the trihedral cavities which the crystals leave in the gangue.

365. **THORITE.** Thorit *Berz.*, Ak. H. Stockh., 1829. Orangit *Bergemann*, Pogg., lxxxii. 561, 1851

Isometric and tetrahedral. In dodecahedral crystals, with octahedral planes tetrahedrally developed, the larger set dull and even, the smaller bright and rounded, and with the three edges about the latter replaced. Also massive and compact.

H.=4·5—5. G.=4·3—5·4; of purest, 5—5·4. Lustre of surface of fresh fracture vitreous to resinous. Color orange-yellow, brownish-yellow; also black, inclining to brown. Streak light orange to dark brown. Transparent in thin splinters to nearly opaque. Fracture conchoidal. Easily frangible. Optically uniaxial.

Var.—The brownish-black and black variety, from Lövö, Norway, was the mineral from which Berzelius obtained the metal thorium, and which received the name *thorite*. The yellowish variety is the *orangite* (so called from the color), from Langesund fiord, which Bergemann, when he so named it, supposed to contain a new metal, called by him *donarium*. The latter has since been found with an exterior of the former. The mineral occurs as pseudomorphs after orthoclase and zircon, and crystals of the latter kind have afforded Zschau (Am. J. Sci., II. xxvi. 359) the angles $I \wedge I=132\frac{1}{2}°$, $1 \wedge 1=123\frac{1}{4}°$, the corresponding angles of zircon being 132° 10′ and 123° 19′. Zschau regards the mineral thorite as tetragonal, and isomorphous with zircon, not considering his crystals as pseudomorphous.

The mineral varies much in specific gravity, *orangite* affording 5·397, Bergemann; 5·34, Krantz; 5·19, Damour; 4·888—5·205, Chydenius; and *thorite*, 4·630, Berz.; 4·686, Bergemann; 4·344—4·397, Chydenius.

Comp.—Essentially $\ddot{\mathrm{Th}}\,\dddot{\mathrm{Si}}+1\frac{1}{3}\dot{\bar{\mathrm{H}}}$=Silica 17·0, thoria 76·2, water 6·8=100; for the black thorite (anal. 1) $\ddot{\mathrm{Th}}\,\dddot{\mathrm{Si}}+2\dot{\bar{\mathrm{H}}}$=Silica 16·4, thoria 73·8, water 9·8=100. Analyses: 1, Berzelius (l. c.); 2, Damour (Ann. d. M., V. i. 587); 3, Bergemann (l. c.); 4, Chydenius (Pogg., cxix. 43):

	$\dddot{\mathrm{Si}}$	$\ddot{\mathrm{Th}}$	$\ddot{\mathrm{Sn}}$	$\bar{\mathrm{Al}}$	$\bar{\mathrm{Fe}}$	$\bar{\mathrm{Mn}}$	$\bar{\mathrm{U}}$	$\dot{\mathrm{Pb}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Na}}$	$\dot{\mathrm{K}}$	$\dot{\bar{\mathrm{H}}}$
1.	18·98	57·91	0·01	0·06	3·40	2·39	1·61	0·80	0·36	2·58	0·10	0·14	9·50, undis. 1·70=99·51 Berz.
2.	17·52	71·65	—	0·17	0·31	0·28	1·13	0·88	*tr.*	1·59	0·83	0·14	6·14=100·14 Damour.
3.	17·70	71·25	—	—	0·31	0·21	—	—	4·04	—	0·30		6·90, $\dot{\mathrm{Ca}}\ddot{\mathrm{C}}$ 4·04=100·74 B.
4.	17·76	73·80	—	—	—	—	—	1·18	*tr.*	1·08	—	—	6·45=100·27 Chydenius.

Pyr., etc.—In the closed tube yields water; the orange variety becomes dull-brown, and, on cooling, orange again. B.B. on charcoal infusible, the edges only being slightly glazed; with borax a yellowish pearl, becoming colorless on cooling; with salt of phosphorus a colorless glass, which becomes milky and greenish on cooling; with borax an orange glass when hot, which becomes grayish on cooling. A little nitre being added, the orange color remains after cooling. With muriatic acid easily forms a jelly before, but not after, calcination. The black thorite becomes pale brownish-red when heated; and on charcoal forms a yellowish-brown slag.

Obs.—Found in syenite by Esmark at Lövö, near Brevig, in Norway; also at Langesund fiord, near Brevig (orangite, anal. 2–4). Masses of orangite weighing several ounces have been obtained. The black thorite appears to be partially altered.

367. **CERITE.** Ferrum calciforme terra quadam incognita intime mixtum, Tungsten von Bastnäs, *Cronstedt*, Ak. H. Stockholm., 1751, Min., 183, 1758. Cerit *His. & Berz.*, Cerium en ny Metal, etc., 1804, Gehlen's J., ii. 397, 1804, Afh., i. 58, 1806. Ochroit, *Klapr.*, Gehlen's J., ii. 303, 1804. Cererit *Klapr.*, Beitr., iv. 140, 1807; *Karst.*, Tab., 74, 1808. Cerium oxydé siliceux *H.*, Tabl., 1809. Cerin-Stein *Wern.*, Hoffm. Min., iv. a, 286, 1817. Kieselcerit *Germ.* Silicate of Cerium. Lanthanocerit *Hermann*, J. pr. Ch., lxxxii. 406, 1861.

Hexagonal? Isometric? In short six-sided prisms, Haid. Commonly massive; granular.

H.=5·5. G.=4·912, Haidinger. Lustre dull adamantine or resinous. Color between clove-brown and cherry-red, passing into gray. Streak grayish-white. Slightly subtranslucent. Brittle; fracture splintery.

Comp.—O. ratio for $\dot{R}$, $\ddot{Si}$, $\dot{H}$=1 : 1 : ½; ($\dot{Ce}$, $\dot{La}$, $\dot{Di}$)^2 $\ddot{Si}$+$\dot{H}$=Silica 20·4, ceria 73·5, water 6·1=100. Analyses: 1, Hisinger (Afh., iii. 287); 2, Hermann (J. pr. Chem., xxx. 193, and lxxxii. 407); 3, Kjerulf (Ann. Ch. Pharm., xxxvii. 12); 4, Rammelsberg (Pogg., cvii. 632, and Min. Ch., 547); 5, Hermann (J. pr. Ch., lxxxii. 406):

	$\ddot{Si}$	$\dot{Fe}$	$\dot{Ce}$	$\dot{La}$	$\dot{Di}$	$\dot{Ca}$	$\dot{H}$
1. Bastnäs	18·00	1·80		68·59		1·25	9·60=99·24 Hisinger.
2. "	16·06	8·17	26·55	16·33	18·05	3·56	8·10, $\dddot{\overline{Al}}$ 1·68, $\dot{Mn}$ 0·27, $\dot{Mg}$ 1·25, $\ddot{C}$ 4·62 H
3. "	21·30	4·98	58·50	8·47		1·23	5·52=100 Kjerulf.
4. "(⅓)	19·18	1·54	64·55	7·28		1·31	5·71=99·57 Rammelsberg.
5. "	21·35	1·46	60·99	3·51	3·90	1·65	6·31, $\ddot{C}$ 0·83=100 Hermann.

From analysis 3, 3·27 of molybdenite, and 0·18 bismuth glance, are removed as impurities. Analyses 1 and 2 give near 10 p. c. of water, with much lanthanum and didymium, and little cerium, according to Hermann; he accordingly applies to this kind the distinctive name *lanthanocerite*, and to the rest that of *cerite*.

Klaproth, who published the first analysis (Beitr., iv. 140), and gave the mineral the name *ochroite*, obtained $\ddot{Si}$ 34·5, $\dot{Ce}$ 54·5, $\dot{Fe}$ 3·5, $\dot{Ca}$ 1·25, $\dot{H}$ 5·0=98·75; with his silica he included all the material not decomposed in his method of analysis. Hermann has supposed the substance analyzed a distinct species.

Pyr., etc.—In a matrass yields water. B.B. infusible alone; with borax in the outer flame forms a yellow globule, which becomes almost colorless on cooling; in the inner flame a weak iron reaction. With soda not dissolved, but fuses to a dark yellow slaggy mass. Gelatinizes with muriatic acid.

Obs.—Occurs at Bastnäs, near Riddarhyttan, in Westmannland, Sweden, forming a bed in gneiss, and associated with mica, hornblende, copper pyrites, cerine, etc. It bears considerable resemblance to the red granular variety of corundum, but is readily distinguished by its hardness.

Hisinger and Berzelius, in 1803–4, detected in this mineral a new metal which they named *cerium*, after the planet *Ceres*, then recently announced; and the mineral they called *cerite*. Klaproth made the same discovery about the same time, and gave the name *ochroite* to the mineral, and *ochroite earth* to the new earth (alluding to its color, from ὠχρός, *brownish-yellow*). In his Beiträge, 1807, Klaproth accepted the names of Hisinger and Berzelius, yet added a syllable (lest they should appear to come from κηρα, *wax*), making them *cererium* and *cererite*—a change not accepted. In 1839 Mosander proved that the oxyd of cerium contained the new metal *lanthanum*, and in 1842 another new metal, *didymium*.

368. ERDMANNITE. *Berlin*, Pogg., lxxxviii. 162.

In imbedded grains and folia; with no traces of crystallization.

G.=3·1. Lustre vitreous. Color dark brown. In thin splinters. Translucent.

Comp.—Analysis by Blomstrand, of half a gramme (l. c.):

$\ddot{Si}$	$\dddot{\overline{Al}}$	Ox. Ce & La	$\dot{Fe}$	$\dot{Mn}$	$\dot{Y}$	$\dot{Ca}$	$\dot{H}$ and loss
31·85	11·71	34·89	8·52	0·86	1·43	6·46	4·28

Obs.—From the island Stokö in the Langesund fiord, near Brevig.
Named after Erdmann.

369. PYROSMALITE. Pirodmalit *Hausm.*, Moll's Efem., iv. 390, 1808. Wesentlicher Bestandtheil Salzsaures Eisenoxyd, *id.*, ib. (fr. blowpipe trials of Gahn, its discoverer). Pyrosmalit *Karst.*, Tab., 103, 1808; *Hausm.*, Handb., 1068, 1813. Fer muriaté *H.*, 1812, Lucas Tabl., ii. 418, 1813.

Hexagonal. $O \wedge 1=148° 30'$; $a=0·5307$. Observed planes: *O*, *I*, 1, 2. $O \wedge 2=129° 13'$, $I \wedge I=120°$. In prisms or tables. Cleavage: basal, perfect; *I* imperfect. Also massive. Double refraction strong, uniaxial. Axis negative.

H.=4—4·5. G.=3—3·2; 3·081, Hisinger; 3·168—3·174, Lang. Lustre of *O* pearly; of other planes, less so. Color blackish-green to pale liver-brown, passing into gray and pistachio-green; usually brown externally, and light greenish-yellow internally. Streak paler than color. Fracture uneven, rather splintery. Somewhat brittle.

Comp.—O. ratio for $\dot{R}$, $\ddot{Si}$, $\dot{H}$=2 : 3 : 1; and ratio of chlorine to oxygen about 1 : 42. Making the water and chlorid of iron basic, the ratio for $\dot{R}+\dot{H}$, $\ddot{Si}$=1 : 1, and the formula $(\frac{1}{3}\dot{H}+\frac{2}{3}(\dot{R}, \text{Fe Cl}))^2 \ddot{Si}$=, if Fe Cl : $\dot{Mn}$: $\dot{Fe}$ (+$\dot{Ca}$)=1 : 5 : 8, Silica 34·7, $\dot{Fe}$ 31·7, $\dot{Mn}$ 19·6, chlorid of iron 7·0, water 7·0=100. Analyses: 1, Hisinger (Afh., iv. 317); 2, same, making the iron and manganese protoxyd, and part of the iron a chlorid, and reckoning the loss as water (Ramm. Min. Ch., 875); 3, J. Lang (J. pr. Ch., lxxxiii. 424):

	$\ddot{Si}$	$\not{F}e$	$\not{M}n$	$\dot{Fe}$	$\dot{Mn}$	$\dot{Ca}$	$\dot{H}$	Cl	Fe	
1.	35·85	35·48	24·26	——	——	1·21	*undet.*	3·77	——	Hisinger.
2.	35·85	——	——	28·07	21·81	1·21	[6·29]	3·77	3·00	"
3.	35·43	——	——	30·72	20·51	0·74	7·75	3·79	——,	$\ddot{\not{A}}l$ 0·24 Lang.

In an earlier trial, Hisinger obtained $\ddot{Si}$ 35·40, $\not{F}e$ 32·60, $\not{M}n$ 23·10, $\ddot{\not{A}}l$ 0·60, the rest undetermined.

Pyr., etc.—In the closed tube yields water, which reacts acid. B.B. fuses at 2—2·5 to a black magnetic glass. With the fluxes gives reactions for iron and manganese. A bead of salt of phosphorus, previously saturated with oxyd of copper, when fused with the pulverized mineral imparts a beautiful azure color to the flame (chlorine). Decomposed by muriatic acid, with separation of silica.

Obs.—Pyrosmalite occurs at Nya Kopparberg in Westmannland, and at Bjelkegruvan, one of the iron mines of Nordmark in Wermland, Sweden, where it is associated with calc spar, pyroxene, apophyllite, and magnetic iron. A hexagonal prism, in the museum at Stockholm, is nearly an inch in diameter and one and a quarter inches long, and weighs five and a half ounces.

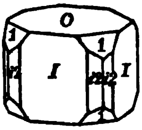
Named from πῦρ, *fire*, and ὀσμή, *odor*, in allusion to the odor when heated.

370. APOPHYLLITE.

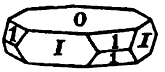
Zeolith von Hellesta *C. Rinman*, Ak. H. Stockh., 82, 1784. Zeolithus lamellaris major *Müller*, De Zeolithis Suecicis, 32, 1791. Ichthyophthalmite (fr. Utö) *d'Andrada*, Scherer's J., iv. 32, 1800, J. de Phys., li. 242, 180. Mesotype épointée (fr. Iceland) *H.*, Tr., iii. 1801. Apophyllite *H.*, Notes pour servir au Cours de Min. de l'an XIII. (1805), Lucas Tabl., i. 266, 1806. Fischaugenstein *Wern.*, 1808. Ichthyophthalmit, Albin, *Wern.*, Letztes Min. Syst., 1817. Tesselite (fr. Faröe) *Brewster*, Ed. Phil. J., i. 5, 1819. Oxhaverite (fr. Iceland) *Brewster*, Ed. J. Sci., vii. 115, 1827. Xylochlor (fr. Sicily) *v. Walt.*, Vulk. Gest., 1853. Leucocyclite *Herschell*, Descl. Min., i. 126, 1862.

Tetragonal. *O* ∧ 1-*i*=128° 38′; *a*=1·2515. Observed planes: *O*, *i-i*, *i*-2, *i*-3, 1, $\frac{1}{3}$, $\frac{1}{5}$, $\frac{1}{2}$-*i*, $\frac{1}{5}$-*i*. *O* ∧ 1=119° 30′, *O* ∧ $\frac{1}{2}$-*i*=147° 58′, 1 ∧ 1, pyr.,=104° 2′, bas., = 121°, *i-i* ∧ *i*-3=161° 34′, *i-i* ∧ *i*-2=153° 26.′ Crystals sometimes nearly cylindrical or barrel-shape. Cleavage: *O* highly perfect; *I* less so. Also massive and lamellar.

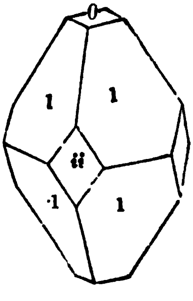
386



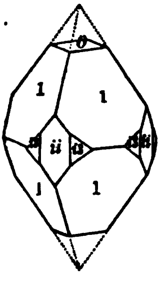
387



388



399



H.=4·5—5. G.=2·3—2·4; 2·335, Haidinger, a variety from Iceland; 2·359, Thomson. Lustre of *O* pearly; of the other faces vitreous. Color white, or grayish; occasionally with a greenish, yellowish, or rose-red tint, flesh-red. Streak uncolored.

Transparent; rarely opaque. Brittle. Double refraction feeble; either positive or negative; sometimes a tesselated structure made apparent by polarized light.

Var.—1. *Ordinary.* Usually in crystals, which are remarkable for their pearly basal cleavage Form sometimes nearly cubic.

Haüy's *Mesotype époinlée* was an Iceland variety; Fuchs and Gehlen in 1816 ascertained its identity with apophyllite. In tabular crystals from the Seisser-Alp Dauber found 1 ∧ 1 = 121° 7½; in red from Andreasberg 120° 29′ 18″; in crystals from Poonah 119° 43′.

1. The name *Oxhaverite* was applied to a pale green crystal found in petrified wood at the Oxhaver Springs, near Husavick in Iceland. *Albin* of Werner (named from *albus, white*) is in small nearly cubic crystals, opaque white in color, from Aussig, Bohemia, partly decomposed. *Xylochlore*, from Sicily, is olive-green, and has G. = 2·2904; it owes its color to the presence of a little iron.

2. *Tesselite*, from Faröe, is a cubical variety, exhibiting a tesselated structure in polarized light.

3. *Leucocyclite*, when plates parallel to the base are examined by means of polarized light, shows a black cross with rings that are alternately white and violet black, with compensation positive (whence the name, from λευκός, *white*, and κύκλος, *circle*), instead of the ordinary colored rings—a peculiarity observed in crystals from the Seisser-Alp, Andreasberg (part of those of this locality), Skye, Faröe, Iceland, Utö, and Poonah in India. Some crystals from Utö and Cziklowa, similarly examined, exhibit a black cross on a deep violet ground, with compensation negative. These different optical phenomena may be presented by contiguous plates of the same crystal; Descl.

Comp.—A silicate of lime and potash containing some fluorine. O. ratio for $\dot{R}$, $\ddot{Si}$, $\dot{H}$ mostly 1 : 3·75 : 2; for the analysis by Berzelius, 1 : 4 : 2; and for $\dot{Ca}$, $\dot{K}$, 8 : 1. Ratio usually taken at 1 : 4 : 2; which corresponds to $\dot{R}+2\,\ddot{Si}+2\,\dot{H}$; and if 1 $\dot{H}$ be basic, the formula may be $\dot{R}^2\,\ddot{Si}+\dot{H}\,\ddot{Si}$, or more specially $(\frac{1}{2}\dot{H}+\frac{1}{2}(\frac{1}{9}\dot{K}+\frac{8}{9}\dot{Ca}))^2\,\ddot{Si}+\dot{H}\,\ddot{Si}$ = Silica 55·5, lime 23·0, potash 4·8, water 16·7 = 100. This makes it a Unisilicate, like other tetragonal silicates, with an opal-like (uncrystallizable?) silicate as accessory. The ratio of the fluorine to the oxygen has not been ascertained.

Analyses: 1, 2, Berzelius (Afh., vi. 181); 3, Rammelsberg (2d Suppl., 16); 4, Stölting (B. H. Ztg., xx. 267); 5, Rammelsberg (Min. Ch., 505); 6, C. T. Jackson (This Min., 1850, 249); 7, E. L. Reakirt (Am. J. Sci, II. xvi. 84); 8, J. L. Smith (This Min., 304, 1854); 9, W. Beck (Verh. Min. St. Pet., 1862, 92); 10, Haughton (Phil. Mag., IV. xxxii. 223):

	$\ddot{Si}$	$\dot{Ca}$	$\dot{K}$	$\dot{H}$	F
1. Utö	52·13	24·71	5·27	16·20	1·54 = 99·85 Berzelius.
2. Faröe, *Tesselite*	52·38	24·98	5·37	16·20	1·12 = 100·05 Berzelius.
3. Andreasberg	51·38	25·86	4·90	*und.*	1·18 Ramm.
4. " *rdh.*	51·73	25·02	5·10	15·73	? = 97·58 Stölting.
5. Radauthal, G. = 1·961	52·69	25·52	4·75	16·78	0·46 Ramm.
6. Michigan, G. = 2·305	51·89	25·60	5·07	16·00	0·91 = 99·47 Jackson.
7. Nova Scotia	52·60	24·88	5·14	16·67	1·71 = 101 Reakirt.
8. L. Superior, G. = 2·37	52·08	25·30	4·93	15·92	0·96 = 99·19 Smith.
9. Pyterlax, Finl. $(\frac{2}{2})$	52·12	24·99	5·75	16·47	0·84 = 100·17 W. Beck.
10. Bombay	51·60	25·08	5·04	16·20	0·97, $\ddot{Al}$ 0·24, $\dot{Mg}$ 0·08, $\dot{Na}$ 0·63 = 99·84 H.

Xylochlore afforded v. Waltershausen, as a mean of two analyses (l. c.), $\ddot{Si}$ 52·07, $\dot{Ca}$ 20·57, $\dot{Fe}$ 3·40, $\dot{Mg}$ 0·33, $\dot{Na}$ 0·55, $\dot{K}$ 3·77, $\ddot{Al}$ 1·54, $\dot{H}$ and $\ddot{C}$ 17·14 = 99·87. The red color of the Andreasberg crystals is attributed by Suckow to fluorid of cobalt.

Pyr., etc.—In the closed tube exfoliates, whitens, and yields water, which reacts acid. In the open tube, when fused with salt of phosphorus, gives a fluorine reaction. B.B. exfoliates, colors the flame violet (potash), and fuses to a white vesicular enamel. F. = 1·5 (v. Kobell). Decomposed by muriatic acid, with separation of slimy silica.

Obs.—Occurs commonly in amygdaloid and related rocks, with various zeolites; also occasionally in cavities in granite, gneiss, etc. Greenland, Iceland, the Faröe Islands, Poonah and Ahmednuggar in Hindostan, afford fine specimens of apophyllite in amygdaloid. At Andreasberg, in silver veins, traversing gray-wacke slate; at Orawicza, Cziklowa, and Szaszka in Transylvania, associated with wollastonite; in Fifeshire, with magnetic iron; at Utö in Sweden; at Puy de la Piquette in Auvergne, in a tertiary limestone, near intruded basaltic rocks; at Finbo, Utö, and Hällesta, Sweden; in the Tyrol, near Frombach; near Nertschinsk, Siberia; in Australia; the Valencian Mines, Mexico.

In America it has been found at Peter's Point and Partridge Island, in the Basin of Mines, Nova Scotia, both massive and crystallized, presenting white, reddish, and greenish colors, and associated with laumontite, thomsonite, and other minerals of trap rocks; also at Chute's cove, Cape d'Or, Isle Haute, Swan's Creek, and Cape Blomidon. Large crystals occur at Bergen Hill, N. J., associated with analcite, pectolite, stilbite, datolite, etc., some of them 3 inches across. It is also found at Gin Cove, near Perry, Maine, with prehnite and analcite in amygdaloid; at the Cliff mine, Lake Superior region (f. 399)

Apophyllite was so named by Haüy in allusion to its tendency to exfoliate under the blowpipe, from ἀπό and φύλλον, *a leaf*. Its whitish pearly aspect, resembling the eye of a fish after boiling, gave rise to the name *Ichthyophthalmite*, from ἰχθύς, *fish*, and ὀφθαλμός, *eye*.

The name *ichthyophthalmite* (or *ichthyophthalme*), given in 1800 by d'Andrada, has priority. But d'Andrada's description (l. c.) is bad in all respects, answering much better for pearly feldspar or adularia, even the specific gravity (2·491) being far out of the way; it affords some evidence that he may have drawn it from another mineral. It was therefore hardly a violation of the strictest rule of priority that Haüy, who had studied carefully the crystallization of the mineral before it was known to d'Andrada, should have named it anew. Neither justice to d'Andrada, nor the good of science, requires that the name *apophyllite* should now yield place to the earlier one. The earliest analyses were made in 1805 by V. Rose (Gehlen's J., v.), and Fourcroy & Vauquelin (Ann. du Mus., v.).

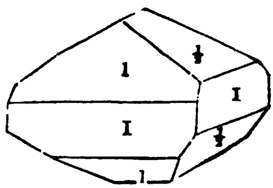
Alt.—Occurs altered to pectolite near Tierno on Monte Baldo, along with unchanged crystals.

Artif.—Crystals have been obtained by Wöhler from heated waters, and he inferred that a temperature of 180° F. was necessary to the result. He stated that when heated in water to this temperature under a pressure of 10 to 12 atmospheres, it forms a solution which crystallizes on cooling. Pearly radiated crystals were formed by Becquerel through the action of a solution of silicate of potash on plates of sulphate of lime (gypsum). Daubrée has detected crystals of apophyllite in the Roman works at the hot springs of Plombières; they were covered in part with incrusting and stalactitic hyalite.

371. EDINGTONITE.

Haid., Brewster's Ed. J. Sci., iii. 316, 1825. Antiedrit *Breith.*, Char 164, 1832.

390



Tetragonal; hemihedral. $O \wedge 1\text{-}i = 145° 59'$; $a = 0·67473$. Observed planes as in the annexed figure, together with another dome in the zone $\frac{1}{2}$, having the summit angle 144°. $O \wedge 1 = 136° 20\frac{1}{2}'$, $I \wedge 1 = 133° 39\frac{1}{2}'$, $I \wedge \frac{1}{2} = 115° 26$, $1 \wedge 1$, over summit, $= 92° 41'$, $\frac{1}{2} \wedge \frac{1}{2}$, ib., $= 129° 8'$. Cleavage: *I* perfect. Also massive.

H.=4—4·5. G.=2·71, Haid.; 2·694, Heddle. Lustre vitreous. White, grayish-white, pink. Streak uncolored. Translucent—opaque. Brittle.

Comp.—O. ratio for $\dot{R}$, $\ddot{\bar{R}}$, $\ddot{Si}$, $\dot{H} = 1:4:7:4$; whence, if half the water is basic, for bases, silica and water $7:7:2 = 1:1:\frac{2}{7}$; and the formula $(\frac{3}{7}(\frac{2}{3}\dot{H}+\frac{1}{3}\dot{B}a)^3+\frac{4}{7}\ddot{\bar{A}}l)^2\ddot{Si}^3+1\frac{5}{7}\dot{H}$. A new determination of the composition is needed. Analysis: F. Heddle (Phil. Mag, IV. ix. 179):

$\ddot{Si}$ 36·98 $\ddot{\bar{A}}l$ 22·63 $\dot{B}a$ 26·64 Ca *tr.* $\dot{N}a$ *tr.* $\dot{H}$ 12·46=98·91.

Turner obtained, in an imperfect and incorrect analysis (Brewst. Ed. J. Sci., iii. 318), $\ddot{Si}$ 35·09, $\ddot{\bar{A}}l$ 27·69, Ca 12·68, $\dot{H}$ 13·32, loss 11·22 supposed to be some alkali.

Pyr., etc.—Yields water, and becomes white and opaque. B.B. at a high heat fuses to a colorless mass. Affords a jelly with muriatic acid.

Obs.—Edingtonite occurs in the Kilpatrick Hills, near Glasgow, Scotland, associated with harmotome, another baryta mineral, and also analcite, calcite, etc. One specimen obtained by Mr. Heddle weighed 2¼ oz.

Glottalite of Thomson (Min., i. 328), from Port Glasgow, on the Clyde, Scotland, is described s occurring in white crystals that "seem to be regular octahedrons; at least 4-sided pyramids, he faces of which appear to be equilateral triangles, are visible; other crystals appear to be ubic." H.=3·5; G.=2·18; lustre vitreous. Thomson obtained (l. c.) $\ddot{Si}$ 37·01, $\ddot{\bar{A}}l$ 16·31, $\ddot{\bar{F}}e$ ·5), Ca 23·93, $\dot{H}$ 21·25=99·00. Heddle states (Phil. Mag., IV. ix. 181) that it is probably edingonite mixed with harmotome, mentioning that Thomson's mineral came from the same locality with the edingtonite, and from the same dealer that furnished him with the edingtonite for his nalysis.

372. GISMONDITE. Zeagonite *Gismondi*, Osserv. Min. di Roma, 1816, Tasch. Min., xi. 164, 1817. Gismondin *Leonh.*, ib., 168. Gismondine. Abrazite *Breislak*, Instit. Geol., iii. 198. Aricite.

Orthorhombic. $I \wedge I = 93° \, 41'$. $O \wedge 1\text{-}\bar{\imath} = 134° \, 35'$; $a : b : c = 1{\cdot}0664 : 1 : 1{\cdot}0146$. $1\text{-}\bar{\imath} \wedge 1\text{-}\bar{\imath}$, top, $= 89° \, 10'$, $I \wedge 1\text{-}\breve{\imath} = 124° \, 42'$, v. Lang. Forms resembling square octahedrons, but made up of the planes I and $1\text{-}\bar{\imath}$; often clustered into mammillated forms with a drusy surface. Cleavage: I, rather perfect.

H.=4·5. G.=2·265. Colorless or white, bluish-white, grayish, reddish. Lustre splendent. Transparent to translucent. Optically biaxial; optic-axial plane parallel to axis *a*, and angle very large, v. Lang; but usually only confused appearances in polarized light, Descl.

Comp.—O. ratio for $\dot{\mathrm{R}}, \bar{\mathrm{R}}, \ddot{\mathrm{Si}}, \dot{\bar{\mathrm{H}}} = 1 : 3 : 4\tfrac{1}{2} : 4\tfrac{1}{2}$. Formula perhaps that of ekebergite *plus* the water. Analysis by Marignac (Ann. Ch. Phys., III. xiv. 41):

$\ddot{\mathrm{Si}}$ 35·38 $\bar{\mathrm{Al}}$ 27·23 $\dot{\mathrm{Ca}}$ 13·12 $\dot{\mathrm{K}}$ 2·85 $\dot{\bar{\mathrm{H}}}$ 21·10=100·18.

Pyr., etc.—At 100° C. yields one-third of its water, and becomes opaque. B.B. whitens, intumesces much, and melts to a milky glass. Easily dissolves in acids and gelatinizes.

Obs.—Occurs in the leucitophyr, a leucitic lava, of the region of Mt. Albano, south-east of Rome, at Capo di Bove, and elsewhere, associated with pyroxene, magnetite, mellilite, phillipsite, wollastonite, etc.; also, according to Kenngott, on the Gorner glacier, near Zermatt, in cavities in a coarse, granular, reddish-brown garnet-rock, with epidote, calcite, chlorite, and genthite; also in the Val di Noto, Sicily, according to Scacchi, in white mammillary concretions, fibrous within.

The name *Zeagonite* is from *ζέω*, *to cook*, and *ἄγονος*, *barren*, and was the first name of the species. Leonhard substituted the describer's name, which it has since held.

Von Kobell and Marignac have analyzed crystals from the locality at Capo di Bove with a result very different from the above; and it is supposed that the crystals taken for the analyses were a mixture of gismondite and phillipsite. The crystals were, however, received from the Italian mineralogist Medici-Spada. Credner examined a part of the same lot of crystals, and has described and figured them in the Jahrb. Min. 1847, p. 559; and the figures have the twin forms (cruciform to octahedral) and striæ of phillipsite. He describes others that are rounded octahedral, with rough edges without the striæ—the true gismondite, according to most authors—but adds that even-faced octahedrons graduate imperceptibly into the rough, and that all appear to be one species. He consequently makes all the crystals orthorhombic, and closely related to phillipsite. But v. Lang has shown that the crystals are not twins, and have the above angles (Phil. Mag., IV. xxviii. 505).

Von Kobell (in the Gel. Anz. München, 1839) described the crystals as tetragonal, mentioned the twins, and published the following analysis. He also places the species very near phillipsite, and in his Geschichte der Min. (p. 487) he even queries the identity of the two. Marignac also made the crystals tetragonal octahedrons, with the angles of basal edges 92° 30′, and of pyramidal 118° 31′. Analyses: 1, v. Kobell (l. c. and J. pr. Ch., xviii. 105); 2, Marignac (Ann. Ch. Phys., III. xiv. 41, 1845):

	$\ddot{\mathrm{Si}}$	$\bar{\mathrm{Al}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{K}}$	$\dot{\bar{\mathrm{H}}}$
1.	42·60	25·50	7·50	6·80	17·66=100·06 Kobell.
2.	43 64	24·39	6·92	10·35	15 05=100·35 Marignac.

The O. ratio for the first is near 1 : 4 : 7½ : 5; for the second 1 : 3 : 6 : 3½. These analyses are sometimes placed under the name *zeagonite*, as if a third mineral existed at Capo di Bove distinct from the phillipsite and gismondite. But v. Kobell holds that his results give the true composition of gismondite. L. Gmelin, more than 40 years ago, made a chemical examination that led him to refer gismondite to phillipsite. Marignac regarded the mineral analyzed by him (anal. 2) as true phillipsite.

Certain pale bluish octahedral crystals from Vesuvius, affording, according to Phillips, the terminal angle 122° 58′, have been called *zeagonite*, which Hausmann refers to zircon (Handb., ii. 797).

373. CARPHOLITE. Karpholith *Wern.*, Letztes Min. Syst., 10, 43, 1817.

Orthorhombic. In radiated and stellated tufts, and groups of acicular crystals. Rhombic prisms of 111° 27′, and 68° 33′, Kenngott, with lateral edges truncated.

H.=5—5·5. G.=2·935, Breithaupt; 2·9365, Stromeyer. Lustre silky, glistening. Color pure straw-yellow to wax-yellow. Opaque. Very brittle.

Comp.—O. ratio for $\dddot{\bar{R}}$, $\dddot{Si}$ $\dot{H}$=1 : 1 : ½, if the bases are all sesquioxyd, as made by v. Hauer; giving the formula $(\dddot{\bar{Al}}, \dddot{\bar{Mn}}, \dddot{\bar{Fe}})^2 \dddot{Si}^3 + 3\dot{H}$. Analyses: 1, Stromeyer (Untersuch., 410); 2, Steinmann (Schw. J., xxv. 413); 3, v. Hauer:

	$\dddot{Si}$	$\dddot{\bar{Al}}$	$\dddot{\bar{Mn}}$	$\dddot{\bar{Fe}}$	$\dot{Fe}$	$\dot{Ca}$	$\dot{H}$	HF
1.	36·15	28·67	19·16	——	2·29	0·27	10·78	1·47=98·79 Stromeyer.
2.	37·53	26·47	18·33	6·27	——	——	11·36	——=99·96 Steinmann.
3.	36 15	19 74	20·76	9·87	——	1·83	10·19	F 1·74=100·28 Hauer.

Pyr., etc.—In the closed tube gives water, which reacts acid and attacks the glass (fluorine). B.B. swells up and fuses at 3·5 to a brown glass. With the fluxes gives reactions for manganese and iron. Not decomposed by muriatic acid. Decomposed on fusion with alkaline carbonates.

Obs.—Occurs in minute divergent tufts, disposed on granite, along with fluor and quartz, in the tin mines of Schlackenwald. It was named by Werner in allusion to its color, from κάρφος, *straw.* Von Kobell suggests that the mineral is altered marceline (Geschichte Min., 677).

III. SUBSILICATES.

374. ALLOPHANE. Allophan *Stromeyer*, Gel. Anz. Gött., 1251, 1816. Riemannit *Breith.*, Hoffm. Min., iv. b, 182, 1817. Elhuyarit *Sack*, Schw. J., lxv. 110, 1832 (announced, not named), Jahrb. Min., 28, 1834 (mentioned, not described).

Amorphous. In incrustations, usually thin, with a mammillary surface, and hyalite-like; sometimes stalactitic. Occasionally almost pulverulent.

H.=3. G.=1·85—1·89. Lustre vitreous to subresinous; bright and waxy internally. Color pale sky-blue, sometimes greenish to deep green, brown, yellow, or colorless. Streak uncolored. Translucent. Fracture imperfectly conchoidal and shining, to earthy. Very brittle.

Comp.—O. ratio for $\dddot{\bar{Al}}$, $\dddot{Si}$, $\dot{H}$, mostly=3 : 2 : 6 (or 5); $\dddot{\bar{Al}}\,\dddot{Si}+6\dot{H}$ or $\dddot{\bar{Al}}\,\dddot{Si}+5\dot{H}$.

Analyses: 1, Stromeyer (Unters., 308); 2, Walchner (Schw. J., xlix. 154); 3, Guillemin (Ann. Ch. Phys., xlii. 260); 4, Bunsen (Pogg., xxxi. 53); 5, Berthier (Ann. d. M., III. ix. 498); 6–9, A. B. Northcote (Phil. Mag., IV. xiii. 338); 10, Silliman, Jr. (Am. J. Sci., II. vii. 417); 11, C. T. Jackson (ib., xix. 119):

	$\dddot{Si}$	$\dddot{\bar{Al}}$	$\dot{Ca}$	$\dot{H}$
1. Gräfenthal	21·92	32·20	0·73	41·30, $\dot{Cu}\ddot{C}$ 3·06, gyps. 0·52, $\dddot{\bar{Fe}}^2\dot{H}^3$ 0·27=99·88 S.
2. Gersbach	24·11	38·76	——	35·75, $\dot{Cu}$ 2·33=100·95 Walchner.
3. Firmy, France	23·76	39·68	——	35·74, " 0 95=99·83 Guillemin.
4. Friesdorf, *Elhuy.*	21·05	30·37	——	40·23, $\dddot{\bar{Fe}}$ 2·74, $\dot{Ca}\ddot{C}$ 2·39, $\dot{Mg}\ddot{C}$ 2·06 Bun.
5. Beauvais	21·90	29·20	——	44·20, clay 4·7=100 Berthier.
6. N. Charlton, *ywh.*	20·50	31·34	1·92	42·91, $\dot{Fe}$ 0·31, $\ddot{C}$ 2·73=99·71 Northcote.
7. " *subopaque*	19·58	37·30	1·36	39·19, $\dot{Fe}$ 0·11, $\ddot{C}$ 2·44=99·98 Northcote.
8. " "	17·00	39·09	1·50	40·92, $\dot{Fe}$ *tr.* $\ddot{C}$ 1·49=100 Northcote.
9. " *ruby-red*	17·05	32·88	1·34	40·31, $\dddot{\bar{Fe}}$ 6·59, $\ddot{C}$ 1·82=99·99 Northcote.
10. Richmond, Mass.	22·65	38·77	——	35·24, $\dot{Mg}$ 2·83=99·49 Silliman.
11. Tennessee	19·8	41·0	0·5	37·7, $\dot{Mg}$ 0·2=99·2 C. T. Jackson.

The coloring matter of the blue variety is due to traces of chrysocolla, the green to malachite, and that of the yellowish and brown to iron. Allophane occurs at Richmond, Mass., mixed intimately with part of the gibbsite of that locality (Silliman).

Pyr., etc.—Yields much water in the closed tube. B.B. crumbles, but is infusible. Gives a blue color with cobalt solution. Gelatinizes with muriatic acid.

Obs.—Allophane is regarded as a result of the decomposition of some aluminous silicate (feldspar, etc.); and it often occurs incrusting fissures or cavities in mines, especially those of copper and limonite, and even in beds of coal. It lines cavities in a kind of marl at Gräfenthal, near Saalfeld in Thuringia, where it was first observed, in 1809, by Riemann, and hence has been called *riemannite*. Found also at Schneeberg in Saxony; at Gersbach in the Schwarzwald; Petrow in Moravia, in a bed of limonite; Chotina in Bohemia, at a copper mine in alum slate; at Friesdorf, near Bonn, in lignite (the *elhuyarite*, of a brownish or honey-yellow color, with G.=1·6); Visé in Belgium, in the carboniferous limestone; at the Chessy copper mine, near Lyons, France; in the chalk of Beauvais, France, presenting a honey-yellow color; at New Charlton, near Woolwich, in Kent, England, in old chalk-pits, of amber-yellow, ruby-red, and nearly opaque white colors. In the United States it occurs in a mine of limonite, with gibbsite, at Richmond, Mass., forming a hyaline crust, scaly or compact in structure, and brittle; at the Bristol Copper Mine, Ct.; at Morgantown, Berks Co., Pa.; at the Friedensville zinc mines, Pa.; in the copper mine of Polk Co., Tenn.

Named from ἄλλος, *other*, and φαίνω, *to appear*, in allusion to its change of appearance under the blowpipe.

A yellowish-white earthy mineral from Kornwestheim, between Stuttgart and Ludwidsburg, with G.=1·794 and 2·098, consists of allophane and aluminite in combination, and has been called *Kiesel-aluminite* (*Siliceous aluminite*) by Groningen and Oppel. In one of their analyses they obtained (Jahresb. 1852, 892, from Würtemb. Nat. Jahreshefte, 1851, 189) $\ddot{\text{Si}}$ 13·06, $\ddot{\bar{\text{S}}}$ 5·04, $\ddot{\bar{\text{Al}}}$ 42·59, ign. 39·32=100·01.

A. CAROLATHINE *F. L Sonnenschein* (ZS. G. Ges., v. 223, and J. pr. Ch., lx. 268, 1853). Amorphous, with a mammillary surface, and approaching allophane in the ratio of $\ddot{\text{Si}}$ to $\ddot{\bar{\text{Al}}}$, but contains less water. H.=2·5; G.=1·515; color honey- to wine-yellow; subtranslucent.

Analysis by Sonnenschein gave:

$\ddot{\text{Si}}$ 29·62 $\ddot{\bar{\text{Al}}}$ 47·25 $\dot{\text{H}}$ 15·10 C 1·33 H 0·74 O 5·96=100.

Heated it affords water, which is neutral in its reactions; at a higher temperature decrepitates, the color darkens, and a black shining mass is obtained. B.B. ignites without flame, owing to the organic ingredients present.

From the coal-bed of the Königin-Louisa Mine, at Zabrze, in Upper Silesia.

375. COLLYRITE. Das man dort Salpeter nannte (fr. Schemnitz) *Freiesleben*, Lempe's Mag., x. 99, 1793. Naturliche Alaunerde (fr. Schemnitz) *v. Fichtel*, Min., 170, 1794; *Klapr.*, Beitr., i. 257, 1795. Kollyrit *Karst.*, Tab., 30, 73, 1800.

A clay-like mineral, white, with a glimmering lustre, greasy feel, and adhering to the tongue. G.=2—2·15. H.=1—2.

Comp.—$\ddot{\bar{\text{Al}}}^2\ddot{\text{Si}}+9\dot{\text{H}}$; or 1 of Allophane+1 of Gibbsite=$[\ddot{\bar{\text{Al}}}\ddot{\text{Si}}+6\dot{\text{H}}]+[\ddot{\bar{\text{Al}}}\dot{\text{H}}^3]$=Silica 14·14, alumina 48·02, water 37·84. Analyses: 1, Klaproth (Beitr., i. 257); 2, Berthier (Ann. d. M., ii. 476); 3, Kersten (Schw. J., lxi. 24); 4, J. H. and G. Gladstone (Phil. Mag., IV. xxiii. 461, 1862):

	$\ddot{\text{Si}}$	$\ddot{\bar{\text{Al}}}$	$\dot{\text{H}}$
1. Schemnitz	14·0	45·0	42·0=101 Klaproth.
2. Ezquerra	15·0	44·5	40·5=100 Berthier.
3. Saxony	23·3	42·8	34·7=100·8 Kersten.
4. Hove	14·49	47·44	36·39, $\dot{\text{C}}\text{a}$ 0·89, $\ddot{\text{C}}$ 0·79=100 Gladstone.

In other specimens Gladstone (l. c.) obtained from 8 to 3 p. c. of silica, indicating a varying proportion of hydrate of alumina.

Pyr., etc.—Yields water. B.B. infusible. Gives a blue color when heated with cobalt solution. Gelatinizes with nitric acid. Does not fall to pieces in water, or increase in weight.

Obs.—From Ezquerra in the Pyrenees; near Schemnitz, Hungary; near Wessenfels, Saxony; at Hove, near Brighton, England, in fissures in the upper chalk, of a pure white color and very soft.

The name *collyrium* (κολλύριον) was applied by the Greeks to the "Samian earth;" Karsten adopted it because the description of this earth by Dioscorides answers well for the above mineral.

375A. Dillnite Haid. (Pogg., lxxviii. 577, 1849) is a related substance. Earthy, with H.=1·8 –2; G.=2·574–2·835. Analyses: Hutzelmann and Karafiat (Pogg., lxxviii. 576):

	$\ddot{\mathrm{S}}\mathrm{i}$	$\ddot{\mathrm{A}}\mathrm{l}$	$\dot{\mathrm{M}}\mathrm{g}$	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\mathrm{H}}$
1.	22·40	56·40	0·44	*tr.*	21·13, $\dot{\mathrm{F}}\mathrm{e}$, $\dot{\mathrm{M}}\mathrm{n}$, alk. *tr.*=100·37 Hutzelmann.
2.	23·53	53·00	1·76	0·88	20·05=99·22 Karafiat.

The analyses correspond to the formula $\ddot{\mathrm{A}}\mathrm{l}^4\,\ddot{\mathrm{S}}\mathrm{i}^3+9\,\dot{\mathrm{H}}$=Silica 24·39, alumina 54·23, $\dot{\mathrm{H}}$ 21·38. The dillnite is the gangue of the diaspore of Schemnitz, at a place called Dilln. Dr. J. L. Smith obtained a very different result for a similar material from the same Schemnitz locality, as given under Pholerite (q. v.); and it is probable that dillnite is a mixture of diaspore and kaolinite or pholerite.

376. SCHRÖTTERITE. Opalin-Allophan *Schrötter*, Baumg. Ztg., iv. 145, 1837. Schrötterit *Glocker*, Grundr., 536, 1839. Opal Allophane.

Resembles allophane; sometimes like gum in appearance.

H.=3–3·5. G.=1·95–2·05. Color pale emerald- to leek-green, greenish-white, yellowish, or at times spotted with brown. Translucent to nearly transparent.

Comp.—O. ratio for $\ddot{\mathrm{R}}$, $\ddot{\mathrm{S}}\mathrm{i}$, $\dot{\mathrm{H}}$=4 : 1 : 5; $\ddot{\mathrm{A}}\mathrm{l}^8\,\ddot{\mathrm{S}}\mathrm{i}^3+30\,\dot{\mathrm{H}}$; equivalent to $3\,[\ddot{\mathrm{A}}\mathrm{l}\,\ddot{\mathrm{S}}\mathrm{i}+5\,\dot{\mathrm{H}}]+5\,[\ddot{\mathrm{A}}\mathrm{l}\,\dot{\mathrm{H}}^3]$, or 3 of allophane and 5 of gibbsite. Analyses: 1, 2, Schrötter (J. pr. Ch., xi. 380); 3, J. W. Mallet (Am. J. Sci., II. xxvi. 79):

	$\ddot{\mathrm{S}}\mathrm{i}$	$\ddot{\mathrm{A}}\mathrm{l}$	$\ddot{\mathrm{F}}\mathrm{e}$	$\dot{\mathrm{H}}$	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\mathrm{C}}\mathrm{u}$	$\dot{\mathrm{H}}$
1. Styria	11·95	46·30	2·95	36·20	1·30	0·25	0·78=99·73 Schrötter.
2. "	11·93	46·28	2·66	35·50	1·03	0·25	0·48=98·14 Schrötter.
3. Alabama	(?) 10·53	46·48	—	41·09, $\dot{\mathrm{Z}}\mathrm{n}$ 0·77, $\dot{\mathrm{F}}\mathrm{e}$, $\dot{\mathrm{M}}\mathrm{g}$ *tr.*, $\dddot{\mathrm{S}}$ 0·80=99·67 Mallet.			

Pyr., etc.—B.B. acts like allophane, but burns white. Decomposed by acids.

Obs.—From Dollinger mountain, near Freienstein, in Styria, in nests between clay-slate and granular limestone; in Cornwall; at the Falls of Little River, on the Sand Mtn., Cherokee Co., Alabama, as an incrustation over half an inch thick and partly stalactitic, resembling gum arabic when broken, having H.=3·5, and G.=1·974.

376A. Scarbroite *Vernon* (Phil. Mag., II. v. 178, 1829) is a white clayey substance, allied to schrötterite in composition. It is without lustre, highly adhesive to moist surfaces, and may be polished by the nail; H.=2·0; G.=1·485? Composition, according to an imperfect analysis by Vernon (l. c.), $\ddot{\mathrm{S}}\mathrm{i}$ 10·50, $\ddot{\mathrm{A}}\mathrm{l}$ 42·50, $\ddot{\mathrm{F}}\mathrm{e}$ 0·25, $\dot{\mathrm{H}}$ 46·75. In a second, equally imperfect, he obtained $\ddot{\mathrm{S}}\mathrm{i}$ 7·90, $\ddot{\mathrm{A}}\mathrm{l}$ 42·75, $\dot{\mathrm{H}}$ 48·55, $\ddot{\mathrm{F}}\mathrm{e}$ 0·80=100. Does not fall to pieces in water, but increases in weight. It fills the veinings of a sandstone, which is much marked with oxyd of iron, or of its septaria, on the coast of Scarborough, Yorkshire, England.

II. ZEOLITE SECTION.

ARRANGEMENT OF THE SPECIES.

I. **MESOTYPE GROUP.** Anisometric; angle $I\wedge I$ near 90°; cleavage parallel to *I*. Crystallizations often acicular, or long fibrous and radiating; thomsonite sometimes in short nearly rectangular forms, with flat summits, and sometimes foliated, but with a less pearly and more glassy surface than in stilbite.

	$\dot{\mathrm{R}}$	$\ddot{\mathrm{R}}$	$\ddot{\mathrm{S}}\mathrm{i}$	$\dot{\mathrm{H}}$	$\dot{\mathrm{R}}\ddot{\mathrm{R}}$	$\ddot{\mathrm{S}}\mathrm{i}$	$\dot{\mathrm{H}}$	
377. Thomsonite	1	3	4	2½	1	1	⅚	$(\tfrac{2}{3}\dot{\mathrm{C}}\mathrm{a}+\tfrac{1}{3}\dot{\mathrm{N}}\mathrm{a})$, $\ddot{\mathrm{A}}\mathrm{l}$, $2\,\ddot{\mathrm{S}}\mathrm{i}$, $2\tfrac{1}{2}\,\dot{\mathrm{H}}$
378. Natrolite	1	3	6	2	1	1½	½ (⅓)	$\dot{\mathrm{N}}\mathrm{a}$, $\ddot{\mathrm{A}}\mathrm{l}$, $3\,\ddot{\mathrm{S}}\mathrm{i}$, $2\,\dot{\mathrm{H}}$

	$\dot{\mathrm{R}}$	$\dddot{\bar{\mathrm{R}}}$	$\ddot{\mathrm{Si}}$	$\dot{\mathrm{H}}$	$\dot{\mathrm{R}}\dddot{\bar{\mathrm{R}}}$	$\ddot{\mathrm{Si}}$	$\dot{\mathrm{H}}$	
379. **Scolecite**	1	3	6	3	1	1½	¾ (⅔)	$\dot{\mathrm{Ca}}, \dddot{\bar{\mathrm{A}}}\mathrm{l}, 3\ddot{\mathrm{Si}}, 3\dot{\mathrm{H}}$
380. **Ellagite**	1	3	6	3	1	1½	¾ (⅔)	$(\frac{2}{3}\dot{\mathrm{Ca}}+\frac{1}{3}\dot{\mathrm{Fe}}), \dddot{\bar{\mathrm{A}}}\mathrm{l}, 3\ddot{\mathrm{Si}}, 3\dot{\mathrm{H}}$
381. **Mesolite**	1	3	6	3	1	1½	¾ (⅔)	$(\frac{2}{3}\dot{\mathrm{Ca}}+\frac{1}{3}\dot{\mathrm{Na}}), \dddot{\bar{\mathrm{A}}}\mathrm{l}, 3\ddot{\mathrm{Si}}, 3\dot{\mathrm{H}}$

II. LEVYNITE GROUP. Hexagonal. $R \wedge R = 106°$, nearly.

382. **Levynite**	1	3	6	4	1	1½	1 (⅓)	$(\dot{\mathrm{Ca}}, \dot{\mathrm{Na}}, \dot{\mathrm{K}}), \dddot{\bar{\mathrm{A}}}\mathrm{l}, 3\ddot{\mathrm{Si}}, 4\dot{\mathrm{H}}$

III. ANALCITE GROUP. Isometric, or else orthorhombic with $I \wedge I = 120°$. O. ratio for $\dot{\mathrm{R}}, \dddot{\bar{\mathrm{R}}}, \ddot{\mathrm{Si}} = 1:3:8$, or $1:3:9$. Never fibrous or acicular.

383. **Analcite**	1	3	8	2	1	2	½	$\dot{\mathrm{Na}}, \dddot{\bar{\mathrm{A}}}\mathrm{l}, 4\ddot{\mathrm{Si}}, 2\dot{\mathrm{H}}$
384. **Eudnophite**	1	3	8	2	1	2	½	$\dot{\mathrm{Na}}, \dddot{\bar{\mathrm{A}}}\mathrm{l}, 4\ddot{\mathrm{Si}}, 2\dot{\mathrm{H}}$
385. **Faujasite**	1	3	9	9	1	2¼	2¼	$(\frac{1}{2}\dot{\mathrm{Ca}}+\frac{1}{2}\dot{\mathrm{Na}}), \dddot{\bar{\mathrm{A}}}\mathrm{l}, 4\frac{1}{2}\ddot{\mathrm{Si}}, 9\dot{\mathrm{H}}$

IV. CHABAZITE GROUP. Hexagonal, or else orthorhombic with $I \wedge I = 120°$. O. ratio for $\dot{\mathrm{R}}, \dddot{\bar{\mathrm{R}}}, \ddot{\mathrm{Si}} = 1:3:8$, or $1:3:9$. Never fibrous or acicular. Not pearly foliated.

386. **Chabazite**	1	3	8	6	1	2	1½	$(\frac{2}{3}\dot{\mathrm{Ca}}+\frac{1}{3}(\dot{\mathrm{Na}}, \dot{\mathrm{K}})), \dddot{\bar{\mathrm{A}}}\mathrm{l}, 4\ddot{\mathrm{Si}}, 6\dot{\mathrm{H}}$
387. **Gmelinite**	1	3	8	6	1	2	1½	$(\frac{1}{3}\dot{\mathrm{Ca}}+\frac{2}{3}(\dot{\mathrm{Na}}, \dot{\mathrm{K}})), \dddot{\bar{\mathrm{A}}}\mathrm{l}, 4\ddot{\mathrm{Si}}, 6\dot{\mathrm{H}}$
388. **Herschelite**	1	3	8	5	1	2	1¼	$(\frac{2}{3}\dot{\mathrm{Na}}+\frac{1}{3}\dot{\mathrm{K}}), \dddot{\bar{\mathrm{A}}}\mathrm{l}, 4\ddot{\mathrm{Si}}, 5\dot{\mathrm{H}}$

V. PHILLIPSITE GROUP. Orthorhombic; $I \wedge I$ near 90°. Often in cruciform twins; never fibrous or acicular. Not pearly foliated.

389. **Phillipsite**	1	3	8	5	1	2	1¼	$(\frac{2}{3}\dot{\mathrm{Ca}}+\frac{1}{3}\dot{\mathrm{K}}), \dddot{\bar{\mathrm{A}}}\mathrm{l}, 4\ddot{\mathrm{Si}}, 5\dot{\mathrm{H}}$

VI. HARMOTOME GROUP. Orthorhombic; $I \wedge I = 124°-125°$. Often in cruciform twins; never fibrous or acicular. Lustre vitreous.

390. **Harmotome**	1	3	10	5	1	2½	1¼ (⅙)	$\dot{\mathrm{Ba}}, \dddot{\bar{\mathrm{A}}}\mathrm{l}, 5\ddot{\mathrm{Si}}, 5\dot{\mathrm{H}}$

VII. HYPOSTILBITE GROUP. Like the mesotypes in acicular and fibrous crystallizations and absence of pearly cleavage. O. ratio for $\dot{\mathrm{R}}, \dddot{\bar{\mathrm{R}}}, \ddot{\mathrm{Si}} = 1:3:9$.

391. **Hypostilbite**	1	3	9	6	1	2¼	1½ (⅙)	$(\frac{1}{3}\dot{\mathrm{Ca}}+\frac{2}{3}\dot{\mathrm{Na}}), \dddot{\bar{\mathrm{A}}}\mathrm{l}, 4\frac{1}{2}\ddot{\mathrm{Si}}+6\dot{\mathrm{H}}$

VIII. STILBITE GROUP. Orthorhombic or monoclinic, with an easy pearly diagonal or basal cleavage. O. ratio for $\dot{\mathrm{R}}, \dddot{\bar{\mathrm{R}}}, \ddot{\mathrm{Si}} = 1:3:12$.

392. **Stilbite**	1	3	12	6	1	3	1½ (⅓)	$\dot{\mathrm{Ca}}, \dddot{\bar{\mathrm{A}}}\mathrm{l}, 6\ddot{\mathrm{Si}}, 6\dot{\mathrm{H}}$
393. **Epistilbite**	1	3	12	5	1	3	1¼ (⅔)	$(\frac{2}{3}\dot{\mathrm{Ca}}+\frac{1}{3}\dot{\mathrm{Na}}), \dddot{\bar{\mathrm{A}}}\mathrm{l}, 6\ddot{\mathrm{Si}}, 5\dot{\mathrm{H}}$
394. **Heulandite**	1	3	12	5	1	3	1¼ (⅔)	$\dot{\mathrm{Ca}}, \dddot{\bar{\mathrm{A}}}\mathrm{l}, 6\ddot{\mathrm{Si}}, 5\dot{\mathrm{H}}$
395. **Brewsterite**	1	3	12	5	1	3	1¼ (⅔)	$(\frac{2}{3}\dot{\mathrm{Sr}}+\frac{1}{3}\dot{\mathrm{Ba}}), \dddot{\bar{\mathrm{A}}}\mathrm{l}, 6\ddot{\mathrm{Si}}, 5\dot{\mathrm{H}}$
396. **Mordenite**	1	3	18	6	1	4½	1½	$(\frac{2}{3}\dot{\mathrm{Ca}}+\frac{1}{3}\dot{\mathrm{Na}}), \dddot{\bar{\mathrm{A}}}\mathrm{l}, 9\ddot{\mathrm{Si}}, 6\dot{\mathrm{H}}$

Appendix.—397. **Sloanite.** 398. **Saspachite.**

In the preceding table the constituents of the species are stated without the arrangement of them into formulas. The resemblance to the Feldspar group in oxygen ratio seems, at first thought, to imply resemblance at least in scheme of composition. But it has been observed (p. 394) that instead of unity of crystalline form and physical characters, as in the Feldspar group, there is the utmost diversity. A relation between the proportion of silica and alkali holds through the feldspars; but none exists, or could be rightly looked for, among the varied groups here brought together under the name of zeolites. The water present has produced the wide divergence from the feldspars; and it is therefore probable that this water is in part, at least, basic. This being so, they may pertain to the two divisions of Unisilicates and Bisilicates. In the following table they are arranged under these heads, and formulas added to correspond with this reference of them.

The species of the Mesotype and Levynite groups are made Unisilicates, because they have not silica enough for the bisilicate type. Thomsonite has the O. ratio for the bases and silica $=1+3:4=1:1$, or that of a true Unisilicate; and natrolite, if the water be basic, is also unisilicate. Further, the close isomorphism of the several species of the Mesotype group renders it probable that they are similar chemically, and therefore all unisilicate.

The species of the remaining groups have silica enough for Bisilicates, and are so arranged in the following table. Yet those of the groups 3 to 5 have water enough for Unisilicates, if this water be mainly basic. Thus chabazite and gmelinite have a unisilicate ratio, if two-thirds of the water is basic; and herschelite and phillipsite, if four-fifths. But the facility with which part of the water in these species escapes is evidence that a considerable part of it, at least, is not basic. Chabazite loses over 7 p. c. of water, or more than a third, by simple exposure to dry air. For other similar facts, see under the species beyond. It is, therefore, not at all probable that enough water is basic to make the species unisilicate. In the preceding table, the fraction written after the column of $\dot{H}$ indicates the proportion of water which is made basic in the formulas which here follow:

1. UNISILICATE.

1. **Thomsonite**	$(\frac{1}{4}(\frac{3}{4}\dot{Ca}+\frac{1}{4}\dot{Na})^3+\frac{3}{4}\ddot{\bar{Al}})^2\ddot{Si}^3+3\frac{3}{4}\dot{H}$	$Si\,\|\,\Theta_4\,\|\,(\frac{1}{4}(\frac{3}{4}\text{Ȼa}+\frac{1}{4}Na_2)+\frac{3}{4}\beta\text{Ⱥl})_2+1\frac{1}{4}\,aq$
Natrolite	$(\frac{1}{2}(\frac{2}{3}\dot{H}+\frac{1}{3}\dot{Na})^3+\frac{1}{2}\ddot{\bar{Al}})^2\ddot{Si}^3$	$Si\,\|\,\Theta_4\,\|\,(\frac{1}{2}(\frac{2}{3}H_2+\frac{1}{3}Na_2)+\frac{1}{2}\beta\text{Ⱥl})_2$
Scolecite	$(\frac{1}{2}(\frac{2}{3}\dot{H}+\frac{1}{3}\dot{Ca})^3+\frac{1}{2}\ddot{\bar{Al}})^2\ddot{Si}^3+\dot{H}$	$Si\,\|\,\Theta_4\,\|\,(\frac{1}{2}(\frac{2}{3}H_2+\frac{1}{3}\text{Ȼa})+\frac{1}{2}\beta\text{Ⱥl})_2+\frac{1}{3}\,aq$
Mesolite	$(\frac{1}{2}(\frac{2}{3}\dot{H}+\frac{2}{9}\dot{Ca}+\frac{1}{9}\dot{Na})^3+\frac{1}{2}\ddot{\bar{Al}})^2\ddot{Si}^3+\dot{H}$	$Si\,\|\,\Theta_4\,\|\,(\frac{1}{2}(\frac{2}{3}H_2+\frac{1}{3}(\text{Ȼa},Na_2))+\frac{1}{2}\beta\text{Ⱥl})_2+\frac{1}{3}\,aq$
Ellagite	$(\frac{1}{2}(\frac{2}{3}\dot{H}+\frac{2}{9}\dot{Ca}+\frac{1}{9}\dot{Fe})^3+\frac{1}{2}\ddot{\bar{Al}})^2\ddot{Si}^3+\dot{H}$	$Si\,\|\,\Theta_4\,\|\,(\frac{1}{2}(\frac{2}{3}H_2+\frac{1}{3}\text{Ɍ})+\frac{1}{2}\beta\text{Ⱥl})_2+\frac{1}{3}\,aq$
2. **Levynite**	$(\frac{1}{2}(\frac{2}{3}\dot{H}+\frac{1}{3}(\dot{Ca},\dot{Na},\dot{K}))^3+\frac{1}{2}\ddot{\bar{Al}})^2\ddot{Si}^3+2\dot{H}$	$Si\,\|\,\Theta_4\,\|\,(\frac{1}{2}(\frac{2}{3}H_2+\frac{1}{3}(R_{:},\text{Ɍ}))+\frac{1}{2}\beta\text{Ⱥl})_2+\frac{2}{3}\,aq$

2. BISILICATE.

3. **Analcite**	$(\frac{1}{4}\dot{Na}^3+\frac{3}{4}\ddot{\bar{Al}})\ddot{Si}^3+1\frac{1}{3}\dot{H}$	$Si\,\Theta\,\|\,\Theta_2\,\|\,(\frac{1}{4}Na_2+\frac{3}{4}\beta\text{Ⱥl})+\frac{1}{3}\,aq$
Eudnophite	$(\frac{1}{4}\dot{Na}^3+\frac{3}{4}\ddot{\bar{Al}})\ddot{Si}^3+1\frac{1}{3}\dot{H}$	$Si\,\Theta\,\|\,\Theta_2\,\|\,(\frac{1}{4}Na_2+\frac{3}{4}\beta\text{Ⱥl})+\frac{1}{3}\,aq$
Faujasite	$(\frac{1}{3}\dot{H}+\frac{2}{3}(\dot{Ca},\dot{Na}))^3+\frac{2}{3}\ddot{\bar{Al}})\ddot{Si}^3+n\dot{H}$	$Si\,\Theta\,\|\,\Theta_2\,\|\,(\frac{1}{3}H_2+\frac{2}{3}(\text{Ȼa},Na_2))+\frac{2}{3}\text{Ⱥl})+n\,aq$
4. **Chabazite**	$(\frac{1}{4}(\frac{5}{6}\dot{Ca}+\frac{1}{6}\dot{Na})^3+\frac{3}{4}\ddot{\bar{Al}})\ddot{Si}^3+4\frac{1}{3}\dot{H}$	$Si\,\Theta\,\|\,\Theta_2\,\|\,(\frac{1}{4}(\text{Ȼa},Na_2)+\frac{3}{4}\beta\text{Ⱥl})+1\frac{1}{3}\,aq$
Gmelinite	$(\frac{1}{4}(\frac{1}{3}\dot{Ca}+\frac{2}{3}\dot{Na})^3+\frac{3}{4}\ddot{\bar{Al}})\ddot{Si}^3+4\frac{1}{3}\dot{H}$	$Si\,\Theta\,\|\,\Theta_2\,\|\,(\frac{1}{4}(\frac{1}{3}\text{Ȼa}+\frac{2}{3}Na_2)+\frac{3}{4}\beta\text{Ⱥl})+1\frac{1}{3}\,aq$
Herschelite	$(\frac{1}{4}(\frac{3}{4}\dot{Na}+\frac{1}{4}\dot{K})^3+\frac{3}{4}\ddot{\bar{Al}})\ddot{Si}^3+3\frac{3}{4}\dot{H}$	$Si\,\Theta\,\|\,\Theta_2\,\|\,(\frac{1}{4}(\frac{3}{4}Na_2+\frac{1}{4}K_2)+\frac{3}{4}\beta\text{Ⱥl})+1\frac{1}{4}\,aq$
5. **Phillipsite**	$(\frac{1}{4}(\frac{2}{3}\dot{Ca}+\frac{1}{3}\dot{K})^3+\frac{3}{4}\ddot{\bar{Al}})\ddot{Si}^3+3\frac{3}{4}\dot{H}$	$Si\,\Theta\,\|\,\Theta_2\,\|\,(\frac{1}{4}(\frac{2}{3}\text{Ȼa}+\frac{1}{3}K_2)+\frac{3}{4}\beta\text{Ⱥl})+1\frac{1}{4}\dot{H}$
6. **Harmotome**	$(\frac{2}{5}(\frac{1}{2}\dot{H}+\frac{1}{2}\dot{Ba})^3+\frac{3}{5}\ddot{\bar{Al}})\ddot{Si}^3+2\frac{3}{5}\dot{H}$	$Si\,\Theta\,\|\,\Theta_2\,\|\,(\frac{2}{5}(\frac{1}{2}H_2+\frac{1}{2}\text{Ƀa})+\frac{3}{5}\beta\text{Ⱥl})+\frac{3}{5}\,aq$
7. **Hypostilbite**	$(\frac{1}{3}(\frac{1}{3}\dot{H}+\frac{2}{3}(\dot{Ca},\dot{Na}))^3+\frac{2}{3}\ddot{\bar{Al}})\ddot{Si}^3+3\frac{2}{3}\dot{H}$	$Si\,\Theta\,\|\,\Theta_2\,\|\,(\frac{1}{3}(\frac{1}{3}H_2+\frac{2}{3}(\text{Ȼa},Na_2))+\frac{2}{3}\beta\text{Ⱥl})+1\frac{2}{3}\,aq$
8. **Stilbite**	$(\frac{1}{2}(\frac{2}{3}\dot{H}+\frac{1}{3}\dot{Ca})^3+\frac{1}{2}\ddot{\bar{Al}})\ddot{Si}^3+2\dot{H}$	$Si\,\Theta\,\|\,\Theta_2\,\|\,(\frac{1}{2}(\frac{2}{3}H_2+\frac{1}{3}\text{Ȼa})+\frac{1}{2}\beta\text{Ⱥl})+\frac{2}{3}\,aq$

Epistilbite	$(\frac{1}{2}(\frac{2}{3}\dot{H}+\frac{1}{3}(\dot{C}a, \dot{N}a))^3+\frac{1}{2}\dddot{Al})\dddot{Si}^3+1\frac{1}{2}\dot{H}$	$Si\Theta \mid \Theta_2 \mid (\frac{1}{2}(\frac{2}{3}H_2+\frac{1}{3}R, R_2)+\frac{1}{2}\beta Al)+\frac{1}{2}aq$
Heulandite	$(\frac{1}{2}(\frac{2}{3}\dot{H}+\frac{1}{3}\dot{C}a)^3+\frac{1}{2}\dddot{Al})\dddot{Si}^3+1\frac{1}{2}\dot{H}$	$Si\Theta \mid \Theta_2 \mid (\frac{1}{2}(\frac{2}{3}H_2+\frac{1}{3}Ca)+\frac{1}{2}\beta Al)+\frac{1}{2}aq$
Brewsterite	$(\frac{1}{2}(\frac{2}{3}\dot{H}+\frac{1}{3}(\dot{B}a, \dot{S}r))^3+\frac{1}{2}\dddot{Al})\dddot{Si}^3+1\frac{1}{2}\dot{H}$	$Si\Theta \mid \Theta_2 \mid (\frac{1}{2}(\frac{2}{3}H_2+\frac{1}{3}(Ba, Sr))+\frac{1}{2}\beta Al)+\frac{1}{2}aq$
9. Mordenite	$(\frac{2}{3}(\frac{5}{6}\dot{H}+\frac{1}{6}(\dot{C}a, \dot{N}a))^3+\frac{1}{3}\dddot{Al})\dddot{Si}^3+\frac{1}{3}\dot{H}$	$Si\Theta \mid \Theta_2 \mid (\frac{2}{3}(\frac{5}{6}H_2+\frac{1}{6}(Ca, Na_2))+\frac{1}{3}\beta Al)+\frac{1}{9}aq$

The term zeolite was first used by Cronstedt in 1756 (Transactions of the Swedish Academy, vol. xviii.), for certain minerals that fused with much intumescence; the word being derived from ζέω, *to boil*, and λίθος, *stone*. Before the close of the century five subdivisions had been recognized by Werner and the mineralogists of his school: (1) *Mehlzeolith* (mealy zeolite); (2) *Fasriger zeolith* or *Fäserzeolith* (fibrous zeolite); these two corresponding to the more modern mesotype (or natrolite, scolecite, mesolite, and thomsonite); (3) *Strahliger zeolith* or *Strahlzeolith* (radiated zeolite), now stilbite; (4) *Blättriger zeolith* or *Blätterzeolith* (foliated zeolite), now heulandite and apophyllite; (5) *Würfelzeolith* (cubic zeolite), now chabazite and analcite. Moreover, *Kreuzstein*, later called harmotome, and *Prehnite* were regarded as distinct species; and so also *Lapis Lazuli*, which had been ranked with the zeolites by Wallerius.

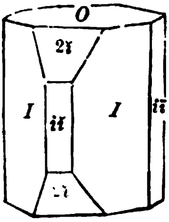
In 1801 Haüy gave the name of *Mesotype*, or *Zeolite* proper, to the varieties included under the first two of the above subdivisions, together with apophyllite; and took a second backward step, which he never retraced, in uniting those of the third and fourth in one species under the name of *Stilbite*. At the same time he rightly removed *Analcime* from the old *Cubic zeolite*.

In 1803 *natrolite* was separated from mesotype by Klaproth, and hence his name should stand for the species so designated. In 1813 *Scolecite*, and in 1816 *Mesolite*, were separated by Fuchs and Gehlen; and in 1820 *Thomsonite* by Brooke. Haüy's name mesotype is at present restricted, or should be, to a generic use to include the group of zeolites, viz., natrolite, scolecite, mesolite, and the related species.

377. THOMSONITE. Mesotype pt. *H.*, Tr., 1801. Thomsonite (fr. Scotland) *Brooke*, Ann. Phil., xvi. 193, 1820. Comptonite (fr. Somma) *Brewster*, Ed. Phil. J., iv. 131, 1821. Mesole *Berz.*, Ed. Phil. J., vii. 6, 1822. Triploklas *Breith.*, Char., 1832. Chalilite *T. Thomson*, Min., i. 324, 1836. Scoulerite *R. D. Thomson*, Phil. Mag., III. xvii. 408, 1840. Ozarkite (fr. Arkansas) *Shep.*, Am. J. Sci., II. ii. 251, 1846. Karphostilbit *v. Walt.*, Vulk. Gest., 272, 1853. Faroelite (=Mesole) *Heddle*, Phil. Mag., IV. xiii. 50, 1857, xv. 28, 1858.

Orthorhombic. $I \wedge I=90° 40'$; $O \wedge 1\text{-}\bar{\imath}=144° 9'$: $a:b:c=0{\cdot}7225:1:1{\cdot}0117$. Observed planes, as in the annexed figure, with also a very low macrodome, nearly coincident with *O*, having the summit angle 177° 35, Naumann. $O \wedge 2\text{-}\bar{\imath}=125°$, $i\text{-}\bar{\imath} \wedge I=134° 40'$. Cleavage: *i-ī* easily obtained; *i-ĭ* less so; *O* in traces. Twins: cruciform, having the vertical axis in common, and *i-ĭ* of one part coincident with *i-ī* of the other; one of the pair of prismatic planes in each broader than the other. Also columnar, structure radiated; in radiated spherical concretions; also amorphous and compact.

391



H.=5—5·5. G.=2·3—2·4; 2·35—2·38, fr. Seeberg, Zippe; 2·357, fr. Hauenstein, Ramm. Vitreous, more or less pearly. Snow-white; impure varieties brown. Streak uncolored. Transparent—translucent. Fracture uneven. Brittle. Pyroelectric. Double refraction weak; optic-axial plane parallel to *O*; bisectrix positive, normal to *i-ĭ*; divergence 82°—82½° for red rays, from Dumbarton; Descl.

Var.—1. *Ordinary.* (*a*) In regular crystals, usually more or less rectangular in outline. (*b*) In slender prisms, often vesicular to radiated. (*c*) Radiated fibrous. (*d*) Spherical concretions, consisting of radiated fibres or slender crystals. (*e*) Massive, granular to impalpable, and white to reddish-brown.

2. *Mesole* (*Faröelite* of Heddle), the original from Faröe, occurs in spherical concretions, consisting of lamellar radiated individuals, pearly in cleavage. The component crystals gave Heddle, for a vertical prism, 127° 20′, which is within 8′ of the corresponding angle in thomsonite; and Descloizeaux regards the two as optically identical. It occurs with mesolite and apophyllite, and probably owes its slight excess of silica to mixture with the former of these minerals, or else with free silica. Mesole was long since referred to thomsonite by Haidinger.

Scoulerite R. D. Thomson, from Port Rush, Antrim, is mesole in structure. It has, Dr. Thomson observes, "the same composition as thomsonite, with only (according to an analysis by R. D. Thomson) rather less alumina, and 6⅓ p. c. of soda. The analysis has not been published.

3. *Chalilite* Thomson, is a compact variety, of a reddish-brown color, from the Donegore Mts., Antrim. Thomson described it in his Mineralogy (i. 324) as having G = 2·252, and as containing 9 p. c. of sesquioxyd of iron (most improbable with so low sp. gr.). In the Phil. Mag. for 1840 (xvii. 408), he describes apparently the same brown "uncrystallized" mineral as having G. = 2·29, with "the same constitution as the Kilpatrick thomsonite, according to an analysis by R. D. Thomson"—an analysis not published. He gives the locality, Ballimony, Antrim. Von Hauer analyzed the chalilite, and found considerable magnesia with only a trace of iron. Greg & Lettsom observe (Min., 160) that the *scoulerite* graduates into the compact chalilite. In view of the facts, it can hardly be doubted that it is impure thomsonite.

Ozarkite is a massive thomsonite, as shown by Smith and Brush, either granular or compact, and of a white color, with G. = 2·24.

Comp.—O. ratio for $\dot{\mathrm{R}}$, $\bar{\dddot{\mathrm{R}}}$, $\ddot{\mathrm{Si}}$, $\dot{\mathrm{H}}$ = 1 : 3 : 4 : 2½; corresponding to 2 $\ddot{\mathrm{Si}}$, $\bar{\dddot{\mathrm{Al}}}$, (¾ $\dot{\mathrm{Ca}}$ + ¼ $\dot{\mathrm{Na}}$), 2½ $\dot{\mathrm{H}}$ = Silica 36·9, alumina 31·6, lime 12·9, soda 4·8, water 13·8 = 100. Analyses: 1, Berzelius (Jahresb., ii. 96); 2, Rammelsberg (J. pr. Ch., lix. 349); 3, Retzius (Jahresb., iv. 154); 4, Zippe (Verh. Ges. Mus. Böhm., v. 39. 1836); 5, 6, Rammelsberg (Pogg., xlvi. 288); 7, Melly (Bib. Univ., N. S., xv. 193); 8, Rammelsberg (J. pr. Ch., lix. 348); 9, 10, Smith & Brush (Am. J. Sci., II. xvi. 50); 11, 12, Waltershausen (Vulk. Gest., 272, 277):

	$\ddot{\mathrm{Si}}$	$\bar{\dddot{\mathrm{Al}}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Na}}$	$\dot{\mathrm{K}}$	$\dot{\mathrm{H}}$
1. Kilpatrick	38·30	30·70	13·54	4·53	—	13·10 = 100·17 Berzelius.
2. Dumbarton	38·09	31·62	12·60	4·62	—	13·40 = 100·20 Rammelsberg.
3. Faröe	39·20	30·05	10·58	8·11		13·40, $\bar{\dddot{\mathrm{Fe}}}$ 0·5 = 101·84 Retzius
4. Seeberg, *Compt.*	38·25	32·00	11·96	6·53	—	11·50 = 100·24 Zippe.
5. " "	38·73	30·84	13·43	3·85	0·54	13·10 = 100·49 Rammelsberg.
6. " "	38·77	31·92	11·96	4·54		12·81 = 100 Ramm. G. = 2·37.
7. Elbogen	37·00	31·07	12·60	6·25	—	12·24 = 99·16 Melly.
8. Hauenstein	39·63	31·25	7·27	8·03	—	13·30 = 99·48 Ramm. G. = 2·357.
9. *Ozarkite*	36·85	29·42	13·95	3·91	—	13·80, $\bar{\dddot{\mathrm{Fe}}}$ 1·55 = 99·48 S. & B.
10. "	37·08	31·13[a]	13·97	3·72	—	13·80 = 99·70 Smith & Brush.
11. *Carphostilbite*	39·28	29·50	12·38	4·09	0·38	13·23, Mg 0·13, $\bar{\dddot{\mathrm{Fe}}}$ 1·49 = 100·48 W.
12. Cyclopean I.	39·86	31·45	13·33	5·30	1·00	11·39 = 102·33 Waltershausen.

[a] With some $\mathrm{Fe^2O^3}$.

The following are analyses of *Mesole:* 1, Berzelius (Jahresb., iii. 147); 2, 3, Hisinger (ib., v. 217, xx. 214); 4, Thomson (Ed. N. Phil. J., xvii. 186); 5–7, Heddle (l. c.); 8, v. Kobell (J. pr. Ch., xcviii. 135); 9, How (Ed. N. Phil. J., II. viii. 207, 1858); 10, O. C. Marsh (priv. contrib.):

	$\ddot{\mathrm{Si}}$	$\bar{\dddot{\mathrm{Al}}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Na}}$	$\dot{\mathrm{H}}$
1. Faröe	42·60	28·00	11·43	5·63	12·70 = 100·36 Berzelius.
2. Annaklef	42·17	27·00	9·00	10·19	11·79 = 100·15 Hisinger.
3. "	41·52	26·80	8·07	10·80	11·79 = 98·99 Hisinger.
4. Bombay	42·70	27·50	7·61	7·00	14·71 = 99·52 Thomson.
5. Storr	41·32	28·44	11·54	5·77	13·26 = 100·33 Heddle.
6. Portree	41·20	30·00	11·40	4·38	13·20 = 100·18 Heddle.
7. Uig	43·17	29·30	9·82	5·33	12·40 = 100·02 Heddle.
8. Iceland	41·00	31·66	10·73	4·50	12·11 = 100·00 Kobell. G. = 2·17.
9. B. of Fundy	41·26	29·60	11·71	5·29	12·73 = 100·59 How.
10. C. Blomidon	41·64	30·52	9·21	4·95	13·11, $\dot{\mathrm{K}}$ 0·44 = 99·87 Marsh.

O. ratio, according to Berzelius, 1 : 3 : 5 : $\frac{7}{3}$. 1 : 3 : 4½ : 2½ corresponds better with ana. 3, 5, 6, 8, and this varies but little from the composition of thomsonite.

Dr. Thomson found for his *chalilite* (l. c.), $\ddot{Si}$ 36·56, $\ddot{\bar{Al}}$ 26·20, $\ddot{\bar{Fe}}$ 9·28, $\dot{Ca}$ 10·28, $\dot{Na}$ 2·72, $\dot{H}$ 16·66=101·70. Von Hauer obtained (Jahrb. G. Reichs., 1853) $\ddot{Si}$ 38·56, $\ddot{\bar{Al}}$ 27·71, $\ddot{\bar{Fe}}$ *tr.*, $\dot{Mg}$ 6·85, $\dot{Ca}$ 12·01, $\dot{H}$ 14·32.

The Hauenstein mineral (formerly called *mesolite* of Hauenstein) occurs mixed with natrolite, and this accounts for the results of Freissmuth's analysis (Schw. J., xxv. 425), which differ widely from Rammelsberg's later results (anal. 8).

Pyr., etc.—The Mittelgebirge mineral changes but slightly in moist or dry air, according to Damour; after two hours at 280° C. it loses 6·1 p. c., and very slowly regains the water lost in the open air, the loss being reduced to 1·5 p. c. after forty hours. At a red heat the loss is 13·3 p. c., and the mineral becomes fused to a white enamel. B.B. fuses with intumescence at 2 to a white enamel. Gelatinizes with muriatic acid.

Obs.—Found in cavities in lava and other igneous rocks; and also in some metamorphic rocks, with elæolite.

Thomsonite occurs near Kilpatrick, and at Kilmalcolm and Port Glasgow, Scotland, in amygdaloid; in the lavas of Somma (*comptonite*); in basalt at the Pflasterkaute in Saxe Weimar; at Seeberg and elsewhere in Bohemia, in the cavities of clinkstone; in the Cyclopean islands, Sicily, with analcite and phillipsite; in Faröe; in phonolite at Hauenstein; in Hungary, near Schemnitz; the Tyrol, at Theiss; at Monzoni, Fassa; in straw-yellow needles (*carphostilbite*) at the Berufiord, Iceland, G.=2·362.

Long, slender, prismatic crystallizations, of a grayish-white color, are obtained at Peter's Point, Nova Scotia, where it is associated with apophyllite, mesotype, laumontite, and other trap minerals; fibrous radiated and amorphous (*ozarkite*) at Magnet Cove, in the Ozark Mts., Arkansas, in cavities in elæolite (from the alteration of which it has apparently resulted), with slender prisms of apatite.

Mesole is from the cave of Nalsöe, island of Faröe; Disco I., Greenland; Annaklef, Sweden; a few miles west of C. Blomidon, Bay of Fundy, near the small village of Ft. George.

On twin crystals, see H. Guthe, 14th Jahresb. Ges. Hannover, Jahrb. Min. 1865, 479.

PICROTHOMSONITE *Meneghini & Bechi* (Am. J. Sci., II. xiv. 63, 1852). Like thomsonite in form, and near it in composition. The soda is replaced by magnesia, and possibly as a result of alteration. Occurs in radiated masses, laminated in structure, and cleaving with equal ease parallel to two sides of a rectangular prism; H.=5; G.=2·278; lustre pearly; white; transparent in small fragments; very fragile.

COMP.—$(\dot{Ca}, \dot{Mg})^3 \ddot{Si} + 2\frac{1}{2}\ \ddot{\bar{Al}}\ \ddot{Si} + 4\frac{1}{2}\ \dot{H}$, Bechi. Analysis: $\ddot{Si}$ 40·36, $\ddot{\bar{Al}}$ 31·25, $\dot{Mg}$ 6·26, $\dot{Ca}$ 10·99, $\dot{Na}$, $\dot{K}$ 0·29, $\dot{H}$ 10·79=99·94. B.B. fuses to a white enamel, with intumescence. Dissolves in cold acids and gelatinizes. Occurs with caporcianite in the gabbro rosso of Tuscany. The name, from πικρός, *bitter*, and thomsonite, alludes to the magnesia present.

378. NATROLITE.

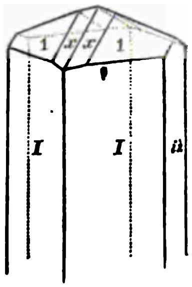
Zeolit pt., Zeolites crystallisatus, prismaticus, capillaris (fr. Gustafsberg), *Cronst.*, Min., 102, 1758; Z. albus fibrosus, capillaris, etc. (fr. Iceland and Gustafsb.), *v. Born*, Lithoph., 46, 1772; *de Lisle*, Crist., 1772, 1783. Mehl-Zeolith, Fasriger-Z., *Wern.*, Ueb. Cronst. 243, 1780; Faserzeolith, Nadelzeolith, *Wern.* Mealy Zeolite, Fibrous Zeolite, Needle Zeolite. Zeolite, Mesotype, pt., *H.*, Tr., iii. 1801. Natrolith (fr. Högau) *Klapr.*, N. Schrift Nat. Ges. Fr. Berlin, iv. 243, 1803, Beitr., v. 44, 1810. Högauit *Selb.*, Schrift, ib., 395. Natrolite *H.*, Cours de Min., 1804, Lucas Tabl., i. 338, 1806. Natron-Mesotype. Soda-Mesotype.

Krokalith (Crocalite) (fr. Felvatza) *Estner*, Min., ii., pt. 2, 559, 1797. Bergmannit (fr. Friedericksvärn) *Schumacher*, Verz. dän. Foss., 46, 1801. Spreustein *Wern.*, 1811, Hoffm. Min., ii. b 303, 1812. Radiolith *Esmark*, Hunefeld, Schw. J., lii. 361, 1828. Brevicit (fr. Brevig) *P. Ström*, Jahresb., xiv. 1834. Lehuntite *Thomson*, Min., i. 338, 1836. Eisen-Natrolith *C. Bergemann*, Pogg., lxxxiv. 491, 1851; Iron-Natrolite. Savite *Meneghini*, Am. J. Sci., II. xiv. 64, 1852. Galaktit *Haid.*, Kenng. Ber. Ak. Wien, xii. 290, 1854, xvi. 157, 1855. Fargite *Heddle*, Phil Mag., IV. xiii. 50, 1857. Palæo-Natrolith *Scheerer*, Pogg., cviii. 416, 1859.

Orthorhombic. $I \wedge I = 91°$, $O \wedge 1\text{-}\bar{\imath} = 144°\ 23'$; $a : b : c = 0·35825 : 1 : 1·0176$. Observed planes: prismatic, I, $i\text{-}\breve{\imath}$; octahedral, 1, $1\text{-}\breve{\tfrac{11}{10}}$ (x), $3\text{-}\breve{3}$ (between 1 and $i\text{-}\breve{\imath}$). $I \wedge i\text{-}\breve{\imath} = 134°\ 30'$, $1 \wedge 1$, ov. x, $= 143°\ 20'$, adj. $= 142°\ 40'$, $I \wedge 1 = 116°\ 40'$, $x \wedge x = 146°\ 28'$, $1 \wedge 3\text{-}\breve{3} = 153°\ 30'$. Crystals usually slender, often acicular; frequently interlacing, divergent, or stellate. Also fibrous, radiating, massive, granular, or compact.

H.=5—5·5. G.=2·17—2·25; 2·249, Bergen Hill, Brush. Lustre vitreous, sometimes inclining to pearly, especially in fibrous varieties. Color white, or colorless; also grayish, yellowish, reddish to red. Streak uncolored. Transparent—translucent. Double refraction weak; optic-axial plane *i-ī*; bisectrix positive, parallel to edge *I*/*I*; axial divergence 94°—96°, red rays, for Auvergne crystals; 95° 12′ for brevicite; Descl.

392



Comp.—O. ratio for $\dot{\mathrm{R}}$, $\bar{\mathrm{R}}$, $\ddot{\mathrm{Si}}$, $\dot{\mathrm{H}}$=1 : 3 : 6 : 2; corresponding to 3 $\ddot{\mathrm{Si}}$, $\ddot{\bar{\mathrm{Al}}}$, $\dot{\mathrm{Na}}$, 2 $\dot{\mathrm{H}}$=Silica 47·2, alumina 27·0, soda 16·3, water 9·5=100.

Var.—1. *Ordinary.* Commonly either (*a*) in groups of slender colorless prisms, often acicular, with *I* ∧ *I*=91°, Haid., 91° 35′, G. Rose, and 1 ∧ 1=143° 20′, Haid, 144° 40′, G. R., 143° 33′, Phillips; or (*b*) in fibrous divergent or radiated masses, vitreous in lustre, or but slightly pearly (these radiated forms often resemble those of thomsonite and pectolite); often also (*c*) solid amygdules, usually radiated fibrous, and somewhat silky in lustre within; and (*d*) rarely compact massive.

Galactite is ordinary natrolite, occurring in colorless acicular crystallizations in southern Scotland, instituted as a species on an erroneous analysis. *Fargite* is a red natrolite from Glen Farg (anal. 24), containing, like galactite, about 4 p. c. of lime.

Bergmannite (= *spreustein*, *brevicite*, *radiolite*, *palæo-natrolite*) is natrolite from the zircon-syenite of southern Norway, near Brevig, on the Langesundfiord, occurring fibrous, massive, and in long prismatic crystallizations, and from white to red in color. *I* ∧ *I*=91°, G. Rose; 90° 54′, Kenngott; and 1 ∧ 1=142° 55′, G. Rose, 143° 26′, Kenngott; and 1 ∧ 1, side, =142° 49′, Kenng. The reddish varieties are impure from mixture with disseminated diaspore, as shown by Scheerer, and hence the variations from natrolite in composition. The radiolite is in radiated masses, and compact fibrous nodules, of a grayish color, from Eckefiord, having G.=2·275—2·286. These minerals result from the alteration of elæolite, cancrinite, and oligoclase, according to Blum and Sæmann & Pisani. The planes 3-3̆ occur on brevicite (G. Rose). *Crocalite*, from the Ural, is a red zeolite, identical with the bergmannite of Laurvig; occurs in small amygdules, and is fibrous or compact.

Savite, according to Sella's crystallographic and other observations (N. Cimento, 1858), is nothing but natrolite, occurring in slender colorless prisms of the same angles. Sella found *I* ∧ *I*=91°, *I* ∧ ½=116° 35′, ½ ∧ ½, macr.,=143° 10′. It comes from a serpentine rock at Mt. Caporciano, Italy, and specimens are ordinarily not pure from serpentine. Meneghini states that H.=3·5 and G.=2·45. See for composition below.

2. *Iron-natrolite* (Eisennatrolith *Bergm.*) is a dark green opaque variety, either crystalline or amorphous, in which a fourth of the alumina is replaced by sesquioxyd of iron (anal. 30); it has H.=5; G.=2·353. Occurs with the Brevig brevicite.

Analyses: 1, Klaproth (Beitr., v. 44); 2, Fuchs (Schw. J., viii. 353, xviii. 8); 3, Riegel (Jhrb. Pharm., xiii.); 4, 5, Fuchs (l. c.); 6, Thomson (Min., i. 317); 7, v. Kobell (J. pr. Ch., xiii. 7); 8, C. G. Gmelin (Pogg., lxxxi. 311); 9, 10, Scheerer (Pogg., lxv. 276); 11, Sieveking, 12, Scheerer (Pogg., cviii. 433); 13, Scheerer (Pogg., lxv. 276); 14, Soudén (Pogg., xxxiii. 112); 15, 16, Körte (G. Rose's Min. Syst., 1852. 96); 17, Michaelson (Œfv. Ak. Stockholm, 1862, 505); 18, Hlasiwetz (Kenng. Uebers., 1858, 72); 19, Vatonne (Ann. d. M., V. xii. 684); 20, v. Hauer (Ber. Ak. Wien, xii. 290); 21–27, Heddle (Phil. Mag., IV. xi. 272); 28, Brush (Am. J. Sci., II. xxxi. 365); 29, C. A. Joy (Ann. Lyc. N. Y., viii. 122); 30, C. Bergemann (l. c.); 31, R. D. Thomson (Thomson's Min., i. 338); 32–34, O. C. Marsh (priv. contrib.):

	$\ddot{\mathrm{Si}}$	$\ddot{\bar{\mathrm{Al}}}$	$\ddot{\bar{\mathrm{Fe}}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Na}}$	$\dot{\mathrm{K}}$	$\dot{\mathrm{H}}$
1. Högau	48·00	24·25	1·75	——	16·50	——	9·00=99·50 Klaproth.
2. "	47·21	25·60	1·35	——	16·12	——	8·88=99·16 Fuchs.
3. "	48·05	25·80	2·10	——	15·75	——	9·00=100·70 Riegel.
4. Auvergne, *cryst.*	47·76	25·88	——	——	16·21	——	9·31=99·16 Fuchs.
5. Tyrol, *fibrous*	48·63	24·82	0·21	——	15·69	——	9·60=98·95 Fuchs.
6. Antrim, *cryst.*	47·56	26·42	0·58	1·40	14·93	——	10·44=101·33 Thomson.
7. Greenland, *massive*	46·94	27·00	——	1·80	14·70	——	9·60=100·04 Kobell.
8. Laurvig, *Natrolite*	48·68	26·37	——	——	16·00	0·35	9·55=100·95 Gmelin.
9. *Bergmannite, red*	47·97	26·66	0·73	0·68	14·07	*tr.*	9·77=99·88 Scheerer.
10. " *white*	48·12	26·96	0·22	0·69	14·23	*tr.*	10·48=100·7 Scheerer.
11. Brevig, *Bergm., white*	47·16	26·13	0·53	0·53	15·60	——	9·47=99·42 Sieveking.
12. " " *red*	44·50	30·05	0·98	0·83	13·52	——	9·93=99·81 Scheerer.

	$\ddot{\text{Si}}$	$\dddot{\overline{\text{Al}}}$	$\dddot{\overline{\text{Fe}}}$	$\dot{\text{Ca}}$	$\dot{\text{Na}}$	$\dot{\text{K}}$	$\dot{\text{H}}$
13. *Radiolite*	48·38	26·42	0·24	0·44	13·87	1·54	9·42=100·31 Scheerer.
14. Brevig, *Brevicite*	43·88	28·39	——	6·88	10·32	——	9·63, $\dot{\text{Mg}}$ 0·21=99·31 S.
15. " "	48·32	26·24	——	*tr.*	15·97	——	9·47=100·00 Körte.
16. " ? "	48·50	26·05	——	*tr.*	16·49	——	9·29=100·33 Körte.
17. " "	47·78	26·04	0·53	2·22	13·37	0·40	10·24=100·55 Michaelson
18. Fassa, *trl.*	48·34	27·43	——	3·60	9·00	——	10·30, $\dot{\text{Mg}}$ 0·40, hygr. $\dot{\text{H}}$ 0·90=99·97 Hlasiwetz
19. Algeria	46·50	26·30	——	0·73	15·20	——	11·00=99·73 Vatonne.
20. Bishopt., *Galactite*	46·99	26·84	——	4·36	9·68	0·45	10·56, $\dot{\text{H}}$ (100°) 0·49=99·37 Hauer.
21. " " *w.*	47·60	26·60	——	0·18	15·86	——	9·56=99·78 Heddle.
22. " " *rdh.*	47·76	27·20	——	0·93	14·28	——	9·56=99·72 Heddle.
23. Glenfarg, "	48·24	27·00	——	0·82	14·82	——	9·24=100·12 Heddle.
24. " " *red*	47·84	27·11	——	4·31	11·30	——	10·24=100·81 Heddle.
25. Campsie H., "	47·32	27·36	——	2·63	13·35	——	10·39=101·05 Heddle.
26. Kilpatrick, "	48·03	25·26	0·86	2·31	13·98	——	9·72, $\dot{\text{Mg}}$ 0·40=100·56 H.
27. Dumbarton, "	46·96	26·91	——	3·76	12·83	——	9·50=99·96 Heddle.
28. Bergen Hill	47·81	26·77	——	0·41	15·44	0·35	9·84=100·12 Brush.
29. New York	47·04	26·76	——	——	14·56	——	10·99=99·35 Joy.
30. *Iron-Natrolite*	46·54	18·94	7·49	——	14·04[a]	——	9·37, $\dot{\text{Fe}}$ 2·40, $\dot{\text{Mn}}$ 0·55=99·33 Bergemann.
31. *Lehuntite*	47·33	24·00	——	1·52	13·20	——	13·60=99·65 Thomson.
32. Two Islands, N. S.	46·84	27·19	——	0·24	14·89	1·50	9·79=100·45 Marsh.
33. C. Blomidon, N. S.	45·74	28·38	——	0·27	14·23	1·16	10·11=99·89 Marsh.
34. Bergen Hill	48·43	26·96	——	0·49	13·09	1·06	9·71=99·74 Marsh.

[a] With a little potash.

Scheerer has shown (Pogg., cviii. 416) that the bergmannite and brevicite, when of a red or reddish color, contain 4 to 7 p. c. of diaspore (a kind containing some iron). The specimen for anal. 12 contained 6½ p. c.; and, allowing for this, the analysis becomes $\ddot{\text{Si}}$ 47·47, $\dddot{\overline{\text{Al}}}$ 26·83, $\dddot{\overline{\text{Fe}}}$ 0·60, $\dot{\text{Ca}}$ 0·88, $\dot{\text{Na}}$ 14·42, $\dot{\text{H}}$ 9·61=99·81. This fact explains the discrepancies in other analyses.

Savite afforded Bechi (l. c.) $\ddot{\text{Si}}$ 49·17, $\dddot{\overline{\text{Al}}}$ 19·66, $\dot{\text{Mg}}$ 13·50, $\dot{\text{Na}}$ 10·52, $\dot{\text{K}}$ 1·23, $\dot{\text{H}}$ 6·57=100·67. Sella suggests that the magnesia may come from the associated serpentine.

Pyr., etc.—The Auvergne natrolite undergoes, according to Damour, no loss in dried air. At 240° C. it loses nearly all its water and becomes milky and opaque; and if afterward exposed to the free air, it regains all it had lost, excepting its transparency and firm texture; if again heated it loses its water at about 90° C. In the closed tube whitens and becomes opaque. B.B. fuses quietly at 2 to a colorless glass. Fusible in the flame of an ordinary stearine or wax candle. Gelatinizes with acids.

Obs.—Occurs in cavities in amygdaloidal trap, basalt, and other igneous rocks; and sometimes in seams in granite, gneiss, and syenite. It is found in the *graustein* of Aussig and Teplitz in Bohemia; in fine crystals at Puy de Marman and Puy de la Piquette in Auvergne; at Alps near Sontra in Hesse; Monte Baldo, Tyrol; Fassathal, Tyrol; Kapnik in Hungary; Dellys in Algeria; Högau in Würtemberg (the Faserzeolith *W.*), in yellowish radiated masses; etc. In red amygdules (crocalite) in amygdaloid of Ireland, Scotland, and the Tyrol; the amygdaloid of Bishoptown (galactite), acicular crystals, several inches long; at Glen Farg in Fifeshire; in Dunbartonshire; in Renfrewshire; at Glenarm in the county of Antrim; at Port Rush; and at Mageo Island, near Larne, Ireland.

In North America, natrolite occurs in the trap of Nova Scotia, at Gates' mountain, Cape d'Or, Swan's Creek, Cape Blomidon, Two Islands; at Bergen Hill, N. J.; sparingly at Chester, Ct.; at Copper Falls, Lake Superior, in crystals, sometimes on native copper; also on New York Islan

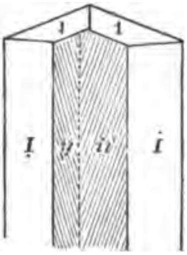
Named *Mesotype* by Haüy, from μεσος, *middle*, and τύπος, *type*, because the form of the crystal—in his view a square prism—was intermediate between the forms of stilbite and analcite. *Natrolite*, of Klaproth, is from *natron*, *soda*; it alludes to the presence of soda, whence also the nam *soda-mesotype*, in contrast with scolecite, or *lime-mesotype*. Schumacher's name *bergmannite*, aft Bergmann, dates from the same year (1801) with Haüy's *mesotype*.

Alt.—Occurs altered to prehnite. Iron-natrolite is probably an altered variety.

379. SCOLECITE. Skolezit *Gehlen & Fuchs*, Schw. J., viii. 361, 1813. **Mesotype p** Fibrous Zeolite pt. Lime-Mesotype. Poonahlite *Brooke*, Phil. Mag., x. 110, 1831. **Punahli** *rm.*

Monoclinic. C=89° 6′, $I \wedge I$=91° 36′, $O \wedge$ 1-ì=161° 16½′; $a:b:c$= 0·3485 : 1 : 1·0282. Observed planes: O; prismatic, I, *i*-ì, *i-i* (only as composition-face), *i*-2; hemidome, 1-*i*; hemioctahedral, 1, –1, 3. 1 ∧ 1=144° 40′, –1 ∧ –1=144° 20′, $I \wedge$ 1=116° 27′, $I \wedge$ –1=143° 28′, *i*-ì ∧ 1=107° 40′, *i*-ì ∧ –1=107° 56′. Crystals long or short prisms, or acicular, rarely well terminated, and always compound. Twins: composition-face *i-i* (orthod.); striæ on *i*-ì meeting along a vertical line in an angle of 24° to 26°, the lines converging downward on the implanted crystals. Cleavage: I nearly perfect. Also in nodules or massive; fibrous and radiated.

393



H.=5–5·5. G.=2·16–2·4. Lustre vitreous, or silky when fibrous. Transparent to subtranslucent. Pyroelectric, the free end of the crystals the antilogue pole. Double refraction weak; optic-axial plane normal to *i*-ì; divergence 53° 41′, for the red rays; bisectrix negative, parallel to *i*-ì; plane of the axis of the red rays and their bisectrix inclined about 17° 8′ to *i-i*, and 93° 3′ to 1-*i*.

Var.—*a*. In acicular crystals. *b*. Fibrous, radiated. *c*. Massive. $I \wedge I$=91° 22′, Phillips and Descl.; 91° 35′, G. Rose. $I \wedge$ 1=116° 34′, Descl.; 117° 10′, Phillips. 1 ∧ 1=144° 40′, Rose and Descl.; 144° 15′, Rose. *Poonahlite* of Brooke, from Poonah, Hindostan, has the angle $I \wedge I$=91° 49′, Kenngott.

Comp.—O. ratio for Ṙ, R̈, S̈i, Ḣ=1 : 3 : 6 : 3; corresponding to 3 S̈i, Äl, Ċa, 3 Ḣ=Silica 45·8, alumina 26·2, lime 14·3, water 13·7=100. Analyses: 1–3, Fuchs & Gehlen (Schw. J., xviii. 13); 4, Guillemin (Ann. d. M., xii. 8); 5, Riegel (J. pr. Chem., xl. 317); 6, Gibbs (Pogg., lxxi. 565); 7, Gülich (Pogg., lix. 378); 8, Domeyko (Ann. d. M., IV. ix. 3); 9, Scott (Ed. Phil. J., liii. 277); 10, J. W. Taylor (Am. J. Sci., II. xviii. 410); 11, P. Collier (priv. contrib.); 12, Gmelin (Pogg., xlix. 538):

	S̈i	Äl	Ċa	Ṅa	Ḣ
1. Iceland	48·93	25·99	10·44	——	13·90=99·26 Fuchs & Gehlen.
2. Faröe, *cryst.*	46·19	25·88	13·86	0·48	13·62=100·03 Fuchs & Gehlen.
3. Staffa, *fibrous*	46·75	24·82	14·20	0·39	13·64=98·80 Fuchs & Gehlen.
4. Auvergne	49·0	26·5	15·3	——	9·0 =99·8 Guillemin.
5. Niederkirchen	48·16	23·50	14·50	0·30	13·50=99·96 Riegel.
6. Iceland	46·72	25·90	13·71	——	13·67=100 Gibbs.
7. "	46·76	26·22	13·68	——	13·94=100·6 Gülich.
8. Chili	46·3	26·9	13·4	——	14·0=100·6 Domeyko.
9. Mull, Scotland	46·21	27·00	13·45	——	13·78=100·44 Scott.
10. E. Indies	46·87	25·32	13·80	0·45	13·46, K̇ 0·13=100·03 Taylor.
11. Ghauts	45·80	25·55	13·97	0·17	14·28, K̇ 0·30=100·07 Collier. G.=2·28.
12. *Poonahlite*	45·12	30·44	10·20	0·66	13·39, K̇ *tr.*=99·81 Gmelin.

Pyr., etc.—According to Damour, Icelsnd columnar masses lost nothing in dried air; nothing until the heat applied exceeded 100° C.; at 300° it had lost 5 p. c., which it regained in moist air; at a dull red heat the loss was 12 p. c., and it was no longer hygroscopic; at a bright red it ost 13·9 p. c., and became after intumescence a white enamel. B.B. sometimes curls up like a worm (whence the name from σκώληξ, *a worm*, which gives *scolecite*, and not *scolesite* or *scolezite*); ther varieties intumesce but slightly, and all fuse at 2—2·2 to a white blebby enamel. Gelatiizes with acids like natrolite.

Obs.—Occurs in the Berufiord, Iceland, where the crystals often exceed two inches in length, nd are occasionally a quarter of an inch thick. It has also been met with in amygdaloid at taffa: in the Isle of Mull; in Skye, at Talisker; near Eisenach in Saxony; near the Vietsch Glacier, Valais; near Poonah, in the Vendayah mountains, Hindostan; in Greenland; at Pargas, Finland; in Auvergne; the valley of Cachapual, in Chili.

R. Hermann states (J. pr. Ch., lxxii. 26) that he took a white amorphous plastic mass from a revice in the columnar basalt of Stolpen, Saxony, and put it away in a box; and that after a long me, on opening the box, he found there, not the amorphous mass, but a group of white acicular rystals, which had all the aspect of scolecite.

380. **Ellagite** *A. Nordenskiöld* (Beskrifn., etc., 155, 1855). Regarded by Rammelsberg as a *ferriferous* natrolite. Occurs in yellow, brownish, or reddish-yellow crystalline masses; crystals cleavable in two directions with the intersections near 90°; opaque to subtranslucent; pearly on a cleavage surface. Igelström obtained (Ramm. Min. Ch., 860) $\ddot{\mathrm{Si}}$ 47·73, $\dddot{\mathrm{Al}}$ 25·20, $\bar{\mathrm{Fe}}$ 6·57, $\dot{\mathrm{Ca}}$ 8·72, $\dot{\mathrm{H}}$ 12·81=101·03, which, taking the iron as protoxyd, as the excess suggests, gives the O ratio 1 : 3·1 : 6·5 : 3, or 1 : 3 : 6 : 3, and the general constitution, therefore, of natrolite. B.B forms a white enamel.

381. MESOLITE. *Fuchs & Gehlen*, Schw. J., viii. 353, xviii. 16, 1816. Mesotype pt. Fibrous Zeolite pt. Mehl-Zeolith pt. Lime-and-Soda Mesotype. Antrimolite *Thom.*, Min., i. 326, 1836. Harringtonite *Thom.*, Ed. N. Phil. J., xvii. 186, 1834.

Triclinic? Descl.; but nearly isomorphous with scolecite, and similar in acicular crystallizations. $I \wedge I'$=88° to 88° 15′, and 91° 41′ to 92°; terminal angles of pyramid 142°—143°, and 146°—146° 10′, the latter between faces of the two united halves. Cleavage: I and I' perfect. Crystals always twins; plane of composition one or both vertical diagonal planes. In more or less divergent groups or tufts, often very delicate; lateral planes commonly vertically striated. Also massive; nodules or masses usually silky fibrous or columnar; often bristled with capillary crystals; sometimes consisting of interlaced fibres; rarely stalactitic, radiated fibrous within; occasionally cryptocrystalline, porcelain-like.

H.=5. G.=2·2—2·4; 2·39, Iceland. Lustre of crystals vitreous; of fibrous massive more or less silky. Color white or colorless, grayish, yellowish. Fragile. Transparent—translucent; opaque, when amorphous. Brittle, but tough when cryptocrystalline. Optical characters different from those of scolecite, and compatible only with a triclinic form. Descl.

Var.—Besides (*a*) the ordinary acicular and capillary crystallizations, divergent tufts (less delicate commonly than those of natrolite, but sometimes downy), and fibrous nodules or masses, mesolite occurs (*b*) in fibrous stalactites, with the fibres radiating from the centre—the variety called *Antrimolite* by Thomson, from Antrim, Ireland, having H.=3·5—4, G.=2·096; also (*c*) amorphous, chalk-white, like an almond in lustre, opaque and tough, with H.=5—5·5, and G.=2·21, the variety named *Harringtonite* by Thomson, also from Antrim; G.=2·174, Haughton. According to Kenngott, the prismatic fibres of the antrimolite have $I \wedge I$=92° 13′, and two vertical edges are bevelled by a prism of 150° 30′.

Comp.—O. ratio for $\dot{\mathrm{R}}$, $\dddot{\mathrm{R}}$, $\ddot{\mathrm{Si}}$, $\dot{\mathrm{H}}$=1 : 3 : 6 : 3; corresponding to $3\ddot{\mathrm{Si}}$, $\dddot{\mathrm{Al}}$, $(\frac{2}{3}\dot{\mathrm{Ca}}+\frac{1}{3}\dot{\mathrm{Na}})$, $3\dot{\mathrm{H}}$= Silica 45·6, alumina 26·0, lime 9·5, soda 5·2, water 13·7=100. Analyses: 1, Berzelius (Jahresb., iii. 147); 2–5, Fuchs & Gehlen (Schw. J., xviii. 1); 6, Reigel (J. pr. Ch., xl. 317); 7, Thomson (Phil. Mag., 1840); 8, Breidenstein (Ramm. 5th Suppl., 168); 9, v. Waltershausen (Vulk Gest., 267); 10, Thomson (Min., i. 326); 10–15, Heddle (Phil. Mag., IV. xiii. 50, 148); 16, 17, H. How (Am. J. Sci., II. xxvi 32); 18, 19, Thomson (l. c.); 20, v. Hauer (Ber. Ak. Wien, 1854); 21, Haughton (Phil Mag., IV. xxxii. 225); 22, 23, O. C. Marsh (priv. contrib.):

		$\ddot{\mathrm{Si}}$	$\dddot{\mathrm{Al}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Na}}$	$\dot{\mathrm{H}}$
1.	Faröe	46·80	26·50	9·87	5·40	12·30=100·87 Berzelius.
2.	" *cryst.*	47·00	26·13	9·35	5·47	12·25=100·20 Fuchs & Gehlen.
3.	Iceland, *fibrous*	46·78	25·66	10·06	4·79	12·31=99·60 Fuchs & Gehlen.
4.	"	47·46	25·35	10·04	4·87	12·41=100·13 Fuchs & Gehlen.
5.	Tyrol	46·04	27·00	9·61	5·20	12·36=100·21 Fuchs & Gehlen.
6.	Niederkirchen	46·65	27·40	9·26	4·91	12·00=100·22 Riegel.
7.	Giant's Causeway	48·88	26·36	7·64	4·20	12·32, $\dot{\mathrm{M}}\mathrm{g}$ 2·46=101·86 Thomson.
8.	Iceland	45·78	27·53	9·00	5·03	12·38, $\dot{\mathrm{K}}$ 0·31=100·03 Breidenstein.
9.	Beruflord, Iceland	46·41	26·24	9·68	4·46	13·76, $\dot{\mathrm{K}}$ 0·41, $\dot{\mathrm{M}}\mathrm{g}$ 0·01=100·97 Waltersh
10.	*Antrimolite*	43·47	30·26	7·50	—	15·32, K 4·10, $\dot{\mathrm{F}}\mathrm{e}$ 0·19, Cl 0·10=100 84 T
11.	"	45·98	26·18	10·78	4·54	13·00=100·45 Heddle.
12.	Talisker, Syke	46·71	26·62	9·08	5·39	12·83=100·63 Heddle.
13.	Storr, "	46·72	26·70	8·90	5·40	12·92=100·64 Heddle.
14.	Kilmore, "	46·26	26·48	10·00	4·98	13·04=100·76 Heddle
15.	Naalsöe, Faröe	46·80	26·46	9·08	5·14	12·28=99·76 Heddle.

		$\ddot{\mathrm{S}}\mathrm{i}$	$\bar{\bar{\mathrm{A}}}\mathrm{l}$	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\mathrm{N}}\mathrm{a}$	$\dot{\mathrm{H}}$
16.	**Nova Scotia**	($\frac{1}{2}$) 46·66	26·48	9·63	4·83	12·25=99·90 How.
17.	"	46·71	26·68	9·55	5·68	11·42=100·04 How.
18.	*Harringtonite*	44·96	26·85	11·01	5·56	10·28, $\dot{\mathrm{F}}\mathrm{e}$ 0·88=99·54 Thomson.
19.	"	44·84	28·48	10 68	5·56	10·28=99·85 Thomson.
20.	"	45·71	26·58	11·48	3·80	13·11=100·68 Hauer.
21.	" Bombay	45·60	27·30	12·12	2·76	12·99, $\dot{\mathrm{M}}\mathrm{g}$ *tr.*, $\dot{\mathrm{K}}$ 0·63=101·40 H. G.=2·174.
22.	C. Blomidon, N. S.	45·89	27·55	9·13	5·09	12·79, $\dot{\mathrm{K}}$ 0·48=100·93 Marsh.
23.	Sandy Cove, N. S.	45·39	28·09	7·55	5·28	12·71, $\dot{\mathrm{K}}$ 0·49=99·51 Marsh.

Pyr., etc.—Yields water in the closed tube. B.B. becomes opaque, swells up into vermicular forms, but not in so marked a manner as scolecite, fusing easily to a blebby enamel. Gelatinizes with muriatic acid (Fuchs).

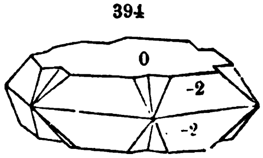
Obs.—Occurs in amygdaloid and related rocks. The fibrous kinds, especially the coarser, are usually a little less smoothly or neatly fibrous than those of natrolite. On Skye, in delicate interlacing crystals called *cotton-stone*, and in feathery tufts, and in solid masses consisting of radiating crystals; in downy tufts and other forms at Naalsöe on Faröe; also with chabazite in Eigg; near Edinburgh and Kinross, and at Hartfield Moss, in Scotland; in Antrim, at the Giant's Causeway, in acicular crystallizations; also at Ballintoy in Antrim, stalactitic (antrimolite), investing yellow calcite, or chabazite; in Antrim, in veins of amorphous mesolite (harringtonite), at Portrush and at the Skerries; and at Magee Island, and Agnew's Hill, 5 m. W. of Larne; also at other localities, as stated above.

In the North Mountain of King's County, and Gates' Mountain, of Annapolis Co., N. Scotia, with faröelite, in masses, sometimes large (one reported as large as a man's head), usually within fine fibrous, radiated, and somewhat plumose; also at Cape Blomidon.

382. LEVYNITE. Levyne *Brewster*, Ed. J. Sci., ii 332, 1825. Mesolin *Berz.*, Ed, Phil. J., vii. 6, 1822.

Rhombohedral. $R \wedge R$=106° 3′; $O \wedge R$=136° 1′; a=0·83583. Observed planes, as in the annexed figure, with also -3; $-2 \wedge -2$, term. edge, =79° 29′, $-2 \wedge 2-$=125° 14′, $O \wedge 3$=109° 3′, $O \wedge 2$=117° 23′. Cleavage: -2, indistinct. Twins: composition-face O, as in chabazite. Crystals often striated; often in druses. Double refraction strong; axis negative.

394



H.=4–4·5. G.=2·09–2·16. Lustre vitreous. Colorless, white, grayish, greenish, reddish, yellowish. Transparent to translucent.

Var.—Levynite occurs in crystals, usually tabular, and presenting the plane O, a plane not known in crystals of chabazite. It differs from chabazite also in cleavage. The original crystals were from Dalsnypen, Faröe. *Mesolin* is a white granular material from Faröe, which may be chabazite; it fills small cavities in amygdaloid.

Comp.—O. ratio for $\dot{\mathrm{R}}$, $\bar{\bar{\mathrm{R}}}$, $\ddot{\mathrm{S}}\mathrm{i}$, $\dot{\mathrm{H}}$=1 : 3 : 6 : 4 from Damour's analyses; corresponding to 3 $\ddot{\mathrm{S}}\mathrm{i}$, $\bar{\bar{\mathrm{A}}}\mathrm{l}$, ($\dot{\mathrm{C}}\mathrm{a}$, $\dot{\mathrm{N}}\mathrm{a}$, $\dot{\mathrm{K}}$), 4 $\dot{\mathrm{H}}$. Berzelius's analyses, which are suspected to have been made on a mixture of chabazite and levynite (see Greg & Lettsom, 179), give the ratio of chabazite, 1 : 3 : 8 : 5. Analyses: 1, 2, Berzelius (Jahresb., iii. 146, v. 216); 3, Connel (Phil. Mag., v. 50); 4, 5, Damour (Ann. 1 M., IV. ix 333):

		$\ddot{\mathrm{S}}\mathrm{i}$	$\bar{\bar{\mathrm{A}}}\mathrm{l}$	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\mathrm{N}}\mathrm{a}$	$\dot{\mathrm{K}}$	$\dot{\mathrm{H}}$
1.	**Faröe**, *Levynite*	48·00	20·00	8·35	2·86	0·41	19·30, $\dot{\mathrm{M}}\mathrm{g}$ 0 4=99·32 Berzelius.
2.	" *Mesolin*	47·50	21·40	7·90	4·80	——	18·19=99·79 Berzelius.
3.	**Skye**, *Levynite*	46·30	22·47	9·72	1·55	1·26	19·51, $\dot{\mathrm{F}}\mathrm{e}$, $\dot{\mathrm{M}}\mathrm{n}$ 0·96=102·07 Connel.
4.	**Iceland**, "	45·04	24·04	9·72	1·42	1·63	17·49=99·34 Damour.
5.	" "	45 76	23 56	10·57	1·36	1·64	17·33=100·22 Damour.

Pyr., etc.—Iceland crystals, according to Damour, lose 4 p. c. in dried air, and regain all gain soon in the free air. When heated, begin to lose water at 70° C.; at 225° the loss is 12 o 13 p. c.; remain hygroscopic up to 360°. The loss is completed at a white heat, when the minral is a white blebby glass. B.B. intumesces and fuses to a white blebby glass, nearly opaque. elatinizes with muriatic and nitric acids.

Obs.—Lines cavities in amygdaloid, and is, with a rare exception, the "*sole tenant* of its druses even though these druses be within a quarter of an inch of others containing chabazite associated with half a dozen other zeolites" (Heddle); it shows thus its distinctiveness from chabazite

Found at Glenarm and at Island Magee, Antrim; near Dungiven, Magilligan, and elsewhere in Londonderry; Hartfield Moss, near Glasgow; at Dalsnypen, Faröe, and on the Island Waagöe; at Godhavn, Disco Island, Greenland; at Onundarfiord, Dyrefiord, and elsewhere in Iceland.

Named after the mineralogist and crystallographer, A. Lévy

383. ANALCITE. Zeolite dure (fr. Etna) *Dolomieu*, F. de St Fond Min. des Volcans, 198, 1784. Würfelzeolith pt. [rest Chabazite] *Emmerling*, Min., 205, 1793; Lenz, i. 241, 1794. [Form, f. 9, described.] Zeolite cubique, Z. leucitique, *Delameth.*, T. T., ii. 307, 308, 1797. Analcime *H.*, Tr., iii. 1801. Analcite *Gallitzin*, Dict. Min., 12, 1801. Kubizit *Wern.*, 1803, Ludwig's Min., ii. 210, 1804. Analzim *Wern.*, Letzt. Min. Syst., 6. Kuboit *Breith.*, Char., 153, 1832 (Analzim, p. 127).

Isometric. In trapezohedrons, f. 10, also f. 9, and another form similar, excepting a very low pyramid, *m*, *m*, in place of each *O*. Cleavage: cubic, in traces. Also massive granular.

H.=5–5·5. G.=2·22–2·29; 2·278, Thomson. Lustre vitreous. Colorless; white; occasionally grayish, greenish, yellowish, or reddish-white. Streak white. Transparent—nearly opaque. Fracture subconchoidal, uneven. Brittle.

Comp.—O. ratio for $\dot{\mathrm{R}}$, $\overset{\cdots}{\mathrm{R}}$, $\overset{\cdots}{\mathrm{Si}}$, $\dot{\mathrm{H}}$=1 : 3 : 8 : 2, corresponding to 4 $\overset{\cdots}{\mathrm{Si}}$, $\overset{\cdots}{\mathrm{Al}}$, $\dot{\mathrm{Na}}$, 2 $\dot{\mathrm{H}}$=Silica 54·4, alumina 23·3, soda 14·1, water 8·2=100. Analyses: 1, H. Rose (Gilb. Ann., lxxii. 181); 2, Henry (Pogg., xlvi. 264); 3, Leschner (Breith. Min., 1847, 410); 4, Connel (Ed. J. Sci., 1829, 262); 5, Thomson (Min., i. 438); 6, Avdejef (Pogg., lv. 107); 7, 8, Riegel (J. pr. Ch., xl. 317); 9, Weltzien (Ann. Ch. Pharm., xcix. 287); 10, Rammelsberg (Pogg., cv. 317, Min. Ch., 804); 11, Waltershausen (Vulk. Gest., 266); 12, 13, Rammelsberg (l. c.):

	$\overset{\cdots}{\mathrm{Si}}$	$\overset{\cdots}{\mathrm{Al}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Na}}$	$\dot{\mathrm{K}}$	$\dot{\mathrm{H}}$
1. Fassathal	55·12	22·99	—	13·53	—	8·27=99·91 Rose.
2. Blagodat, *Cuboite*	57·34	22·58	0·35	11·86	0·55	9·00=101·68 Henry.
3. " "	51·00	24·13	0·75	11·75	—	9·75, $\overset{\cdots}{\mathrm{Fe}}$ 1·50=98·88 Leschner.
4. Kilpatrick	55·07	22·23	—	13·17	—	8·22=99·23 Connel
5. Giant's Causeway	55·60	23·00	—	14·65	—	7·90=101·15 Thomson.
6. Brevig	55·16	23·55	*tr.*	14·23	*tr.*	8·26=101·20 Avdejef.
7. Niederkirchen	57·50	23·15	5·63	6·45	—	8·00, $\overset{\cdots}{\mathrm{Fe}}$ 0·10=100·83 Riegel.
8. "	56·12	24·00	5·82	6·45	—	8·00, $\overset{\cdots}{\mathrm{Fe}}$ 0·15=100·54 Riegel.
9. Kaiserstuhl	54·02	22·54	2·91	10·14	0·71	8·93, $\dot{\mathrm{Mg}}$ 0·57, $\overset{\cdots}{\mathrm{Fe}}$ 1·35, $\overset{\cdots}{\mathrm{P}}$ *tr.*= 101·17 W
10. Wessela	56·22	22·22	0·27	12·10	1·45	8·33=100·59 Rammelsberg.
11. Cycl. I'ds, G.=2·286	53·72	24·03	1·23	7·92	4·46	8·50, $\dot{\mathrm{Mg}}$ 0·05=99·91 Waltersh.
12. "	55·22	23·14	0·25	12·19	1·52	7·68=100 Rammelsberg.
13. "	54·34	23·61	0·21	12·95	0·66	8·11, $\overset{\cdots}{\mathrm{Fe}}$ 0·12=100 Rammelsberg.

Pyr., etc.—Yields water in the closed tube. B.B. fuses at 2·5 to a colorless glass. Gelatinizes with muriatic acid.

Breithaupt has found (B. H. Ztg., xxiv. 337) the sp. gr. of the opaque analcite from Lake Superior =2·09, and for the nearly transparent =2·1–2·11. But a microscope shows, as Brush has observed, that the crystals are full of air cavities.

Obs.—The Cyclopean Islands, near Catania, Sicily, afford pellucid crystals (f. 9); also the Tyrol; Scotland, in the Kilpatrick Hills; Bowling, pseudomorphs after laumontite; Glen Farg: near Edinburgh; at Kilmalcolm; the Campsie Hills, etc.; at Antrim, etc., in Ireland; the Faroe Islands; Iceland; the Vincentine, with prehnite, chabazite, apophyllite, etc.; Wessela, near Aussig, Bohemia; at Arendal, in Norway, in beds of iron ore; at Andreasberg, in the Harz in silver mines.

Nova Scotia affords fine specimens at Martial's Cove, Five Islands, Cape d'Or, Swan's Creek, and Cape Blomidon; crystals like f. 9, 10, occur at Bergen Hill, New Jersey: in gneiss, near Yonkers, Westchester Co., N. Y. (f. 10); at Perry, Maine, with apophyllite, in greenstone; abundant in fine crystals, with prehnite, datolite, and calcite, in the Lake Superior region; in the gangue of the copper, at Copper Falls and north-western mines, and at Michipicoton Island (form 2-2), and also at other mines not now worked.

The name *Analcime* is from ἀνάλκις, *weak*, and alludes to its weak electric power when heated or rubbed. The correct derivative is *analcite*, as here adopted for the species.

Alt.—*Picranalcime* of Meneghini and Bechi (Am. J. Sci., II. xiv. 62) is probably analcite altered by the magnesian process. It occurs in geodes in the gabbro rosso of Tuscany, and also in the steatitic paste of a metalliferous dyke; forms f. 9, 10, with distinct cubic cleavage. H.=5. G. =2·257. Color flesh-red to colophonite-red. Lustre vitreous. *Composition*, according to mean of two analyses by E. Bechi (l. c.), $\ddot{Si}$ 59·11, $\ddot{\bar{Al}}$ 22·08, $\dot{Mg}$ 10·12, $\dot{Na}$ 0·45, $\dot{K}$ 0·02, $\dot{\bar{H}}$ 7·67=99·45. Formula $\dot{Mg}^3 \ddot{\bar{Si}}^3 + 3 \ddot{\bar{Al}} \ddot{\bar{Si}}^3 + 6 \dot{\bar{H}}$, Bechi. Associated with calcite, caporcianite, and picrothomsonite.

A somewhat similar compound, a pseudomorph after analcite, has been observed by Guthe (Jahrb. Min., 1863, 590) in the clay-iron ore of Duingen. An analysis by Stromeyer (l. c.) afforded $\ddot{Si}$ 56·7, $\ddot{\bar{Al}}$ 21·2, $\ddot{\bar{Fe}}$ 2·8, $\dot{Na}$ 9·1, $\dot{\bar{H}}$ 9·8=99·6.

The *Cluthalite* of Thomson (Min., i. 339, 1836) occurs in flesh-red vitreous crystals in amygdaloid at the Kilpatrick Hills. H.=3·5. G.=2·166. Opaque or subtranslucent. Fragile. Analysis afforded $\ddot{Si}$ 51·266, $\ddot{\bar{Al}}$ 23·560, $\ddot{\bar{Fe}}$ 7·306, $\dot{Na}$ 5·130, $\dot{Mg}$ 1·233, $\dot{\bar{H}}$ 10·553=99·048. It may be altered analcite.

Analcite altered to a mixture of calcite and hydrous silicate of alumina has been observed by Tschermak. Also occurs altered to prehnite.

384. **EUDNOPHITE.** Eunophit *Weibye*, Pogg., lxxix. 303, 1850.

Orthorhombic. $I \wedge I = 120°$, $I \wedge 1\text{-}\bar{\imath} = 130°$, $1\text{-}\bar{\imath} \wedge 1\text{-}\bar{\imath}$, over O, $= 84°\ 9'$. Form a six-sided prism (I, $i\text{-}\breve{\imath}$) with the dome $1\text{-}\bar{\imath}$. Cleavage: O perfect; $i\text{-}\bar{\imath}$ and $i\text{-}\breve{\imath}$, less so. Commonly massive, cleavable.

H.=5·5. G.=2·27. Lustre weak, a little pearly on the cleavage-faces. Color white, grayish, brownish. Streak white. Translucent; in thin laminæ transparent. Optically biaxial; double refraction strong; Descl.

Comp.—O. ratio for $\dot{R}$, $\ddot{\bar{R}}$, $\ddot{Si}$, $\dot{\bar{H}}$=1 : 3 : 8 : 2, or the same as for analcite. Analyses by von Borck and Berlin (l. c.):

	$\ddot{Si}$	$\ddot{\bar{Al}}$	$\dot{Na}$	$\dot{\bar{H}}$
1.	54·93	25·59	14·06	8·29=102·87 Borck.
2.	55·06	23·12	14·06	8·16=100·40 Berlin.

Pyr., etc.—Fuses to a colorless glass. Gelatinizes with muriatic acid.

Obs.—Occurs in a coarse syenite on the island Lamöe, near Brevig, Norway, with catapleiite, leucophanite, mosandrite, etc.

Named from εὐδνοφος, *obscurity*, in allusion to the cloudiness of the mineral.

385. **FAUJASITE.** *Damour*, Ann. d. M., IV. i. 395, 1842.

Isometric. In octahedrons. Twins: composition-face the octahedral.

H.=5. G.=1·923. Lustre vitreous; sometimes adamantine. Colorless—white; brown externally. Fragile; fracture vitreous and uneven. No action on polarized light.

Comp.—O. ratio for $\dot{R}$, $\ddot{\bar{R}}$, $\ddot{Si}$, $\dot{\bar{H}}$=1 : 3 : 9 : 9; corresponding to $4\tfrac{1}{2}\ \ddot{Si}$, $\ddot{\bar{Al}}$, $(\tfrac{1}{2}\dot{Ca} + \tfrac{1}{2}\dot{Na})$, $9\dot{\bar{H}}$= Silica 45·5, alumina 17·4, lime 4·7, soda 5·2, water 27·2=100.

Analyses: 1, Damour (l. c.); 2, id. (ib., xiv. 67):

		$\ddot{Si}$	$\ddot{\bar{Al}}$	$\dot{Ca}$	$\dot{Na}$	$\dot{\bar{H}}$
1.	**Kaiserstuhl**	49·36	16·77	5·00	4·34	22·49=97·96.
2	"	46·12	16·81	4·79	5·09	27·02=99·83.

Pyr., etc.—According to Damour, loses 15 p. c. of water when exposed for one month to dry

air, but regains almost all of it in ordinary air in 24 hours. Heated at 50°–55° C. for one hour loses 15·2 p. c.; at 60°–65°, 10·4 p. c.; at 70°–75°, 19·5 p. c., which is almost entirely regained by exposure to air for a few weeks. B.B. fuses with intumescence to a white blebby enamel. Decomposed by muriatic acid without gelatinization.

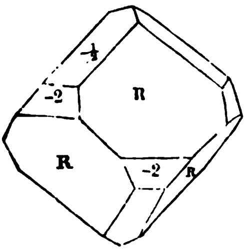
Obs.—Occurs with augite in the amygdaloid of Kaiserstuhl, Baden. The adamantine lustre sometimes existing is attributed to a thin bituminous coating. Named by Damour after Faujas de Saint Fond.

386. CHABAZITE. **Zeolithus albus cubicus Islandiæ *v. Born*, Lithoph. i. 46, 1772. Zeolite en cubes *Faujas*, Volc. Viv., 126, 1778; *de Lisle*, Crist., ii. 40, 1783. Chabazie (fr. Oberstein) *Bosc d'Antic*, J. d'Hist. N., ii. 181, 1780. Würfelzeolith pt. (rest analcite) *Wern.*, Emmerling Min., i. 205, 1793. Chabasie (rhombohedral form recognized) *H.*, Tr., iii. 1801. Chabasin *Karst.*, Tab., 30, 1808. Schabasit *Wern.*, *Hoffm.* Kuboizit *Weiss*, Hoffm. Min., iv. b, 41, 1818, Mag. Ges. N. Fr., Berlin, vii. 181, 1816.**

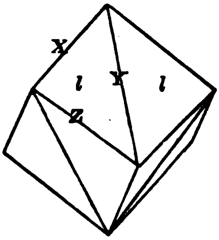
Phakolit *Breith.*; *Tamnau*, Jahrb. Min., 653, 657, 1836. Haydenite *Cleaveland*, Min., 478, 1822. Acadialite *Alger & Jackson* (without publication)="No Chabasie" *E. Hoffmann*, Am. J. Sci., xxx. 366, 1836;=Acadiolite *Thomson*, Phil. Mag., xxii. 192, 1843; *Hayes*, Am. J. Sci., II. i. 122, 1846.

Rhombohedral. $R \wedge R = 94°\ 46'$, $O \wedge R = 129°\ 15'$; $a = 1{\cdot}06$. Observed planes: prismatic, i-2; rhombohedral, R, $-\frac{1}{2}$, -2; pyramidal, $\frac{4}{3}$-2 (t); scalenohedral, $\frac{1}{4}^{3}$ (o, bevelling terminal edge of R, or replacing edge between R and $-\frac{1}{2}R$); $\frac{13}{16}^{\frac{4}{3}}$ (l), always striated parallel to edge X (f. 396).

395

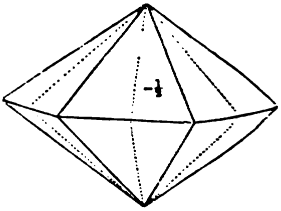


396

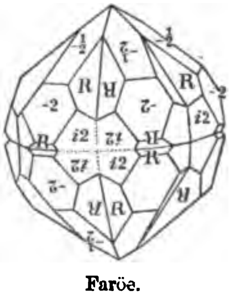


Haydenite

397



398



Faröe.

$R \wedge -\frac{1}{2} = 137°\ 23'$
$R \wedge -\frac{1}{2}$, ov. -2, $= 83\ 31$
$R \wedge -2$, vert., $119\ 42$
$R \wedge -2$, across, $126\ 26\frac{1}{2}$
$-\frac{1}{2} \wedge -\frac{1}{2}$, term., $= 125\ 13$
$t \wedge t$, term., $= 145\ 54$
$-2 \wedge -2$, term., $= 72°\ 53'$
$-\frac{1}{2} \wedge \frac{1}{4}^{3} = 155\ 18$
X in $l = 103\ 28$
Y in $l = 174\ 5$
X in $\frac{1}{4}^{3}$, ov. $-\frac{1}{2}$, $= 130\ 36$
Y in $\frac{1}{4}^{3} = 155\ 53$

Twins: composition-face O, very common, and usually in compound twins, as in f. 397, 398; 2, c.-fac R, rare. Cleavage rhombohedral, rather distinct.

H.=4–5. G.=2·08–2·19. Lustre vitreous. Col white, flesh-red; streak uncolored. Transparent-translucent. Fracture uneven. Brittle. Double refraction weak; in p larized light, images rather confused; axis in some crystals (Bohemi negative, in others (from Andreasberg) positive; Descl.

Var.—1. *Ordinary.* The most common form is the fundamental rhombohedron, in which the angle is so near 90° that the crystals were at first mistaken for cubes. *R* ∧ *R*=94° 46′, Phillips, Haid.: 94° 36′, fr. Kilmalcolm, Tamnau; 94° 58′, fr. Rübendörfel, id.; 95° 2′, fr. Fassa, id.; 94° 24′, fr Oberstein, Breith. *Acadialite*, from Nova Scotia (*Acadia* of the French of last century), is only a reddish chabazite; sometimes nearly colorless. In some specimens the coloring matter is arranged in a tesselated manner, or in layers, with the angles almost colorless.

2. *Phacolite* is a colorless variety occurring in twins of mostly a hexagonal form (f. 397), and often much modified so as to be lenticular in shape (whence the name, from φακός, *a bean*); the original was from Leipa in Bohemia; *R* ∧ *R*=94° 24′, fr Oberstein, Breith.

3. *Haydenite* is a yellowish variety in small crystals of the form in fig. 396, from Jones's Falls, near Baltimore, Md.; the crystals are often twinned parallel to *R*.

Chabazite crystals discovered by Ulrich in the Okerthal, Harz, in cavities in the granite, have G.=2·189, and their edges scratch glass (v. Rath, Pogg., cxxii. 404).

Comp.—For most chabazite O. ratio for $\dot{\mathrm{R}}$, $\bar{\dddot{\mathrm{R}}}$, $\ddot{\mathrm{Si}}$, $\dot{\mathrm{H}}$=1 : 3 : 8 : 6; corresponding to 4 $\ddot{\mathrm{Si}}$, $\bar{\dddot{\mathrm{Al}}}$, (⅔ $\dot{\mathrm{Ca}}$ + ⅓ ($\dot{\mathrm{Na}}$, $\dot{\mathrm{K}}$)), 6 $\dot{\mathrm{H}}$; some, 1 : 3 : 9 : 6, the same in constituents except 4½ $\ddot{\mathrm{Si}}$. For the phacolite, according to Rammelsberg, 1 : 3 : 7 : 5.

Analyses: 1–3, Hofmann (Pogg., xxv. 495); 4, Berzelius (Afh., vi. 190); 5, Rammelsberg (Handw., i. 149); 6, Thomson (Min., i. 334); 7, Connell (Edinb. J., 1829, 262); 8, Durocher (Ann. d. M., III. xix. 585); 9, Genth (Ann. Ch. Pharm., lxvi. 274, 1848); 10, Engelhardt (Ann. Ch. Pharm., lxv. 372); 11, Rammelsberg (2d Suppl., p. 34); 12, 13, A. A. Hayes (Am. J. Sci., II. i. 122); 14, Rammelsberg (Pogg., lxii. 149); 15, Anderson (Ed. N. Phil. J., 1843, 23); 16, Schröder (Jahrb. Min., 1860, 795):

	$\ddot{\mathrm{Si}}$	$\bar{\dddot{\mathrm{Al}}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Na}}$	$\dot{\mathrm{K}}$	$\dot{\mathrm{H}}$
1. Parsboro, N. S.	51·46	17·65	8·91	1·09	0·17	19·66, $\bar{\dddot{\mathrm{Fe}}}$ 0·85=99·79 Hofmann.
2. Fassathal	48·63	19·52	10·22	0·56	0·28	20·70=99·91 Hofmann.
3. "	48·18	19·27	9·65	1·54	0·21	21·10=99·95 Hofmann.
4. Gustafsberg	50·65	17·90	9·37	——	1·70	19·90=99·52 Berzelius.
5. Aussig	48·36	18·62	9·73	0·25	2·56	[20·47]=100 Rammelsberg.
6. Kilmalcolm	48·76	17·44	10·47	——	1·55	21·72=99·93 Thomson.
7. "	50·14	17·48	8·47	——	2·58	20·83=99·50 Connell.
8. Faröe	47·75	20·85	5·74	2·34	1·65	21·30=99·63 Durocher.
9. Annerode	47·00	19·71	10·63	0·65	0·83	22·29, $\bar{\dddot{\mathrm{Fe}}}$ 0·15=100·76 Genth.
10. Giessen	48·31	19·47	11·01	——	1·17	19·65, $\dot{\mathrm{Mg}}$ 0·26 Engelhardt.
11. Parsboro	52·14	19·14	7·84	0·71	0·98	19·19=100 Rammelsberg.
12. *Acadialite*	52·02	17·88	4·24	4·07	3·03	18·30=99·54 Hayes.
13. "	52·20	18·27	6·58	2·12		20·52=99·69 Hayes.
14. Leipa, *Phacolite*	46·33	21·87	10·40	0·95	1·29	[19·16]=100 Rammelsberg.
15. " "	45·63	19·48	13·30	1·68	1·81	17·98, $\dot{\mathrm{Mg}}$ 0·14, $\bar{\dddot{\mathrm{Fe}}}$ 0·43=99·95 Anderson.
16. Oberstein	50·19	17·45	7·13	2·12	0·62	22·09, $\dot{\mathrm{Ba}}$ 0·48, $\dot{\mathrm{Sr}}$ 0·32=100·40 Schröder

The baryta and strontia of the Oberstein crystals were first detected by spectral analysis; and by the same method the absence of those earths from the Iceland was ascertained.

Delesse obtained in an analysis of haydenite, made on too small an amount of material to be correct (Rev. Sci., xxv. 107), $\ddot{\mathrm{Si}}$ 49·5, $\bar{\dddot{\mathrm{Al}}}$, $\bar{\dddot{\mathrm{Fe}}}$ 23·5, $\dot{\mathrm{Ca}}$ 2·70, $\dot{\mathrm{Mg}}$ *tr.*, $\dot{\mathrm{K}}$ 2·50, $\dot{\mathrm{H}}$ 21·0=99·2. Silliman's analysis (This Min., 2d ed.) is wholly erroneous.

Pyr., etc.—According to Damour, crystals from Dyrefiord, Iceland, and Rübendörfel, Bohemia, lost 7·2 p. c. after 5 mos. in dried air; after some months in the free air again had regained this, and also an excess of 0·15 p. c. Heated for 1 h. to 100° C., the loss was 2·75 p. c.; to 180°, 14 p. c.; to 230°, 17 p. c.; to 300°, 19 p. c.; this loss was reduced to zero in 8 days; at a dull red heat, the loss was 21 p. c., and the mineral was no longer hygroscopic; at a bright red, it lost 22·4 p. c., intumesced, and was partially fused.

Phacolite of Scotland [Ireland?] lost 7 p. c. after 7 mos. in dried air; and 4 months after, in an atmosphere saturated with moisture, it had an excess of 12·5 p. c., which it lost very nearly again in ordinary air. Heated to 100° C., the loss was 3·7 p. c.; to 210°, 15·7 p. c.; to 290°–360°, 18 p. c.; and after 48 hours' exposure to the free air, the amount lost was restored. At a dull red heat, the loss was 22·2 p. c.; at a bright red, 22·8 p. c., and the material was fused to a blebby enamel.

B.B. intumesces and fuses to a blebby glass, nearly opaque. Decomposed by muriatic acid, with separation of slimy silica.

Obs.—Chabazite occurs mostly in trap, basalt, or amygdaloid, and occasionally in gneiss, syenite, mica schist, hornblendic schist.

Occurs at the Faröe Islands, Greenland, and Iceland, associated with chlorite and stilbite; at Aussig in Bohemia, in a kind of greenstone (the *graustein* of Werner); at Oberstein, with harmotome; at Annerode, near Giessen; at the Giant's Causeway, Kilmalcolm (some an inch across); Renfrewshire, Isle of Skye, etc.; Poonah in Hindostan, etc. In Nova Scotia, wine-yellow or flesh-red (the last the *acadialite*), associated with heulandite, analcite, and calcite, at Five Islands, Swan's Creek, Digby Neck, Mink Cove, William's Brook. *Phacolite* occurs at Leipa in Bohemia; also at Salesel and Wannow, in Bohemia; in Antrim, Ireland, at Giant's Causeway.

Both massive and incrusted at the Paugatuck stone-quarry, Stonington, Conn., with scapolite, sphene, and apatite; also yellowish-red in North Killingworth, on the Essex turnpike; at Hadlyme, Conn., on gneiss; in syenite at Charlestown, Mass.; also at Chester, Mass., in amygdaloid; at Bergen Hill, N. J., in small crystals; in the same rock at Piermont, N. Y.; in fissures in hornblendic gneiss at Jones's Falls, near Baltimore (*haydenite*), with heulandite. Phacolite has been reported from New York Island.

At Husavic, Iceland, fossil clam shells (Venus) occur in a recent deposit, lined within with small rhombohedrons of chabazite. Daubrée states that crystals occur at the warm springs of Luxeuil, Dept. of Haute Saône, France, as well as at those of Plombières, under conditions which indicate that they were formed through the agency of the warm waters; the temperature at Luxeuil is 115° F., and at Plombières 163° F.

The name *Chabazite* is from χαβάζιος, an ancient name of a stone.

Alt.—The haydenite is often covered with chlorite, and sometimes chlorite takes the place of the crystal.

Altered crystals from the Vogelsgebirge, that had lost part of their protoxyd bases, have been analyzed by Suckow (Verwitt., etc., 148):

	$\dddot{\mathrm{Si}}$	$\dddot{\bar{\mathrm{A}}}\mathrm{l}$	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\mathrm{N}}\mathrm{a}$	$\dot{\mathrm{K}}$	$\dot{\mathrm{H}}$	$\ddot{\mathrm{C}}$
Interior	48·40	19·13	1·88	1·47	8·13	21·01	——=100·02.
Exterior	47·29	19·16	5·78	1·50	1·47	21·00	3·20=99·40.

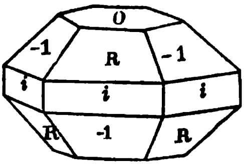
Removing $\dot{\mathrm{C}}\mathrm{a}\,\ddot{\mathrm{C}}$ from the latter, the O. ratios are, for the first, 0·76 : 3 : 8·6 : 6·3; for the second, 0·37 : 3 : 8·4 : 6·2 (Ramm. Min. Ch., 818).

Doranite of Thomson may be altered chabazite, if the analysis is not an incorrect one of the unaltered mineral. It is described as occurring in aggregated crystals, apparently cubic, yellowish-white, and translucent, with G.=2·15; and as consisting of $\dddot{\mathrm{Si}}$ 48·0, $\dddot{\bar{\mathrm{A}}}\mathrm{l}$ 22·0, $\dddot{\bar{\mathrm{F}}}\mathrm{e}$ 2 75, $\dot{\mathrm{M}}\mathrm{g}$ 13·0, $\dot{\mathrm{C}}\mathrm{a}$ 6·0, $\dot{\mathrm{H}}$ 7·70=99·45. Found in basalt, 2 m. W. of Carrickfergus, Co. Antrim.

387. GMELINITE. Sarcolite *Vauq.*, Ann. d. Mus., ix. 249, 1807, xi 42. Hydrolithe *Leman*, Cat. Min. de Drée, 18, 1811. Gmelinite *Brooke*, Ed. J. Sci., ii. 262, 1825. Ledererite *C. T. Jackson*, Am. J. Sci., xxv. 78, 1834.

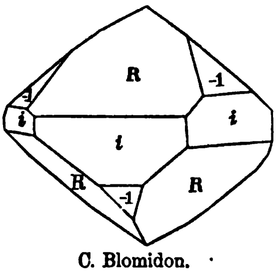
Rhombohedral. $R \wedge R$=112° 26′, $O \wedge R = O \wedge -1$=140° 3′; a=0·7254. Observed planes: prismatic, i, i-2; rhombohedral, R, −1; and also the plane 1-2 truncating the edge between R and −1. $R \wedge -1$, pyr., = 142° 23′, $R \wedge -1$, bas.,=79° 54′, $R \wedge$ 1-2= −1 $\wedge$ 1-2=161° 16′. Crystals usually hexagonal in aspect; sometimes −1 smaller than R, and habit rhombohedral; i often horizontally striated. Cleavage: i perfect. Observed only in crystals, and never as twins.

399



C. Blomidon, etc.

400



C. Blomidon.

H.=4·5. G.=2·04—2·17; 2·099—2·169, fr. C. Blomidon. Lustre vitreous. Colorless, yellowish-white, greenish-white, reddish-white, flesh-red. Transparent to translucent. Brittle. Double refraction weak; axis positive for crystals from Cyprus, negative for those of Andreasberg, the Vicentine, and Glenarm; no evidence of compound structure by polarized light; Descl.

Var.—The angle $R \wedge -1$, ov. i,=80° 8′, Brewster, 80° 54′, G. Rose, 80° 6′, Dufren., 79° 44′ Breith., 80° 8′, B. & M., 79° 44′, from Andreasberg, Descl. Plane 1-2 observed only on Andreas berg crystals. The *sarcolite* of Vauquelin is a flesh-red gmelinite from Montecchio-Maggiore in the Vicentin, supposed by Vauquelin, when he used the name, to be identical with the Vesuvian sarcolite.

Ledererite is ordinary gmelinite from Nova Scotia, impure with some free silica. Marsh has shown that it does not differ in the amount of water; and Descloizeaux that it has the same angles, finding $R \wedge -1$, ov. i, $=80°$, and $O \wedge R=140°$. Marsh found G.=2·108 (anal. 6), and 2·099 (anal. 7); most of the crystals obtained by him were implanted on quartz.

Comp.—O. ratio for $\dot{R}$, $\ddot{\ddot{R}}$, $\ddot{Si}$, $\dot{H}=1:3:8:6$, as in chabazite, G. Rose; corresponding to 4 $\ddot{Si}$, $\ddot{\ddot{Al}}$, $\frac{1}{3}\dot{Ca}+\frac{2}{3}(\dot{Na}, \dot{K})$, 6 $\dot{H}$. Analyses: 1, Connell (Edinb. New Phil. J., 1838); 2, 3, Rammelsberg (Pogg., xlix. 211); 4, Damour (Bull. Soc. G, III. xvi. 675); 5, A. A. Hayes (Am. J. Sci, xxv. 78); 6, 6A, 7, O. C. Marsh (Am. J. Sci., II. xliv. 362):

	$\ddot{Si}$	$\ddot{\ddot{Al}}$	$\dot{Ca}$	$\dot{Na}$	$\dot{K}$	$\dot{H}$
1. Glenarm	48·56	18·05	5·13	3·85	0·39	21·66, $\ddot{\ddot{Fe}}$ 0·11=98·75 Connell.
2. "	46·40	21·08	3 67	7·29	1·60	20·41=100·45 Rammelsberg.
3. "	46·56	20·18	3·89	7·69	1·87	29·41=100 Rammelsberg.
4. Cyprus	46·37	19 55	5·26	5·51	0·78	22·00=99·47 Damour.
5. *Ledererite*	49·47	21·48	11·48	3 94	——	8·58, $\ddot{\ddot{Fe}}$ 0·14, $\ddot{\ddot{P}}$ 3·48=98·57 Hayes.
6 "	53·71	17·63	6·52	3·10	0·80	17 98=99·74 Marsh.
6A. "	47·19	20·13	7·44	3·54	0·91	20·53=99·74 Marsh.
7. "	51·32	18·45	6·40	[3·48]		20 35=100 Marsh.

Analyses 6, 7, give an excess of silica, and Marsh attributes it to free quartz, visible particles of which were detected by him in the crystals; 6A is the same analysis with 6 after separation of this excess, amounting to about 12 p. c. Both 6 and 7 are of crystals from Cape Blomidon, but from different localities.

Pyr., etc.—According to Damour, the Cyprus gmelinite loses 6 p. c. in dried air; at 100° C. loss 13 p. c., and the amount is regained rapidly in free air; at 230° C. loss 20 p. c.; at a bright red heat 21·5 p. c., and the grains become soldered together. The Irish crystals lose 7·25 p. c. in dried air, which in six months increases to 9·3 p. c.; the loss is reduced to 1·5 p. c. after a few days of exposure. In the closed tube crumbles, giving off much water. B.B. fuses easily (F.=2·5–3) to a white enamel. Decomposed by muriatic acid with gelatinization.

Obs.—Occurs in amygdaloidal rocks at Montecchio Maggiore, and at Castel, in the Vicentine; at Andreasberg, in argillaceous schist, with analcite and heulandite; in Transylvania; at Glenarm and Portrush in Antrim, Ireland; the island of Magee, some crystals ¼ in. across; near Larne, flesh-colored; at Talisker in Skye, in large colorless crystals; on the I. of Cyprus, near Pyrgo, of a pale reddish color, and G.=2·07; at Cape Blomidon in Nova Scotia (ledererite), on the north coast, at a point nearly opposite Cape Sharp, in geodes, with analcite and quartz, often implanted on the latter mineral.

Gmelinite is usually considered rhombohedral, and the crystals as twins, secondary to a rhombohedron of 86° 18′. Tamnau makes $R \wedge R$ as in chabazite, and the pyramidal faces the form $\frac{2}{3}^{2}$. The hexagonal cleavage observed by Rose separates it widely from chabazite.

Named *Gmelinite* after Prof. Ch. Gmelin of Tübingen; *Hydrolite* from the water present; *Ledererite* after Baron Lederer, Austrian Consul at New York. The name hydrolite has the priority, but is objectionable because the mineral is not so eminently hydrous as to make it deserving of the appellation.

388. **HERSCHELITE.** *Levy*, Ann. Phil., x. 361, 1825. Gmelinite pt. *many authors.* Herschelite *v. Lang*, Phil. Mag., IV. xxviii. 506.

Orthorhombic, v. Lang. $I \wedge I=120°$, or nearly, $O \wedge 1\text{-}\breve{i}=139°\ 23'$. Observed planes: O, $i\text{-}i$, $1\text{-}\breve{i}$, $2\text{-}\breve{i}$, $\frac{5}{2}\text{-}\breve{i}$, $3\text{-}\breve{i}$. $i\text{-}\breve{i} \wedge 1\text{-}\breve{i}=130°\ 37'$, $i\text{-}\breve{i} \wedge 2\text{-}\breve{i}=149°\ 45'$, $i\text{-}\breve{i} \wedge \frac{5}{2}\text{-}\breve{i}=155°$. Not known in simple forms. Cleavage: basal. Twins: composition-face I, the crystals hexagonal tables, with replaced basal edges, but consisting of six sectors from composition. The tables often aggregated, as in prehnite; and also into spherules. Surfaces of planes hardly smooth; O often rounded or rough.

H.=5·5. G.=2·06. Lustre weak vitreous. Colorless or white. Translucent; transparent in thin plates. Fracture conchoidal. Optically biaxial, as observed in each sector of the tables, v. Lang; double refraction weak; axial divergence small; bisectrix negative.

Comp.—O. ratio for Ṙ, R̶, S̈i, Ḣ=1 : 3 : 8 : 5; corresponding to 4 S̈i, A̶l, (½ Ṅa+½ K̇), 5 Ḣ. Near gmelinite in the general form of the crystals and in composition, but the crystals are orthorhombic and not simple, and it contains as its protoxyd bases potash and soda in place of lime and soda. Analyses: 1, 2, Damour (Ann. Ch. Phys., III. xiv. 99); 3, v. Waltershausen (Vulk. Gest., 261):

		S̈i	A̶l	Ċa	Ṅa	K̇	Ḣ
1. Aci Castello		47·39	20·90	0·38	8·83	4·39	17·84=99·23 Damour.
2. "		47·46	20·18	0·25	9·35	4·17	17·65=99·06 Damour.
3. "	(⅓)	46·46	19·21	4·75	5·27	2·88	17·86, Ṁg 0·42, F̶e 1·14=97·99 Walt.

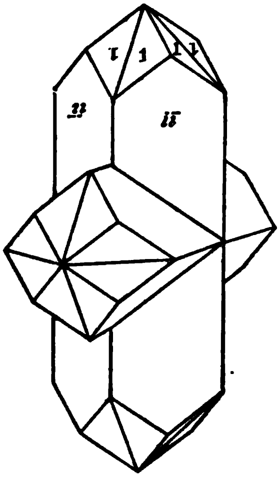
Pyr., etc.—In the closed tube whitens and yields water. B.B. fuses easily to a white enamel. Easily decomposed by acids, yielding semi-gelatinous silica (Damour).

Obs.—Accompanies phillipsite in a lava at Aci Castello, near Aci Reale, Sicily; also at Cyclops, Catania; in basalt near Richmond, in Victoria, Australia, the crystals in mode of twinning and in optical properties like the Sicilian.

389. PHILLIPSITE. *Levy*, Ann. Phil., II. x. 362, 1825. Lime-Harmotome. Kalk-Harmotome *Germ.* Kali-Harmotom, Normalin, *Breith.*, Schw. J., l. 327, 1827, Uib., 32, 1830, Char., 126, 1832. Christianite *Descl.*, Ann. d. M., IV. xii. 373, 1847.

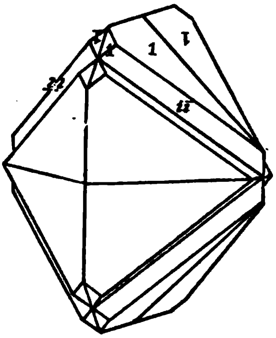
Orthorhombic. *I* ∧ *I*=91° 12′ and 88° 48′; 1 ∧ 1=121° 20′, 120° 44′ and 88° 40′, Marignac; 120° 42′, 119° 18′, and 90°, Brooke and Miller. Faces 1 and *i*-ī striated parallel to the edge between them. Simple crystals unknown. Twins: (1) composition-face *I*, producing penetration forms like either part of f. 401; (2) cruciform crystals, consisting of two crossing crystals, each a twinned prism (f. 401); (3) cruciform, consisting of three crossing twinned prisms at right angles to one another. The prisms of f. 401 sometimes short, as in f. 402. Crystals either isolated, or grouped in tufts or spheres that are radiated within and bristled with angles at surface.

401



C. di Bove.

402



C. di Bove.

H.=4—4·5. G.=2·2; 2·201, Iceland, Damour, and Sicily, v. Waltershausen. Lustre vitreous. Color white, sometimes reddish. Streak uncolored. Translucent—opaque.

Comp.—O. ratio for $\dot{\text{R}}$, $\bar{\text{R}}$, $\ddot{\text{Si}}$, $\dot{\text{H}}$=1 : 3 : 8 : 5; corresponding to 4 $\ddot{\text{Si}}$, $\bar{\text{Al}}$, ($\frac{2}{3}$ $\dot{\text{Ca}}$ + $\frac{1}{3}$ $\dot{\text{K}}$), 5 $\dot{\text{H}}$= Silica 47·9, alumina 20·5, lime 7·4, potash 6·3, water 17·9=100.

Analyses: 1, 2, Gmelin (Leonh. ZS. Min., 1825); 3, 4, Köhler (Pogg., xxxvii.); 5, Connel (Edinb. Phil. J., xxxv. 1843, 375); 6, 7, Damour (Ann. d. M., IV. ix. 336); 8, Genth (Ann. Ch. Pharm., lxvi. 272); 9, 10, Waltershausen (Vulk. Gest., 263):

	$\ddot{\text{Si}}$	$\bar{\text{Al}}$	$\dot{\text{Ca}}$	$\dot{\text{Na}}$	$\dot{\text{K}}$	$\dot{\text{H}}$
1. Marburg	48·51	21·76	6·26	—	6·33	17·23, $\bar{\text{Fe}}$ 0·99=100·38 Gmelin.
2. "	48·02	22·61	6·56	—	7·50	16·75, $\bar{\text{Fe}}$ 0·18=100·62 Gmelin.
3. "	50·45	21·78	6·50	—	3·95	16·82=99·49 Köhler.
4. Cassel	48·22	23·33	7·22	—	3·89	17·55=100·22 Köhler.
5. G. Causeway	47·35	21·80	4·85	3·70	5·55	16·96=100·21 Connel. G.=2·17.
6. Iceland	48·41	22·04	8·49	—	6·19	15·60=100·73 Damour.
7. "	50·16	20·94	7·74	—	6·50	14·66=100·00 Damour.
8. Marburg	48·17	21·11	6·97	0·63	6·61	16·62, $\bar{\text{Fe}}$ 0·24, $\dot{\text{Ba}}$ *tr.*=100·35 G.
9. Aci Castello, Sic.	48·53	19·88	2·92	6·18	3·82	14·76, $\bar{\text{Fe}}$ 2·64[a], $\dot{\text{Mg}}$ 1·60=100·34 W.
10. Palagonia, Sic.	48·37	21·07	3·24	3·41	6·15	14·54, $\bar{\text{Fe}}$ 0·71, $\dot{\text{Mg}}$ 1·42=98·91 W.

[a] Probably as phosphate.

Marignac published as an analysis of the phillipsite of C. di Bove results differing widely from the above. See page 418, under GISMONDITE.

Pyr., etc.—According to Damour, the Kaiserstuhl crystals (mixed with a little faujasite) lose 8 p. c. after a month in dried air, and regain all again in ordinary air in 24 hours. Heated to 50° C. for an hour, the mineral loses 12·3 p. c., and recovers nearly all in 24 hours' exposure to ordinary air, but becomes a powder and opaque (the faujasite remaining transparent). Heated to 150° C., the loss is 16 p. c., and only 0·8 p. c. after exposure again to the air for 4 days. At 250° C., the loss is 18·5 p. c., part of which is due to the faujasite; it is reduced to 9 p. c. in the free air. B.B. crumbles and fuses at 3 to a white enamel. Gelatinizes with muriatic acid.

Obs.—In translucent crystals in amygdaloid, at the Giant's Causeway, Ireland; in small colorless crystals, and in spheroidal groups, in leucitophyr, at Capo di Bove, near Rome; in crystals and radiating masses at Aci Castello and elsewhere in Sicily; among the lavas of Somma; at Stempel, near Marburg; Habichtswalde, near Cassel; Annerode, near Giessen; near Eisenach, in Saxe Weimar; Petersberg, in Siebengebirge; Laubach, in Hesse Darmstadt; in Kaiserstuhl, with faujasite; at Härtlingen, Duchy of Nassau; in Silesia; Bohemia; on the west coast of Iceland, the shores of Dyrefiord. Very small transparent crystals, of recent formation, in the masonry at the hot baths of Plombières, France, observed by Daubrée, are stated by Senarmont to have the angles, and by Descloizeaux the optical characters, of phillipsite.

Named after the English mineralogist, J. Phillips. The name *christianite* was given by Descloizeaux (after Christian VIII. of Denmark) to the Marburg harmotome and crystals from Iceland; and in his Man. Min., 1862, he places all of phillipsite under his name christianite.

On cryst. see Descl., l. c., and Min., i. 399; v. Rath, ZS. G., xviii. 530, from whom the above figures are taken.

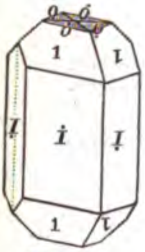
390. **HARMOTOME.** Spatum calcarium cryst. dodecaedrum album, opacum, et lamellis quatuor erectis, etc. (fr. Zellerfeld), *v. Born*, Lithoph., ii. 81, Tab. I., f. 1; Figura hyacinthica, etc.: hæ crystalli non sunt calcareæ, sed siliceæ, *Bergm.*, Opusc., ii. 7, 1780. Hyacinte blanche *Démeste*, Lett. 417, var. 5, 1779. Hyacinte blanche cruciforme *de Lisle*, Crist., ii. 299, pl. iv. f. 119 (good), 1783. Kreuzkristalle *Heyer*, v. Trebra's Erfahrungen, etc., 89; Crell's Ann., i. 212, 1789. Kreutzstein *Wern.*, *Karsten*, Lempe's Mag., ii. 58, 59, 1786. Andreasbergolite *Delametherie*, Sciagr., i. 267, 1792. Andreolite *Delameth.*, T. T., ii. 285, 1797. Staurolite *Kirwan*, i. 282, 1794. Ercinite *Napione*, Elem. Min., 239, 1797. Harmotome *Haüy*, Tr., iii. 1801. Pierre cruciforme *Brochant*, i. 311, 1808. Morvenite *Thom.*, Min., i. 351, 1836. Baryt-Harmotome.

Orthorhombic. *I* ∧ *I*=124° 47′. Observed planes: *O*, *I*, 1, 4; 1, 4, and sometimes *I*, hemihedral.

O ∧ 1=120° 28′	*I* ∧ 1=149° 32′	1 ∧ I, adj.,=121° 6′
O ∧ 4=98 22	1 ∧ 1, ov. *I*,=119 3	*I* ∧ *I*, adj.,=110 26

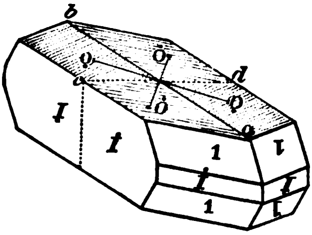
Cleavage: *I*, *O*, easy. Simple crystals unknown. Twins: 1. Composition-face *I*, f. 403, 404; f. 403 elongated, and f. 404 shortened in the direction of the vertical axis; both penetration-twins, the two anterior quadrants twinned parallel to *I*, and then these parts prolonged backward in the direction of the shorter diagonal, making a crystal composed of two intersecting crystals, but apparently composed of 4 parts; each part having one narrow plane *I* between two planes 1, and one broad *I*, because the form 1 is hemihedral, the planes occurring only on one of the two basal edges of either half of the prism. 2. Composition the same, but twins double twins, as in f. 405; also in f. 406, which is like f. 405 in a different position, except in the enlargement of planes 1 and the consequent absence of the terminal planes *I*, the large lateral planes corresponding to 4 *O*'s and each reëntering pair to 4 *I*'s. Unknown massive.

403



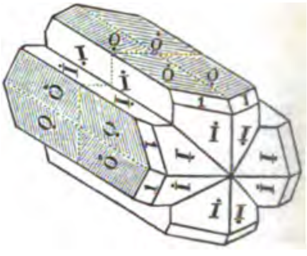
Strontian.

404



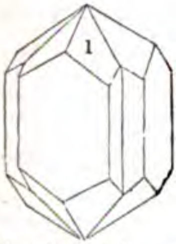
Andreasberg.

405



Andreasberg.

406



H.=4·5. G.=2·44—2·45. Lustre vitreous. Color white; passing into gray, yellow, red, or brown. Streak white. Subtransparent—translucent. Fracture uneven, imperfectly conchoidal. Brittle. Double refraction weak. Optic-axial plane *i*-ī (having the direction of the lines in base in f. 404); acute bisectrix positive. Dispersion inappreciable.

Var.—The variety *morvenite*, from Strontian, Scotland, occurs in transparent and translucent brilliant crystals like fig. 403. G.=2·447, Damour.

Comp.—O ratio for Ṙ, R̶⃛, S⃛i, Ḣ=1 : 3 : 10 : 5 (or 4½); corresponding to 5 S⃛i, A̶⃛l, Ḃa, 5 Ḣ=Silica 46·5, alumina 15·9, baryta 23·7, water 13·9=100.

Analyses: 1, Köhler (Pogg., xxxvii. 561); 2, Rammelsberg (Handw., i. 200); 3, id. (Pogg., cx. 624); 4, 5, Köhler (1 c.); 6, Rammelsberg (Pogg., cx. 624); 7, Connel (Ed. N. Phil. J., July, 1832, 33); 8, Damour (Ann. d. M., IV. ix. 336, and C. R., xxii. 745); 9, 10, Damour (Ann. d. M., IV. ix. 345):

	S⃛i	A̶⃛l	Ḃa	Ċa	Ṅa	K̇	Ḣ
1. Andreasberg	46·63	16·82	20·32	0·26	——	1·02	15·03=100·08 Köhler.
2. Andreasberg	48·74	17·65	19·22	——	——	——	14·66=100·27 Rammelsberg.
3. "	48·49	16·35	20·08	——	*tr.*	2·07	13·00=99·99 Rammelsberg.
4. Oberstein	46·65	16·54	19·12	1·10	——	1·10	15·24=99·77 Köhler.
5. Strontian	46·10	16·41	20·81	0·63	——	0·90	15·11=99·96 Köhler.
6. "	47·52	16·94	20·25	——	1·09	1·00	13·45=100·25 Ramm.
7. "	47·04	15·24	20·85	0·10	0·84	0·88	14·92, F̶e 0·24=100·11 Connel.
8. "	47·74	15·68	21·06	——	0·80	0·78	13·19, F̶e 0·51=99·76 Damour.
9. *Morvenite*	47·60	16·39	20·86	——	0·74	0·81	14·16, F̶e 0·65=101·21 Damour.
10. "	47·59	16·71	20·45	——	——	——	14·16, F̶e 0·56=99·47 Damour.

Pyr., etc.—According to Damour, the Scotch harmotome loses 4·3 p. c. by 6 mos.' exposure to dried air. Heated to 100° C. it loses 1·8 p. c. between 100° and 150°, 9·9 p. c.; between 100°

and 190°, 13·5 p. c.; and after 24 h. exposure to the ordinary air, what is lost is restored. At a dull red heat the loss is 14·65 p. c., and the mineral is disaggregated; the total loss at a bright red heat is 14·70 p. c. B.B. whitens, then crumbles and fuses without intumescence at 3·5 to a white translucent glass. Some varieties phosphoresce when heated. Decomposed by muriatic acid without gelatinizing.

Obs.—Harmotome occurs in amygdaloid, phonolite, trachyte; also on gneiss, and in some metalliferous veins.

Occurs at Strontian, in Scotland, in fine crystals, some an inch through; in a metalliferous vein at Andreasberg in the Harz; at Rudelstadt in Silesia; Schiffenberg, near Giessen; at Schima and Hauenstein in Bohemia; near Eschwege in Hesse; at Oberstein in Birkenfeld, implanted on agate in siliceous geodes; at Kongsberg in Norway; with analcite in the amygdaloid of Dumbartonshire.

Named from 'αρμός, *joint*, and τέμνω, *to cut*, alluding to the fact that the octahedron (made by the planes 1) divides parallel to the plane that passes through the terminal edges.

On cryst. see Levy's Heuland; Descloizeaux, Ann. d. M., IV. ix. 339, and Min., i. 412. The prismatic angle 124° 47′ gives for the prism *i*-2 the angle 87° 26′ and 92° 34′, which is near the angle in phillipsite; so that while phillipsite has the O. ratio for bases and silica of a bisilicate and the angle $I \wedge I$ of pyroxene, harmotome has the O ratio nearly and angle $I \wedge I'$ of hornblende. Damour and Descloizeaux show morvenite to be harmotome (Ann. d. M., IV. ix 339).

The name *Andreolite* of Delametherie (derived from the locality at Andreasberg) has the priority, and also *Ercinite* of Napione; but Haüy substituted *harmotome*. of no better signification, and all subsequent mineralogists have followed him.

391. HYPOSTILBITE. *Beudant* (fr. Faröe), Min, ii. 119, 1832. Desmin, Puflerit, *Bukeisen*, Ber. Ak. Wien, xxiv. 286, 1857.

In small concretions, compactly fine fibrous within; also in large radiate-fibrous or columnar masses.

H.=3·5—4. G.=2·1—2·25. Lustre vitreous, strongly so to feebly shining. Color white, sometimes greenish-white. Transparent to translucent.

Comp., Var.—O. ratio for Ṙ, R̶, S̈i, Ḣ=1 : 3 : 9 : 6, corresponding to 4½ S̈i, Ä̶l, (⅓ Ċa+⅔ Ṅa), 6 Ḣ=, if Ṙ=Ċa, Silica 50·3, alumina 19·2, lime 10·4, water 20·1=100. The ordinary hypostilbite contains some soda, with Ṅa : Ċa=2 : 7, nearly; while the variety *puflerite* is without alkalies.

G. of hypostilbite, 2·14, Beudant; 2·18, Haughton; 2·252, Mallet; of puflerite, 2, Bukeisen; 2·21, Damour. In puflerite the fibres have two unequal cleavages, at right angles with one another, with lustre strongly vitreous. Double refraction is strong; axial divergence small; bisectrix parallel to the sides of the fibres and negative; axial plane parallel to the plane of more difficult cleavage; Descl.

Analyses: 1, Beudant (Min., ii. 120); 2, Duménil (ib.); 3, Mallet (Am. J Sci., II. xxii. 179); 4, Haughton (Phil. Mag, IV. xiii. 510); 5, id. (ib., xxxii. 224); 6, Bukeisen (Ber. Ak. Wien, xxiv. 286):

	S̈i	Ä̶l	Ṁg	Ċa	Ṅa	K̇	Ḣ
1. Faröe	52·43	18·32	——	8·10	2·41	——	18·70=99·96 Beudant.
2. Dalsnypen	52·25	18·75	——	7·36	2·39	——	18·75=99·50 Duménil.
3. Skye	53·95	20·13	*tr.*	12·86	0·87		12·42=100·23 Mallet.
4. "	52·40	17·98	0·36	9·97	1·40	0·03	17·83=99·97 Haughton.
5. Bombay	52·80	17·12	*tr.*	7·89	2·35	0·07	18·52=98·75 Haughton.
6. *Puflerite*	52·84	16·30	——	11·19	——	——	17·16=98·09 Bukeisen.

Thomson found (Min., i. 345) a "red stilbite" from Dumbarton to contain S̈i 52·50, Ä̶l 17·32, Ċa 11·52, Ḣ 18·45=99·79. As he calls the mineral *red stilbite* from Dumbarton, a noted locality of red stilbite familiar to him, and stilbite is easily distinguished by its pearly cleavage, it is far safer to give credit to his mineralogical opinion than to his analysis. Until hypostilbite is announced on good authority from Dumbarton, the analysis may, therefore, be taken only as a coincidence by error.

Pyr., etc.—According to Beudant, intumesces a little, and fuses with difficulty on the edges; attacked by acids without gelatinizing. According to Mallet, gelatinizes readily with acids.

Puflerite, according to Bukeisen. intumesces much, and fuses easily to a snow-white bubbly glass.

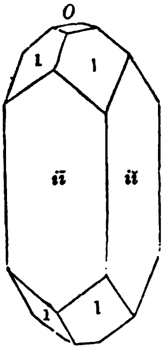
Obs.—Hypostilbite occurs on the island of Faröe with stilbite and epistilbite, forming fibrous nodules or concretions in amygdaloid; on the island of Skye, in a similar manner; in the Nerbudda valley, and near Bombay in India, in the same rock, constituting large, fibrous, transparent masses, radiated like natrolite or thomsonite.

Puflerite occurs at Pufler-loch in the Seiser Alps, Tyrol, in cavities in melaphyre, with analcite and chabazite, and often implanted on these minerals in small concretions.

Named from ὑπό, *below*, and *stilbite*, in allusion to its containing less silica than stilbite. It has been considered altered stilbite.

392. STILBITE. Zeolit pt. *Cronst.*, Ak. H. Stockh., 1756; Zeolites cryst., crystalli ad centrum tendentes (fr. Gustafsberg, etc.), *Cronst.*, 102, 1758. Z. facie Selenitica lamellaris, Blättricher Zeolit pt, *Wall.*, Min., i. 313, 1772. Strahliger Zeolith *Wern.*, Ueb. Cronst., 242, 1780. Strahl-Zeolith (var. of Z.) *Wern.*, 1800, Ludwig., i. 49, 1803. Radiated Zeolite. Zeolite nacrée, Stilbite, *Delameth.*, T.T., ii. 305, 1797. Stilbite (Heulandite incl.) *H.*, J. d M., iii. 66, 1798, Tr., iii. 1801, 1822;=Strahl-Zeolith *Hoffm.*, Min., ii. 237, 1812. Desmine [=Stilbite with Heul. excl.] *Breith.*, Hoffm. Min., iv. b, 40, 1818;=Stilbite *Brooke*, Ed. Phil. J., vi. 112, 1822. Sphærostilbite *Beud.*, Tr., ii. 120, 1832. Syhedrite *Shepard*, Am. J. Sci., II. xl. 110, 1865.

407



Orthorhombic. $I \wedge I = 94° \ 16'$ (whence $i\text{-}2 \wedge i\text{-}2 = 130° \ 12'$, analogue of $I \wedge I$ in heulandite); $1 \wedge 1$, front, $= 119° \ 16'$, side, $114° \ 0'$, $i\text{-}\bar{i} \wedge i\text{-}\breve{i} = 90°$. Brooke and Miller make $O \wedge i\text{-}\bar{i}$ or $i\text{-}\breve{i} = 90°$, $i\text{-}\bar{i} \wedge 1 = 123°$, $i\text{-}\breve{i} \wedge 1 = 120° \ 22'$. Cleavage: $i\text{-}\breve{i}$ perfect, $i\text{-}\bar{i}$ less so. Forms as in f. 407; more common with the prism flattened parallel to $i\text{-}\breve{i}$ or the cleavage-face, and pointed at the extremities; sometimes with the vertical edges replaced by the prism I. Twins: cruciform, composition-face $1\text{-}\bar{i}$, rare. Common in sheaf-like aggregations; divergent or radiated; sometimes globular and thin lamellar-columnar.

H.=3·5–4. G.=2·094 – 2·205; 2·161, Haidinger. Lustre of $i\text{-}\breve{i}$ pearly; of other faces vitreous. Color white; occasionally yellow, brown, or red, to brick-red. Streak uncolored. Transparent—translucent. Fracture uneven. Brittle. Double refraction strong; optic-axial plane $i\text{-}\bar{i}$; divergence 50°–55°; bisectrix negative, perpendicular to O: Descl.

Var.—1. *Ordinary.* Either (*a*) in crystals, flattened and pearly parallel to the plane of cleavage, or sheaf-like or divergent groups; or (*b*) in radiated stars or hemispheres, with the radiating individuals showing a pearly cleavage surface. *Sphærostilbite* Beud. is in spheres, radiated within, with a pearly fracture, rather soft externally, but harder at centre, and having G.=2·31. Heddle shows that it is stilbite impure from mixture with mesolite; the original was from Faröe

Comp.—O. ratio 1:3:12:6; corresponding to 6 $\ddot{Si}$, $\dddot{\overline{Al}}$, $\dot{Ca}$, 6 $\dot{H}$=Silica 57·4, alumina 16·5, lime 8·9, water 17·2=100. Analyses: 1, Fuchs & Gehlen (Schw. J., viii. 253); 2, Hisinger (ib., xxiii 63); 3, Retzius (Jahresb., iv. 153); 4, Moss (Pogg., lv. 114); 5, Riegel (J. pr. Ch., xl. 317); 6, Hermann (Bull. Soc. Nat. Moscou, 1848, 318); 7, Münster (Pogg., lxv. 297); 8, 9, Sjögren (Œfv. Ak. Stockh., 1848, 111); 10, Waltershausen (Vulk. Gest, 254); 11, Kerl (B. H. Ztg., 1853, No. 2); 12, R. Weber (ib.); 13, Beudant (Min., ii. 119, 120); 14, Heddle (Greg & L. Min., 164); 15, 16, Haughton (Phil. Mag., IV. xiii. 510, xxxii. 224):

	$\ddot{Si}$	$\dddot{\overline{Al}}$	$\dot{Ca}$	$\dot{Na}$	$\dot{K}$	$\dot{H}$
1. Iceland	55·07	16·58	7·58	1·50		19·30=100·03 F. & G.
2. "	58·0	16·1	9·2	—	—	16·4=99·70 Hisinger.
3. Faröe	56·08	17·22	6·95	2·17	—	18·35=100·77 Retzius.
4. "	57·18	16·44	7·74	1·11	0·32	17·79=100·58 Moss.
5. Niederkirchen	58·33	16·66	7·16	1·62	—	14·50, $\dddot{\overline{Fe}}$ 0·26=98·53 Riegel.
6. Ilmen Mts.; G.=2·19	56·31	16·25	7·66	1·03	—	17·75, $\dddot{\overline{Fe}}$, Mn 1·0=100 Hermann.
7. Christiana; G.=2·203	58·53	15·73	7·02	3·07[a]		17·05, $\dddot{\overline{Fe}}$ 0·5 Munster.

[a] With some magnesia.

	S̈i	Äl	Ċa	Ṅa	K̇	Ḣ
8. Gustafsberg	57·41	16·14	8·97	1·21	1·04	16·60, Ṁg tr.=101·40 Sjögren.
9. Barbro, Norway	58·41	16·56	7·89	—	—	16·53, Ṁg, Ṁn 0·59=99·93 S.
10. Iceland; G.=2·134	57·40	16·23	7·71	0·60	0·34	16·68, Ṁg 0·13=99·09 Waltersh.
11. Andreasberg	56·3	15·9	7·4	—	0·6	17·6, F̈e 1·3=99·1 Kerl.
12. Berufiord, Iceland	58·02	14·94	8·33	—	1·30	17·71=100·30 Weber.
13. *Sphærostilbite*	55·91	17·61	9·03	0·68	—	17·84=100·07 Beudant.
14. Skye	56·54	16·43	8·90	0·46	—	17·05=99·38 Heddle.
15. Bombay	58·20	15·60	8·07	0·49	0·92	18·00=101·28 Haughton.
16. Nerbudda	56·59	15·35	5·88	1·45	0·89	17·48 Haughton.

A white silky incrustation on chert, from the hot spring of Olette, eastern Pyrenees, afforded J. Bouis S̈i 57·6, Äl 16·1, Ċa 8·6, Ḣ 17·6=99·9; and Descloizeaux observes that it occurs also in cleavable rectangular prisms like those of stilbite.

Syhedrite of Shepard (l. c.), from trap in the Syhedree Mountains, Bombay, has a greenish color, with G.=2·321; and afforded W. S. Tyler (l. c.) Äl 15·06, F̈e 2·71, Ṁg 2·46, Ċa 6·45, Ḣ 16·40, the rest 56·92, undetermined, but supposed to be all silica. Alkalies wanting. It may be an impure stilbite, colored by a chlorite-like mineral.

Pyr., etc.—According to Damour, loses 1·3 p. c. at 100° C.; 13 p. c. between 100° and 150° C.; regaining all lost but 3·1 p. c. after 5 days' exposure to the ordinary air; at 170° C. the loss is 16·2 p. c., which is reduced to 9·2 p. c. after 15 days' exposure. B.B. exfoliates, swells up, curves into fan-like or vermicular forms, and fuses to a white enamel. F.=2—2·5. Decomposed by muriatic acid, without gelatinizing. The *sphærostilbite* gelatinizes, but Heddle says this is owing to a mixture of *mesolite* with the stilbite.

Obs.—Stilbite occurs mostly in cavities in amygdaloid. It is also found in some metalliferous veins, and in granite and gneiss.

Abundant on the Faröe Islands, in Iceland, and on the Isle of Skye, in amygdaloid; also found on the Isle of Arran, Scotland; in Dumbartonshire, at Long Craig, and at Kilpatrick, Scotland, in red crystals; at Kincardine, Kilmalcolm, Campsie, Scotland; at the Giant's Causeway, in the Mourne Mts., etc., Ireland; at Andreasberg in the Harz, and Kongsberg and Arendal in Norway, with iron ore; in the Vendayah Mts., Hindostan, in large translucent crystals having a reddish tinge; also in the Nerbudda valley and in the Bombay Presidency; a brown variety on granite, at the copper mines of Gustafsberg, near Fahlun in Sweden; at Andreasberg, Kongsberg, etc.

Sphærostilbite occurs in minute spheres over faröelite in Skye; at Storr (anal. 13, 14); and at Quiraing, in spheres as large as a pea.

In North America, sparingly in small crystals at Chester and the Charlestown syenite quarries, Mass.; at the gneiss quarry, Thachersville, Conn., in crystals lining cavities in coarse granite; at Hadlyme, in radiated forms on gneiss, associated with epidote, garnet, and apatite; at Phillipstown, N. Y., in crystals or fan-like groups; opposite West Point, in a vein of decomposing bluish feldspar, intersecting gneiss, in honey-yellow crystals; in the greenstone of Piermont, in minute crystals; in scopiform crystals of a dull yellow color, near Peekskill, N. Y.; and at Bergen Hill, New Jersey, in small but bright crystals; also at the Michipicoton Islands, Lake Superior; at Partridge Island, Nova Scotia, forming a perpendicular vein from 3 to 4 inches thick, and from 30 to 50 feet long, intersecting amygdaloid, its colors white and flesh-red; also at Isle Haute, Digby Neck, Gulliver's Hole, Black Rock, Cape Blomidon, Hall's Harbor, Long Point.

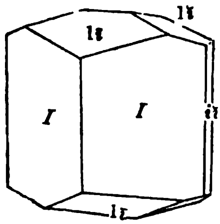
The name *stilbite* is from στίλβη, *lustre;* and *desmine* from δέσμη, *a bundle.* The species stilbite, as adopted by Haüy, included Strahlzeolith *Wern.* (radiated zeolite, or the above), and Blätterzeolith *Wern.* (foliated zeolite, or the species heulandite beyond). The former was the typical part of the species, and is the first mentioned in the description; and the latter (made the variety *stilbite anamorphique*) he added to the species, as he observes, with much hesitation. In 1817, Breithaupt separated the two zeolites, and called the former *desmine* and the latter *euzeolite*, thus throwing aside entirely, contrary to rule and propriety, Haüy's name *stilbite*, which should have been accepted by him in place of desmine, it being the typical part of his species. In 1822 Brooke (apparently unaware of what Breithaupt had done) used *stilbite* for the first, and named the other *heulandite.* In this he has been followed by the French and English mineralogists: while the Germans have unfortunately followed Breithaupt.

Alt.—Stilbite has been observed changed to quartz.

393. EPISTILBITE. Epistilbit *G. Rose*, Pogg., vi. 183, 1826. Monophan *Breith.*, Char., 279, 1823.

Orthorhombic. *I* ∧ *I*=135° 10′, *O* ∧ 1-ī=144° 53′; *a* : *b* : *c*=1·422 : 1 : 2·4242. Observed planes, as in f. 408, with 2-2̆ replacing edge *I* ∧ 1-ī.

408



1-ī ∧ 1-ī, top, =109° 46′, 1-ĭ ∧ 1-ĭ, top, =147° 40′, *I* ∧ 1-ī =122° 9′, 1-ī ∧ 1-ĭ=141° 47′. Cleavage: *i*-ĭ, very perfect; indistinct in other directions. Face *I* mostly uneven. Generally in twins; composition-face *Ĭ*. Also granular.

H.=4—4·5. G.=2·249—2·363. Lustre of cleavage-face pearly; of *I* vitreous. Color white, bluish- or yellowish-white, reddish. Transparent—translucent. Fracture uneven. Double refraction weak; plane of optical axes parallel to *i*-ĭ, and bisectrix normal to *i*-ī.

Comp.—O. ratio for $\dot{\mathrm{R}}$, $\bar{\mathrm{R}}$, $\ddot{\mathrm{S}}\mathrm{i}$, $\dot{\mathrm{H}}$=1 : 3 : 12 : 5; corresponding to 6 $\ddot{\mathrm{S}}\mathrm{i}$, $\bar{\mathrm{A}}\mathrm{l}$, ($\frac{4}{5}$ $\dot{\mathrm{C}}\mathrm{a}$+$\frac{1}{5}$ $\dot{\mathrm{N}}\mathrm{a}$), 5 $\dot{\mathrm{H}}$= Silica 59·0, alumina 16·9, lime 7·3, soda 2·0, water 14·8=100. Analyses: 1, 2, G. Rose (l. c.); 3, Dr. Limpricht (Waltersh. Vulk. Gest., 248); 4, 5, Waltershausen (ib.); 6, Kurlbaum (Am. J. Sci., II. xxiii. 421); 7, 8, How (ib., xxvi. 33):

		$\ddot{\mathrm{S}}\mathrm{i}$	$\bar{\mathrm{A}}\mathrm{l}$	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\mathrm{N}}\mathrm{a}$	$\dot{\mathrm{H}}$
1. Berufiord		58·59	17·52	7·56	1·78	14·48=99·93 Rose.
2. "		60·28	17·36	8·32	1·52	12·51 (loss)=100 Rose.
3. "	*bh.*	58·99	18·21	6·92	2·35	14·98=101·44 Limpricht.
4. "		59·22	17·23	8·20	2·46	13·90=101·01 Waltershausen.
5. "	*ywh.*	60·08	16·74	8·14	$\dot{\mathrm{K}}$ 2·35	14·31=101·62 Waltershausen.
6. "		58·74	17·10	7·81	$\dot{\mathrm{N}}\mathrm{a}$2·05	14·21, $\bar{\mathrm{F}}\mathrm{e}$ 0·12, $\dot{\mathrm{K}}$ 0·19=100·23 Kurlbaum.
7. N. Scotia	(½)	58·57	15·34	7·00	0·99	15·42, $\bar{\mathrm{F}}\mathrm{e}$ 1·58, $\dot{\mathrm{K}}$ 0·99=99·89 How.
8. "		58·35	16·73	7·87	2·10	14·93=100 How.

Pyr., etc.—B.B. intumesces and forms a vesicular enamel. Soluble in concentrated muriatic acid without gelatinizing.

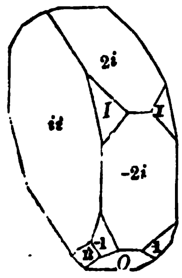
Obs.—Occurs with scolecite at the Berufiord in Iceland; in Faröe; at Poonah in India; in small flesh-colored crystals at Skye; in small reddish crystals, nearly or quite opaque, with stilbite, at Margaretville, N. Scotia, 7 m. E. of Port George (anal. 7; loc. for anal. 8 not precisely known). Reported as occurring with stilbite, apophyllite, etc., at Bergen Hill, N. J.

Parastilbite. Von Waltershausen thus names (l. c., p. 251) a specimen from Borgarfiord, which afforded on analysis $\ddot{\mathrm{S}}\mathrm{i}$ 61·87, $\bar{\mathrm{A}}\mathrm{l}$ 17·83, $\dot{\mathrm{C}}\mathrm{a}$ 7·32, $\dot{\mathrm{N}}\mathrm{a}$ 2·00, $\dot{\mathrm{K}}$ 1·78 $\dot{\mathrm{H}}$ 9·20=100, for which he deduces the O. ratio 1 : 3 : 12 : 3, and writes the formula $\dot{\mathrm{R}}\,\ddot{\mathrm{S}}\mathrm{i}+\bar{\mathrm{A}}\mathrm{l}\,\ddot{\mathrm{S}}\mathrm{i}^3+3\,\dot{\mathrm{H}}$. It resembles epistilbite, but gives (Pogg., xcix. 170) 136° 39′ for the angle *I* ∧ *I*.

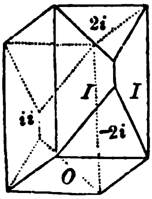
394. HEULANDITE. Blättriger Zeolith *Meyer*, Beschaft. Ges. N. Fr. Berlin, iv. 1779; *Hoffm.*, Bergm. J., 430, 1789. Blätter-Zeolith (var. of Z.) *Wern.*, 1800, Ludw. Min., 49, 1803. Stilbite pt., Stilbite anamorphique, *H.*, Tr., iii. 1801. Euzeolith *Breith.*, Hoffm. Min., iv., b, 40, 1818. Heulandite *Brooke*, Ed. Phil. J., vi. 112, 1822. Lincolnite *Hitchcock*, Rep. G. Mass., 1833, 437, 1835, 662, 1841. Beaumontite *Levy*, C. R., 1839.

Monoclinic. *C*=88° 35′, *I* ∧ *I*=136° 4′, *O* ∧ 1-ì=156° 45′; *a* : *b* : *c*= 1·065 : 1 : 2·4785. Observed planes as in the annexed figures.

409



410



Jones's Falls.

O ∧ 2-*i*=116° 20′ *i*-ì ∧ −1=106° 32′
O ∧ −2-*i*=114 *i*-ì ∧ *I*=111 58
2-*i* ∧ −2-*i*=129 40 −1 ∧ −1=146 56

Cleavage: clinodiagonal (*i*-ì) eminent. Also in globular forms; also granular.

H.=3·5—4. G.=2·2, Haidinger; 2·195, Faröe Islands, Thomson; 2·175, Iceland. Lustre of *i*-ì strong pearly; of other faces vitreous. Color various shades of white, passing into red, gray, and brown. Streak white. Transparent—subtranslucent. Fracture subconchoidal, uneven. Brittle. Double refraction weak; optic-axial plane normal to *i-ì*; bisectrix positive, parallel to the horizontal diagonal of the base; Descl.

Comp.—O. ratio 1 : 3 : 12 : 5, corresponding to 6 $\ddot{Si}$, $\overset{\dots}{\bar{A}}l$, $\dot{Ca}$, 5 $\dot{\bar{H}}$=Silica 59·1, alumina 16·9, lime 9·2, water 14·8=100. Analyses: 1 Meyer (l. c.); 2, Thomson (Min., i. 347); 3, 4, Rammelsberg (Handw., i. 302, Pogg., cx. 525); 5, Damour (Ann. d. M., IV. x. 207); 6, Waltershausen (Vulk Gest., 252); 7, Haughton (Phil. Mag., IV. xiii. 509):

	$\ddot{Si}$	$\overset{\dots}{\bar{A}}l$	$\dot{Ca}$	$\dot{Na}$	$\dot{K}$	$\dot{\bar{H}}$
1.	58·3	17·2	6·6	—	—	17·5=99·6 Meyer.
2. Faröe	59·15	17·92	7·65	—	—	15·40=100·12 Thomson.
3. Iceland	58·2	17·6	7·2	—	—	16·0=99·0 Rammelsberg.
4. “	59·63	15·14	6·24	0·46	2·35	15·48 Rammelsberg.
5. “	59·64	16·33	7·44	1·16	0·74	14·33=99·64 Damour.
6. “	58·90	16·81	7·38	0·57	1·63	14·33, $\overset{\dots}{\bar{F}}e$ 0·12, $\dot{Mg}$ 0·29=100·04 W.
7. Nerbudda	56·59	15·35	5·88	1·45	0·89	17·48, $\dot{Mg}$ 0·82=98·46 Haughton.

The red color of the Fassa crystals is due, according to Kenngott, to minute crystalline grains of another mineral.

Pyr., etc.—According to Damour, the Faröe mineral loses part of its water in dry air, which it retakes in ordinary air; the loss of the mineral is 2·1 p. c. at 100° C., and 8·7 p. c. between 100° and 150° C.; and this is restored again after 24 hours in the air. At 190° the loss is 12·3 p. c.; and by the end of two months all is regained but 2·1 p. c. B.B. same as with stilbite.

Obs.—Heulandite occurs principally in amygdaloidal rocks. Also in gneiss, and occasionally in metalliferous veins.

The finest specimens of this species come from Berufiord, and elsewhere, Iceland; the Faröe Islands; the Vendayah Mountains, Hindostan. It also occurs in the Kilpatrick Hills, near Glasgow; on the I. of Skye; in the Fassa Valley, Tyrol; Andreasberg, Harz; near Semil and Rodisfort, Bohemia; Poremba, Poland; Marschendorf, Moravia; Neudörfel, near Zwickau, Saxony; Siberia, at Nertschinsk, etc.; in the amygdaloid of Abyssinia. Red varieties occur at Campsie in Sterlingshire, with red stilbite; also in Fassa Valley, Tyrol; and brown in ore beds at Arendal.

At Peter's Point, Nova Scotia, it occurs in amygdaloid, presenting white and flesh-red colors, and associated with laumontite, apophyllite, thomsonite, etc.; also at Cape Blomidon, in crystals an inch and a half in length; at Martial's Cove, Isle Haute, Partridge Island, Swan's Creek, Two Islands, Hall's Harbor, Long Point.

In the United States, with stilbite and chabazite on gneiss, at Hadlyme, Ct., and Chester, Mass.; with these minerals and datolite, apophyllite, etc., in amygdaloid at Bergen Hill, New Jersey; sparingly at Kipp's Bay, New York Island, on gneiss, along with stilbite; at McKinney's quarry, Rittenhouse Lane, near Philadelphia, sparingly; on north shore of Lake Superior, between Pigeon Bay and Fond du Lac; in minute crystals, seldom over half a line long, with haydenite, at Jones's Falls, near Baltimore, on a syenitic schist (Levy's *beaumontite*, which is crystallographically and optically identical with heulandite).

Named after the English mineralogist, H. Heuland.

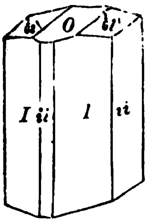
CERINITE *How* (Ed. N. Phil. J., II. x. 84, 1859) is near heulandite in composition, but is massive, with a subresinous or waxy lustre, H.=3·5, white or yellowish-white color, and it fuses B.B. without intumescence. How obtained, as a mean of two analyses, $\ddot{Si}$ 57·57, $\overset{\dots}{\bar{A}}l$ 12·66, $\overset{\dots}{\bar{F}}e$ 1·14, $\dot{Mg}$ 1·87, $\dot{Ca}$ 9·82, $\dot{K}$ 0·37, $\dot{\bar{H}}$ 15·69=99·12. Forms the thin outer crust of amygdules in trap of the Bay of Fundy, near Black Rock. A pure species could hardly be expected from a massive material in such a condition.

395. **BREWSTERITE.** *Brooke*, Ed. Phil. J., vi. 112, 1822. Diagonit *Breith.*, Char., 118, 1832.

Monoclinic. C=86° 56′, $I \wedge I$=136°, $O \wedge 1$-ì=157° 14′; $a : b : c$= 1·0387 : 1 : 2·4715. $O \wedge i$-i=93° 4′, $O \wedge i$-ì=90°, $O \wedge I$=93° 24′, $O \wedge \frac{1}{8}$-ì =176°, $\frac{1}{8}$-ì $\wedge \frac{1}{8}$-ì=172°, Brooke. From measurements by Mallet, $I \wedge I$= 136° 13′, $I \wedge i$-i=157° 17′–23′, $I \wedge i$-ì=112° 12′–17′, $O \wedge \frac{1}{8}$-ì=175° 49′–55′, $\frac{1}{8}$-ì $\wedge \frac{1}{8}$-ì=171° 40′–43′. Cleavage: *i-ì* highly perfect.

H.=4·5–5. G.=2·432 Thomson; 2·45, Damour; 2·453, Mallet. Lus-

411



tre of *i-ì* pearly; of other faces vitreous. Color white, inclining to yellow and gray. Streak white. Transparent—translucent. Fracture uneven. Double refraction weak; optic-axial plane normal to *i-ì*; bisectrix parallel to orthodiagonal; plane of axes of the red rays inclined 21°–23° to *i-i*, and 70°–72° 4′ to *O*.

Comp.—O. ratio for Ṙ, R̶, S̈i, Ḣ=1 : 3 : 12 : 5, corresponding to 6 S̈i, Ä̶l, (⅔ Ṡr + ⅓ Ḃa), 5 Ḣ=Silica 53·5, alumina 15·3, baryta 7·6, strontia 10·2, water 13·4=100. Analyses: 1, Connel (Ed. N. Phil. J., xix. 35); 2, Thomson (Min., i. 348); 3, J. W. Mallet (Phil. Mag., IV. xviii. 218):

	S̈i	Ä̶l	F̶e	Ḃa	Ṡr	Ċa	Ḣ
1. Strontian	53·67	17·49	0·29	6·75	8·32	1·35	12·58=100·45 Connel.
2. "	53·04	16·54	—	6·05	9·01	0·80	14·73=100·17 Thomson.
3. "	(⅔) 54·32	15·25	0·08	6·80	8 99	1·19	13·22=99·85 Mallet.

Pyr., etc.—According to Damour, brewsterite loses water in unheated dried air, experiencing a loss of weight of 1·65 p. c. in the course of a month. At 100° C., after 2 hours, the loss is 0·2 p. c., but at 130° C. 7·7 p. c., when the mineral while still hot is electric, the crystals mutually attracting; they have become opaque and pearly; by 48 hours' exposure to ordinary air, the loss is reduced to 2·7 p. c. At 190° C., the loss is 8·2 p. c.; this is reduced to zero after 48 hours' exposure; and at 270°, the loss is 10·1 p. c., which is reduced to 1·2 p. c. after 8 days' exposure. At a dull red heat the loss is 12·8 p. c., and at a bright red, 13·3 p. c. B.B. swells up and fuses at 3 to a white enamel. Decomposed by acids without gelatinizing.

Obs.—First observed at Strontian in Argyleshire, with calcite. Occurs also at the Giant's Causeway, coating the cavities of amygdaloid; in the lead mines of St. Turpet; near Freiburg in the Brisgau; at the Col du Bonhomme, S. W. of Mont Blanc, on a quartz rock; near Barèges, in the Pyrenees, in a calcareous schist; and it has been reported from the department of the Isère in France.

Named after Sir David Brewster.

396. MORDENITE. *How*, J. Ch. Soc., II. ii. 100.

In small hemispherical, reniform, or cylindrical concretions. Structure fibrous.

H.=5. G.=2·08. Lustre highly silky. Color white, yellowish, or pinkish. Translucent on the edges. Rather brittle.

Comp.—O. ratio, Ṙ, R̶, S̈i, Ḣ=1 : 3 : 18 : 6; corresponding to 9 S̈i, Ä̶l, (⅔ Ċa + ⅓ Ṅa), 6 Ḣ=S̈i 66·92, Ä̶l 12·66, Ċa 4·59, Ṅa 2·54, Ḣ 13·29=100. Analysis: How (l. c.):

S̈i	Ä̶l	Ċa	Ṅa	Ḣ
(⅝) 68·40	12·77	3·46	2·35	13·02=100.

The soda includes 0·09 to 0·23 of potash. The silica varied from 67·33 to 69·27.

Pyr., etc.—Yields water. B.B. fuses without intumescence. Not perfectly decomposed by acids

Obs.—Occurs near Morden, King's Co., Nova Scotia, in trap, with apophyllite, barite, and a prehnite-like mineral; also at Peter's Point, eight miles west, with gyrolite.

APPENDIX TO ZEOLITE SECTION.

397. SLOANITE *Meneghini & Bechi*, Am. J. Sci., II. xiv. 64.

Orthorhombic. $I \wedge I = 105°$. Cleavage: *I* very distinct. In radiated masses, with often a fracture transverse to the radiation.

H.=4·5. G.=2·441. Lustre pearly. White. Opaque.

COMP.—O. ratio for $\dot{R}$, $\bar{R}$, $\ddot{Si}$, $\dot{H}$, from analysis=1 : 5 : 7 : 1=Silica 42·7, alumina 34·9, lime 11·4, water 11·0=100. Analysis: Bechi (Am J. Sci., II. xiv. 64):

$\ddot{Si}$	$\bar{Al}$	$\dot{Ca}$	$\dot{Mg}$	$\dot{Na}$	$\dot{K}$	$\dot{H}$
42·19	35·00	8·12	2·67	0·25	0·30	12·50=100·76.

PYR., ETC.—Yields water. B.B. fuses without intumescence to a white enamel. Dissolves in the acids even in the cold, and gelatinizes.

From the gabbro rosso of Tuscany.

398. SASPACHITE *Descloizeaux* (Min., i. 420). A *zeolitic* mineral from Saspach in Kaiserstuhl, afforded J. Schill (Jahrb. Min. 1846, 452) $\ddot{Si}$ 51·50, $\ddot{\bar{Al}}$ 16·51, $\dot{Ca}$ 6·20, $\dot{K}$ 6·82, $\dot{Mg}$ 1·93, $\dot{H}$ 17·00 =99·96. Occurs in tufts of fibres and concretions; G.=1·465; H.=4—5; white or colorless; lustre silky to vitreous. Easily soluble in muriatic acid. Occurs in doleryte in cavities, and is often overlaid by faujasite and apophyllite.

III. MARGAROPHYLLITE SECTION.

The Margarophyllites, whose general characteristics are mentioned on page 393, have the crystallization of the micas, and the name alludes to the pearly folia. Massive varieties are, however, much the most common with a large part of the species, and they often have the compactness of clay or wax. Talc, pyrophyllite, serpentine, are examples of species presenting both extremes of structure; while pinite occurs, as thus far known, only in the compact condition.

The proportion of silica varies widely, the oxygen ratio between it and the bases having the limits 3 : 1 and $\frac{1}{3}$: 1, corresponding to tersilicates at one extreme and the lower of subsilicates at the other. But, reckoning the water, or part of it, among the bases, the species may all be arranged under the heads of Bisilicates, Unisilicates, and Subsilicates; and, although there must be much that is hypothetical in such an arrangement, the method is adopted beyond.

This method of arrangement is in fact no more arbitrary than the common one of making no account of the water. Talc has the oxygen ratio for the silica, bases, $2\frac{1}{2}$: 1; but, at the same time, it contains water, and holds it even when highly heated, thereby indicating that part, at least, of the water is basic; and with basic water the ratio may be 2 : 1, or that of a true Bisilicate. The arrangement of talc at the head of the Bisilicates appears, therefore, not to be altogether arbitrary. Pyrophyllite is a true alumina talc, it having the same oxygen ratio as talc, and like structure, lustre, greasy feel, and even range of color; and it has its place, therefore, next to talc, among the Bisilicates. Serpentine has not silica enough for a Bisilicate; but, with half of its water basic, it is a Unisilicate. Kaolinite is identical with serpentine in oxygen ratio, as pyrophyllite is with talc, and is similarly a Unisilicate. Pinite has the same ratio, excepting half less of water, and is strictly an alumina-alkali serpentine; and palagonite is another of like ratio and characters. These species, moreover, are all related to the margarodites or hydrous micas.

In the following table the species are distributed under the three heads above mentioned. The catalogue of the species and their formulas in the first two of these subdivisions is followed by a table containing the oxygen ratio for the protoxyds, sesquioxyds, silica, and water, and also, in another column, those for the bases, silica, and water; and under $\dot{H}$ in the latter, a fraction is added in parentheses, which indicates what proportion of the water (when any) is made basic in the formulas.

ARRANGEMENT OF THE SPECIES.

I. BISILICATES.

I. TALC GROUP. Foliated when crystallized.

899.	**Talc** A	$(\frac{1}{5}\dot{\mathrm{H}}+\frac{4}{5}\dot{\mathrm{Mg}})\ddot{\mathrm{Si}}$	$\mathrm{Si}\,\Theta\|\Theta_2\|(\frac{1}{5}\mathrm{H}_2+\frac{4}{5}\bar{\mathrm{Mg}})$
	B	$(\frac{1}{5}\dot{\mathrm{H}}+\frac{4}{5}\dot{\mathrm{Mg}})\ddot{\mathrm{Si}}+\frac{1}{5}\dot{\mathrm{H}}$	$\mathrm{Si}\,\Theta\|\Theta_2\|(\frac{1}{5}\mathrm{H}_2+\frac{4}{5}\bar{\mathrm{Mg}})+\frac{1}{15}\,\mathrm{aq}$
400.	**Pyrophyllite**	$(\frac{1}{5}\dot{\mathrm{H}}^3+\frac{4}{5}\dddot{\mathrm{Al}})\ddot{\mathrm{Si}}^3+\frac{1}{15}\dot{\mathrm{H}}$	$\mathrm{Si}\,\Theta\|\Theta_2\|(\frac{1}{5}\mathrm{H}_2+\frac{4}{5}\beta\bar{\mathrm{Al}})+\frac{1}{15}\,\mathrm{aq}$
401.	**Pihlite**	$(\dot{\mathrm{R}}^3,\dot{\mathrm{H}}^3,\dddot{\mathrm{Al}})\ddot{\mathrm{Si}}^3+\frac{3}{10}\dot{\mathrm{H}}$	$\mathrm{Si}\,\Theta\|\Theta_2\|(\frac{1}{5}(\mathrm{H}_2,\mathrm{K}_2,\bar{\mathrm{R}})+\frac{4}{5}\beta\bar{\mathrm{Al}})+\frac{1}{10}\dot{\mathrm{H}}$

II. SEPIOLITE GROUP. Contain magnesium or aluminum. Known only massive.

402.	**Sepiolite**	$(\frac{1}{3}\dot{\mathrm{H}}+\frac{2}{3}\dot{\mathrm{Mg}})\ddot{\mathrm{Si}}+\frac{1}{3}\dot{\mathrm{H}}$	$\mathrm{Si}\,\Theta\|\Theta_2\|(\frac{1}{3}\mathrm{H}_2+\frac{2}{3}\bar{\mathrm{Mg}})+\frac{1}{3}\,\mathrm{aq}$
403.	**Aphrodite**	$\dot{\mathrm{Mg}}\ddot{\mathrm{Si}}+\frac{3}{4}\dot{\mathrm{H}}$	$\mathrm{Si}\,\Theta\|\Theta_2\|\bar{\mathrm{Mg}}+\frac{3}{4}\,\mathrm{aq}$
404.	**Cimolite**	$(\frac{1}{3}\dot{\mathrm{H}}^3+\frac{2}{3}\dddot{\mathrm{Al}})\ddot{\mathrm{Si}}^3+\dot{\mathrm{H}}$	$\mathrm{Si}\,\Theta\|\Theta_2\|(\frac{1}{3}\mathrm{H}_2+\frac{2}{3}\beta\bar{\mathrm{Al}})+\frac{1}{3}\,\mathrm{aq}$
405.	**Smectite**	$(\frac{1}{2}\dot{\mathrm{H}}^3+\frac{1}{2}\dddot{\mathrm{Al}})\ddot{\mathrm{Si}}^3+4\frac{1}{2}\dot{\mathrm{H}}$	$\mathrm{Si}\,\Theta\|\Theta_2\|(\frac{1}{2}\mathrm{H}_2+\frac{1}{2}\beta\bar{\mathrm{Al}})+1\frac{1}{2}\,\mathrm{aq}$
406.	**Montmorillonite**	$(\frac{1}{5}\dot{\mathrm{H}}^3+\frac{4}{5}\dddot{\mathrm{Al}})\ddot{\mathrm{Si}}^3+5\dot{\mathrm{H}}$	$\mathrm{Si}\,\Theta\|\Theta_2\|(\frac{1}{5}\mathrm{H}_2+\frac{4}{5}\beta\bar{\mathrm{Al}})+1\frac{2}{3}\,\mathrm{aq}$

III. CHLOROPAL GROUP. Contain iron in the sesquioxyd state.

407.	**Stilpnomelane**	$(\dot{\mathrm{R}}^3,(\dddot{\mathrm{Fe}},\dddot{\mathrm{Al}}))\ddot{\mathrm{Si}}^3+2\dot{\mathrm{H}}$	$\mathrm{Si}\,\Theta\|\Theta_2\|(\bar{\mathrm{R}},\beta(\bar{\mathrm{Fe}},\bar{\mathrm{Al}}))+\frac{2}{3}\,\mathrm{aq}$
408.	**Chloropal**	$(\dot{\mathrm{Fe}}^3,\dddot{\mathrm{Fe}})\ddot{\mathrm{Si}}+4\frac{1}{2}\dot{\mathrm{H}}$	$\mathrm{Si}\,\Theta\|\Theta_2\|(\bar{\mathrm{Fe}},\beta\bar{\mathrm{Fe}})+1\frac{1}{2}\,\mathrm{aq}$
409.	**Glauconite**		
410.	**Celadonite**		

	$\dot{\mathrm{R}}$	$\dddot{\mathrm{R}}$	$\ddot{\mathrm{Si}}$	$\dot{\mathrm{H}}$	$\dot{\mathrm{R}}\dddot{\mathrm{R}}$	$\ddot{\mathrm{Si}}$	$\dot{\mathrm{H}}$		$\dot{\mathrm{R}}$	$\dddot{\mathrm{R}}$	$\ddot{\mathrm{Si}}$	$\dot{\mathrm{H}}$	$\dot{\mathrm{R}}\dddot{\mathrm{R}}$	$\ddot{\mathrm{Si}}$	$\dot{\mathrm{H}}$
Talc A	1		2½	¼	1	2½	¼	Cimolite		1	3	1	1	3	1 (½)
B	1		2½	⅓	1	2½	⅓ (¾)	Smectite		1	4	4?	1	4	4 (½)
Pyrophyllite		1	2½	⅓	1	2½	⅓ (¾)	Montmorillonite		1	2½	2½	1	2½	2½
Pihlite	1	8	20	2	1	2²⁄₉	²⁄₉ (½)	Stilpnomelane					1	2	⅔
Sepiolite	1		3	1	1	3	1 (½)	Chloropal		1	2	½	1	2	½
Aphrodite	1		2	¾	1	2	¾	Glauconite	1	3	9	3?	1	2¼	¾?

II. UNISILICATES.

IV. SERPENTINE GROUP. Contain magnesium.

411.	**Serpentine**	$(\frac{1}{4}\dot{\mathrm{H}}+\frac{3}{4}\dot{\mathrm{Mg}})^2\ddot{\mathrm{Si}}+\frac{1}{2}\dot{\mathrm{H}}$	$\mathrm{Si}\|\Theta_4\|(\frac{1}{4}\mathrm{H}_2+\frac{3}{4}\bar{\mathrm{Mg}})_2+\frac{1}{2}\,\mathrm{aq}$
412.	**Bastite**		
413.	**Deweylite**	$(\frac{1}{4}\dot{\mathrm{H}}+\frac{3}{4}\dot{\mathrm{Mg}})^2\ddot{\mathrm{Si}}+\frac{3}{4}\dot{\mathrm{H}}$	$\mathrm{Si}\|\Theta_4\|(\mathrm{H}_2+\frac{3}{4}\bar{\mathrm{Mg}})_2+\frac{3}{4}\,\mathrm{aq}$
414.	**Cerolite**	$(\frac{1}{2}\dot{\mathrm{H}}+\frac{1}{2}\dot{\mathrm{Mg}})\ddot{\mathrm{Si}}+\frac{1}{2}\dot{\mathrm{H}}$	$\mathrm{Si}\|\Theta_4\|(\frac{1}{2}\mathrm{H}_2+\frac{1}{2}\bar{\mathrm{Mg}})_2+\frac{1}{2}\,\mathrm{aq}$
415.	**Hydrophite**	$(\frac{1}{3}\dot{\mathrm{H}}+\frac{3}{4}(\dot{\mathrm{Mg}},\dot{\mathrm{Fe}}))^2\ddot{\mathrm{Si}}+\frac{3}{4}\dot{\mathrm{H}}$	$\mathrm{Si}\|\Theta_4\|(\frac{1}{4}\mathrm{H}_2+\frac{3}{4}(\bar{\mathrm{Mg}},\bar{\mathrm{Fe}}))^2+\frac{3}{4}\,\mathrm{aq}$
416.	**Genthite**	$(\frac{1}{4}\dot{\mathrm{H}}+\frac{3}{4}(\dot{\mathrm{Ni}},\dot{\mathrm{Mg}}))^2\ddot{\mathrm{Si}}+\frac{3}{4}\dot{\mathrm{H}}$	$\mathrm{Si}\|\Theta_4\|(\frac{1}{4}\mathrm{H}_2+\frac{3}{4}(\bar{\mathrm{Ni}},\bar{\mathrm{Mg}}))_2+\frac{3}{4}\,\mathrm{aq}$
417.	**Saponite**		

V. KAOLINITE GROUP. Contain aluminum.

418. Pholerite	$\ddot{\mathrm{Al}}^3\ddot{\mathrm{Si}}^3+4\dot{\mathrm{H}}$	$\mathrm{Si}\Vert\Theta_4\Vert\beta\,\mathrm{Al}_2+\tfrac{2}{3}\,\mathrm{aq}$
419. Kaolinite	$(\tfrac{1}{4}\dot{\mathrm{H}}^3+\tfrac{3}{4}\ddot{\mathrm{Al}})^2\ddot{\mathrm{Si}}^3+\tfrac{3}{4}\dot{\mathrm{H}}$	$\mathrm{Si}\Vert\Theta_4\Vert(\tfrac{1}{2}\,\mathrm{H}_2+\tfrac{3}{4}\,\beta\mathrm{Al})_2+\tfrac{1}{2}\,\mathrm{aq}$
420. Halloysite	$(\tfrac{1}{4}\dot{\mathrm{H}}^3+\tfrac{3}{4}\ddot{\mathrm{Al}})^2\ddot{\mathrm{Si}}^3+3\dot{\mathrm{H}}$	$\mathrm{Si}\Vert\Theta_4\Vert(\tfrac{1}{2}\,\mathrm{H}_2+\tfrac{3}{4}\,\beta\mathrm{Al})_2+\mathrm{aq}$
421. Samoite		

VI. PINITE GROUP. Contain aluminum, and generally alkali metals.

422. Pinite	$(\tfrac{1}{4}\dot{\mathrm{H}}^3+\tfrac{3}{4}(\dot{\mathrm{K}}^3,\ddot{\mathrm{Al}}))^2\ddot{\mathrm{Si}}^3$	$\mathrm{Si}\Vert\Theta_4\Vert(\tfrac{1}{4}\,\mathrm{H}_2+\tfrac{3}{4}(\mathrm{K}_2,\beta\mathrm{Al}))_2$
423. Cataspilite	$(\tfrac{3}{8}\dot{\mathrm{R}}^3+\tfrac{5}{8}\ddot{\mathrm{Al}})^2\ddot{\mathrm{Si}}^3+\tfrac{3}{8}\dot{\mathrm{H}}$	$\mathrm{Si}\Vert\Theta_4\Vert(\tfrac{3}{8}(\mathrm{K}_2,\mathrm{Ca},\mathrm{Mg})+\tfrac{5}{8}\,\beta\mathrm{Al})_2+\tfrac{1}{8}\,\mathrm{aq}$
424. Biharite	$(\tfrac{2}{3}\dot{\mathrm{R}}^3+\tfrac{1}{3}\ddot{\mathrm{Al}})^2\ddot{\mathrm{Si}}^3+\tfrac{2}{3}\dot{\mathrm{H}}$	$\mathrm{Si}\Vert\Theta_4\Vert(\tfrac{2}{3}(\mathrm{Mg},\mathrm{Ca})+\tfrac{1}{3}\,\beta\mathrm{Al})_2+\tfrac{1}{3}\,\mathrm{aq}$
425. Palagonite	$(\tfrac{1}{4}\dot{\mathrm{H}}^3+\tfrac{3}{4}(\dot{\mathrm{R}}^3,\ddot{\mathrm{Al}}))^2\ddot{\mathrm{Si}}^3+n\dot{\mathrm{H}}$	$\mathrm{Si}\Vert\Theta_4\Vert(\tfrac{1}{4}\,\mathrm{H}_2+\tfrac{3}{4}(\mathrm{R},\beta(\mathrm{Al},\mathrm{Fe}))_2+\mathrm{aq}$

VII. MARGARODITE GROUP. Structure micaceous. Contain aluminum, and generally alkali metals.

426. Fahlunite, A	$(\tfrac{2}{5}(\tfrac{1}{2}\dot{\mathrm{H}}+\tfrac{1}{2}\dot{\mathrm{R}})^3+\tfrac{3}{5}(\ddot{\mathrm{Al}},\ddot{\mathrm{Fe}}))^2\ddot{\mathrm{Si}}^3$	$\mathrm{Si}\Vert\Theta_4\Vert(\tfrac{2}{5}(\mathrm{H}_2,\mathrm{R})+\tfrac{3}{5}\,\beta(\mathrm{Al},\mathrm{Fe}))_2$
B	$(\tfrac{2}{5}(\tfrac{1}{2}\dot{\mathrm{H}}+\tfrac{1}{2}\dot{\mathrm{R}})^3+\tfrac{3}{5}(\ddot{\mathrm{Al}},\ddot{\mathrm{Fe}}))^2\ddot{\mathrm{Si}}^3+\tfrac{3}{5}\dot{\mathrm{H}}$	$\mathrm{Si}\Vert\Theta_4\Vert(\tfrac{2}{5}(\mathrm{H}_2,\mathrm{R})+\tfrac{3}{5}\,\beta(\mathrm{Al},\mathrm{Fe}))_2+\tfrac{2}{5}\,\mathrm{ao}$
427. Groppite	$(\tfrac{1}{2}(\tfrac{1}{3}\dot{\mathrm{H}}+\tfrac{2}{3}\dot{\mathrm{R}})^3+\tfrac{1}{2}\ddot{\mathrm{Al}})^2\ddot{\mathrm{Si}}^3+\dot{\mathrm{H}}$	$\mathrm{Si}\Vert\Theta_4\Vert(\tfrac{1}{2}(\mathrm{H}_2,\mathrm{R})+\tfrac{1}{2}\,\beta\mathrm{Al})_2+\tfrac{1}{3}\,\mathrm{aq}$
428. Voigtite	$(\tfrac{1}{2}\dot{\mathrm{R}}^3+\tfrac{1}{2}(\ddot{\mathrm{Al}},\ddot{\mathrm{Fe}}))^2\ddot{\mathrm{Si}}^3+3\dot{\mathrm{H}}$	$\mathrm{Si}\Vert\Theta_4\Vert(\tfrac{1}{2}\,\mathrm{R}+\tfrac{1}{2}\,\beta(\mathrm{Al},\mathrm{Fe}))_2+\mathrm{aq}$
429. Margarodite	$(\tfrac{1}{3}(\tfrac{2}{3}\dot{\mathrm{H}}+\tfrac{1}{3}\dot{\mathrm{K}})^3+\tfrac{2}{3}(\ddot{\mathrm{Al}},\ddot{\mathrm{Fe}}))^2\ddot{\mathrm{Si}}^3$	$\mathrm{Si}\Vert\Theta_4\Vert(\tfrac{1}{3}(\mathrm{H}_2,\mathrm{K}_2)+\tfrac{2}{3}\,\beta(\mathrm{Al},\mathrm{Fe}))_2$
430. Damourite	$(\tfrac{1}{4}(\tfrac{2}{3}\dot{\mathrm{H}}+\tfrac{1}{3}\dot{\mathrm{K}})^5+\tfrac{3}{4}(\ddot{\mathrm{Al}},\ddot{\mathrm{Fe}})^2\ddot{\mathrm{Si}}^3$	$\mathrm{Si}\Vert\Theta_4\Vert(\tfrac{1}{4}(\mathrm{H}_2,\mathrm{K}_2)+\tfrac{3}{4}\,\beta(\mathrm{Al},\mathrm{Fe}))_2$
431. Paragonite	$(\tfrac{1}{4}(\tfrac{2}{3}\dot{\mathrm{H}}+\tfrac{1}{3}\dot{\mathrm{Na}})^3+\tfrac{3}{4}\ddot{\mathrm{Al}})^2\ddot{\mathrm{Si}}^3$	$\mathrm{Si}\Vert\Theta_4\Vert(\tfrac{1}{4}(\mathrm{H}_2,\mathrm{Na}_2)+\tfrac{3}{4}\,\beta\mathrm{Al})_2$
432. Euphyllite	$(\tfrac{1}{9}\dot{\mathrm{R}}^3+\tfrac{8}{9}\ddot{\mathrm{Al}})^2\ddot{\mathrm{Si}}^3+\tfrac{4}{3}\dot{\mathrm{H}}$	$\mathrm{Si}\Vert\Theta_4\Vert(\tfrac{1}{9}(\mathrm{K}_2,\mathrm{Na}_2)+\tfrac{8}{9}\,\beta\mathrm{Al})_2+\tfrac{4}{9}\,\mathrm{aq}$
433. Œllacherite	$(\tfrac{1}{3}(\tfrac{1}{2}\dot{\mathrm{H}}+\tfrac{1}{2}\dot{\mathrm{R}})^3+\tfrac{2}{3}\ddot{\mathrm{Al}})^2\ddot{\mathrm{Si}}^3$	$\mathrm{Si}\Vert\Theta_4\Vert(\tfrac{1}{3}(\mathrm{H}_2,\mathrm{K}_2,\mathrm{R})+\tfrac{2}{3}\,\beta\mathrm{Al})_2$
434. Cookeite.		

VIII. HISINGERITE GROUP. Consist largely of iron, or iron and manganese.

435. Hisingerite	$(\tfrac{1}{3}\dot{\mathrm{H}}^3+\tfrac{2}{3}\ddot{\mathrm{Fe}})^2\ddot{\mathrm{Si}}^3+4\dot{\mathrm{H}}$	$\mathrm{Si}\Vert\Theta_4\Vert(\tfrac{1}{3}(\mathrm{H}_2,\mathrm{R})+\tfrac{2}{3}\,\beta\mathrm{Fe})_2+\tfrac{4}{3}\,\mathrm{aq}$
436. Ekmannite	$(\tfrac{1}{3}\dot{\mathrm{H}}^3+\tfrac{2}{3}(\dot{\mathrm{Fe}},\dot{\mathrm{Mn}})^3)^2\ddot{\mathrm{Si}}^3+\dot{\mathrm{H}}$	$\mathrm{Si}\Vert\Theta_4\Vert(\tfrac{1}{3}\,\mathrm{H}_2+\tfrac{2}{3}(\mathrm{Fe},\mathrm{Mn}))_2+\tfrac{1}{3}\,\mathrm{aq}$
437. Neotocite	$(\tfrac{1}{3}\dot{\mathrm{H}}^3+\tfrac{2}{3}(\dot{\mathrm{Mn}}^3,\dot{\mathrm{Mg}}^3,\ddot{\mathrm{Fe}}))^2\ddot{\mathrm{Si}}^3+3\dot{\mathrm{H}}$	$\mathrm{Si}\Vert\Theta_4\Vert(\tfrac{1}{3}\,\mathrm{H}_2+\tfrac{2}{3}(\mathrm{Mn},\mathrm{Mg},\beta\mathrm{Fe})_2+\tfrac{1}{3}\,\mathrm{aq}$
438. Stubelite		
439. Gillingite	$(\dot{\mathrm{R}}^3,\ddot{\mathrm{Fe}})^2\ddot{\mathrm{Si}}^3+6\dot{\mathrm{H}}$	$\mathrm{Si}\Vert\Theta_4\Vert(\mathrm{R},\beta\mathrm{Fe})_2+2\,\mathrm{aq}$
440. Jollyte	$(\tfrac{1}{3}\dot{\mathrm{R}}^3+\tfrac{2}{3}\ddot{\mathrm{Al}})^2\ddot{\mathrm{Si}}^3+4\dot{\mathrm{H}}$	$\mathrm{Si}\Vert\Theta_4\Vert(\tfrac{1}{3}(\mathrm{Fe},\mathrm{Mg})+\tfrac{2}{3}\,\beta\mathrm{Al})_2+\tfrac{4}{3}\,\mathrm{aq}$

Appendix.—441. Epichlorite. 442. Polyhydrite. 443. Lillite.

	$\dot{\mathrm{R}}$	$\ddot{\mathrm{R}}$	$\ddot{\mathrm{Si}}$	$\dot{\mathrm{H}}$	$\dot{\mathrm{R}}\ddot{\mathrm{R}}$	$\ddot{\mathrm{Si}}$	$\dot{\mathrm{H}}$		$\dot{\mathrm{R}}$	$\ddot{\mathrm{R}}$	$\ddot{\mathrm{Si}}$	$\dot{\mathrm{H}}$	$\dot{\mathrm{R}}\ddot{\mathrm{R}}$	$\ddot{\mathrm{Si}}$	$\dot{\mathrm{H}}$
Serpentine	3		4	2	3	4	2 (½)	Pinite	1	8	12	3	3	4	1 (†)
Deweylite	2		3	3	2	3	3 (⅓)	Cataspilite	3	5	8	1	4	4	½
Cerolite	2		4	3	2	4	3 (⅔)	Biharite	2	1	3	⅔	3	3	⅔
Hydrophite	2		3	3	2	3	3 (⅓)	Palagonite	1	2	4	*n*	3	4	*n*
Genthite	2		3	3	2	3	3 (⅓)	Fahlunite, A	1	3	5	1	4	5	1 (†)
Pholerite		3	3	2	3	3	2	B	1	3	5	2	4	5	2 (½)
Kaolinite		3	4	2	3	4	2 (½)	Voigtite	1	1	2	1	2	2	1
Halloysite		3	4	3	3 ·	4	3 (⅓)	Groppite	2	3	6	2	5	6	2

	$\dot{R}$	$\bar{R}$	$\ddot{Si}$	$\dot{H}$	$\dot{R}\bar{R}$	$\ddot{Si}$	$\dot{H}$		$\dot{R}$	$\bar{R}$	$\ddot{Si}$	$\dot{H}$	$\dot{R}\bar{R}$	$\ddot{Si}$	$\dot{H}$
Margarodite	1	6	9	2	7	9	2 ($\frac{1}{7}$)	Hisingerite					2	3	3 ($\frac{1}{3}$)
Damourite	1	9	12	2	10	12	2 ($\frac{1}{5}$)	Ekmannite	4		6	3	2	3	$\frac{3}{2}$ ($\frac{1}{3}$)
Paragonite	1	9	12	2	10	12	2 ($\frac{1}{5}$)	Neotocite					2	3	2½ ($\frac{2}{5}$)
Euphyllite	1	8	9	2	9	9	2	Gillingite					1	1	1
Œllacherite	1	4	6	1	5	6	1 ($\frac{1}{5}$)	Jollyte	1	2	3	2	1	1	$\frac{2}{3}$
Cookeite															

III. SUBSILICATES.

The species here arranged as Subsilicates seem to blend indefinitely with the Unisilicates. The common chlorites have atomically three-fourths, two-thirds, or less, of silica than bases, and are manifestly subsilicate in ratio. But they graduate into the pyrosclerites, which are true Unisilicates, if the water is not partly basic, and thus pass into the margarodites above. Yet the pyrosclerites have so much resemblance to the chlorites that they seem to belong to the same natural group.

Under the uncertainty with regard to the amount of basic water, the species are enumerated in the following table with their oxygen ratios, and with the constituents unarranged into formulas.

It is, however, interesting to observe that the species of pyrosclerites and chlorites may all have the formula of a two-thirds silicate if all or part of the water be made basic; and if the ratio 3 : 2 be the right one for this first section of the Subsilicates, the Subsilicates will then have the ratio 3 : 2 for the first or Chlorite group, 2 : 1 for the second or Chloritoid, and 3 : 1 for the Seybertite group. In a second table below, the formulas are written on this scheme.

I. CHLORITE GROUP. O. ratio for bases and silica, water excluded, 1 : 1 to 3 : 2.

	$\dot{R}$	$\bar{R}$	$\ddot{Si}$	$\dot{H}$	$\dot{R}\bar{R}$	$\ddot{Si}$	$\dot{H}$	
445. PYROSCLERITE	4	2	6	3	1	1	½ ($\frac{1}{6}$)	$2(\frac{2}{3}\dot{M}g^3+\frac{1}{3}\bar{A}l), 3\ddot{Si}, 3\dot{H}$
446. CHONICRITE	3	2	5	2½	1	1	½ ($\frac{1}{6}$)	$2(\frac{1}{3}(\dot{M}g, \dot{C}a)^3+\frac{2}{3}\bar{A}l), 3\ddot{Si}, 3\dot{H}$
447. JEFFERISITE	2	3	5	2½	1	1	½ ($\frac{1}{6}$)	$2(\frac{1}{3}\dot{M}g^3+\frac{2}{3}(\bar{A}l, \bar{F}e)), 3\ddot{Si}, 3\dot{H}$
448. PENNINITE	4	2	4½	3	4	3	2 ($\frac{1}{4}$	$8(\frac{2}{3}\dot{M}g^3+\frac{1}{3}\bar{A}l), 9\ddot{Si}, 12\dot{H}$
449. DELESSITE								
450. RIPIDOLITE	5	3	6	4	4	3	2 ($\frac{1}{4}$)	$8(\frac{5}{8}\dot{M}g^3+\frac{3}{8}(\bar{A}l, \bar{F}e)), 9\ddot{Si}, 12\dot{H}$
451. LEUCHTENBERGITE	4½	3	5	3½	3	2	1⅓	$(\frac{3}{5}\dot{M}g^3+\frac{2}{5}\bar{A}l), \ddot{Si}, 1\frac{1}{3}\dot{H}$
452. PROCHLORITE	4	3	4⅔	3⅕	3	2	1⅓	$3(\frac{4}{7}(\frac{1}{2}\dot{M}g^3+\frac{1}{2}\dot{F}e)+\frac{3}{7}\bar{A}l), \ddot{Si}, 1\frac{1}{3}\dot{H}$
453. GRENGESITE								
454. APHROSIDERITE								
455. METACHLORITE								
456. CRONSTEDTITE	3	3	4	3	3	2	1⅓	$3(\frac{1}{2}(\dot{F}e, \dot{M}n)^3+\frac{1}{2}\bar{F}e), \ddot{Si}, 1\frac{1}{3}\dot{H}$

II. CHLORITOID GROUP. O. ratio for bases and silica, 2 : 1, or nearly.

457. CORUNDOPHILITE	1	1	1	$\frac{5}{6}$	2	1	$\frac{5}{6}$	$4(\frac{1}{2}(\frac{3}{4}\dot{M}g+\frac{1}{4}\dot{F}e)^3+\frac{1}{2}\bar{A}l), 3\ddot{Si}$
458. CHLORITOID	1	3	2	1	2	1	½	$4(\frac{1}{4}\dot{F}e^3+\frac{3}{4}\bar{A}l), 3\ddot{Si}, 3\dot{H}$
459. MARGARITE	1	6	4	1	7	4	1 ($\frac{1}{7}$)	$7(\frac{1}{7}\dot{C}a^3+\frac{6}{7}\bar{A}l), 6\ddot{Si}, 3\dot{H}$
460. THURINGITE	2	3	3	2	5	3	2 ($\frac{1}{2}$)	$10(\frac{2}{5}\dot{F}e^3+\frac{3}{5}(\bar{A}l, \bar{F}e)), 9\ddot{Si}, 12\dot{H}$

III. SEYBERTITE GROUP. O. ratio for bases and silica, 3 : 1 (to 4 : 1 ?).

1. SEYBERTITE	6	9	5	½	3	1	$\frac{1}{10}$	$2(\frac{2}{5}(\dot{M}g, \dot{C}a)^3+\frac{3}{5}\bar{A}l), \ddot{Si}, \frac{1}{2}\dot{H}$

Formulas of the Subsilicates based on the ratios 3 : 2, 2 : 1, 3 : 1.

CHLORITE GROUP. O. ratio for bases and silica 3 : 2.

PYROSCLERITE	$(\frac{7}{9}(\dot{\text{H}}, \dot{\text{Mg}})^3 + \frac{2}{9}\dddot{\text{Al}})\ddot{\text{Si}}$	$(\frac{7}{9}(\text{H}_2, \bar{\text{Mg}}) + \frac{2}{9}\beta\,\bar{\text{Al}})_3\,\Theta\,\|\Theta_4\|\,\text{Si}$
CHONICRITE	$(\frac{11}{15}(\dot{\text{H}}, \dot{\text{Mg}}, \dot{\text{Ca}})^3 + \frac{4}{15}\dddot{\text{Al}})\ddot{\text{Si}}$	$(\frac{11}{15}(\text{H}_2, \bar{\text{Mg}}, \Theta\text{a}) + \frac{4}{15}\beta\,\bar{\text{Al}})_3\,\Theta\,\|\Theta_4\|\,\text{Si}$
JEFFERISITE	$(\frac{9}{15}(\dot{\text{H}}, \dot{\text{Mg}})^3 + \frac{6}{15}\dddot{\text{Al}})\ddot{\text{Si}} + \frac{1}{5}\dot{\text{H}}$	$(\frac{9}{15}(\text{H}_2, \bar{\text{Mg}}) + \frac{6}{15}\beta\,\bar{\text{Al}})_3\,\Theta\,\|\Theta_4\|\,\text{Si} + \frac{1}{5}\,\text{aq}$
PENNINITE	$(\frac{19}{27}(\dot{\text{H}}, \dot{\text{Mg}})^3 + \frac{8}{27}\dddot{\text{Al}})\dddot{\text{Si}} + \dot{\text{H}}$	$(\frac{19}{27}(\text{H}_2, \bar{\text{Mg}}) + \frac{8}{27}\beta\,\bar{\text{Al}})_3\,\Theta\,\|\Theta_4\|\,\text{Si} + \text{aq}$
RIPIDOLITE	$(\frac{2}{3}(\dot{\text{H}}, \dot{\text{Mg}})^3 + \frac{1}{3}(\dddot{\text{Al}}, \bar{\text{Fe}}))\ddot{\text{Si}} + \dot{\text{H}}$	$(\frac{2}{3}(\text{H}_2, \bar{\text{Mg}}) + \frac{1}{3}\beta(\bar{\text{Al}}, \bar{\text{Fe}}))_3\,\Theta\,\|\Theta_4\|\,\text{Si} + \text{aq}$
LEUCHTENBERGITE	$(\frac{3}{5}\dot{\text{Mg}}^3 + \frac{2}{5}\dddot{\text{Al}})\dddot{\text{Si}} + 1\frac{1}{3}\dot{\text{H}}$	$(\frac{3}{5}\bar{\text{Mg}} + \frac{2}{5}\beta\,\dddot{\text{Al}})_3\,\Theta\,\|\Theta_4\|\,\text{Si} + \frac{4}{3}\,\text{aq}$
PROCHLORITE	$(\frac{4}{7}(\dot{\text{Mg}}, \dot{\text{Fe}})^3 + \frac{3}{7}\dddot{\text{Al}})\dddot{\text{Si}} + 1\frac{1}{3}\dot{\text{H}}$	$(\frac{4}{7}(\bar{\text{Mg}}, \bar{\text{Fe}}) + \frac{3}{7}\beta\,\bar{\text{Al}})_3\,\Theta\,\|\Theta_4\|\,\dddot{\text{Si}} + \frac{4}{3}\,\text{aq}$
CRONSTEDTITE	$(\frac{1}{2}(\dot{\text{Fe}}, \dot{\text{Mn}})^3 + \frac{1}{2}\bar{\text{Fe}})\ddot{\text{Si}} + 1\frac{1}{2}\dot{\text{H}}$	$(\frac{1}{2}(\bar{\text{Fe}}, \bar{\text{Mn}}) + \frac{1}{2}\beta\,\bar{\text{Fe}})_3\,\Theta\,\|\Theta_4\|\,\text{Si} + \frac{3}{2}\,\text{aq}$

CHLORITOID GROUP. O. ratio for bases and silica 2 : 1.

CORUNDOPHILITE	$(\frac{1}{2}(\dot{\text{Mg}}, \dot{\text{Fe}})^3 + \frac{1}{2}\dddot{\text{Al}})^4\ddot{\text{Si}}^3 + 5\dot{\text{H}}$	$(\frac{1}{2}(\bar{\text{Mg}}, \bar{\text{Fe}}) + \frac{1}{2}\beta\,\bar{\text{Al}})_4\,\Theta_2\,\|\Theta_4\|\,\text{Si} + \frac{5}{3}\,\text{aq}$
CHLORITOID	$(\frac{1}{4}\dot{\text{Fe}}^3 + \frac{3}{4}\dddot{\text{Al}})^4\dddot{\text{Si}}^3 + 3\dot{\text{H}}$	$(\frac{1}{4}\bar{\text{Fe}} + \frac{3}{4}\beta\,\bar{\text{Al}})_4\,\Theta_2\,\|\Theta_4\|\,\text{Si} + \text{aq}$
MARGARITE	$(\frac{1}{4}(\dot{\text{H}}, \dot{\text{Ca}})^3 + \frac{3}{4}\dddot{\text{Al}})^4\dddot{\text{Si}}^3$	$(\frac{1}{4}(\text{H}_2, \Theta\text{a}) + \frac{3}{4}\beta\,\bar{\text{Al}})_4\,\Theta_2\,\|\Theta_4\|\,\text{Si}$
THURINGITE	$(\frac{1}{2}(\dot{\text{H}}, \dot{\text{Fe}})^3 + \frac{1}{2}(\dddot{\text{Al}}, \bar{\text{Fe}}))^4\dddot{\text{Si}}^3 + 2\dot{\text{H}}$	$(\frac{1}{2}(\text{H}_2, \bar{\text{Fe}}) + \frac{1}{2}\beta(\bar{\text{Al}}, \bar{\text{Fe}}))_4\,\Theta_2\,\|\Theta_4\|\,\text{Si} + \frac{2}{3}\,\text{aq}$

SEYBERTITE GROUP. O. ratio for bases and silica 3 : 1.

SEYBERTITE	$(\frac{2}{5}(\dot{\text{Mg}}, \dot{\text{Ca}})^3 + \frac{3}{5}\dddot{\text{Al}})^2\dddot{\text{Si}} + \frac{1}{5}\dot{\text{H}}$	$(\frac{2}{5}(\bar{\text{Mg}}, \Theta\text{a}) + \frac{3}{5}\beta\,\bar{\text{Al}})_6\,\Theta_4\,\|\Theta_4\|\,\text{Si} + \frac{1}{5}\,\text{aq}$

APPENDIX TO HYDROUS SILICATES.

462. WOLCHONSKOITE	$\ddot{\text{Si}}$, $\bar{\text{Cr}}$, $\bar{\text{Fe}}$, $\dot{\text{H}}$	467. CHLOROPHÆITE	$\ddot{\text{Si}}$, $\bar{\text{Fe}}$, $\dot{\text{H}}$
463. SELWYNITE	$\ddot{\text{Si}}$, $\dddot{\text{Al}}$, $\bar{\text{Cr}}$, $\dot{\text{Mg}}$, $\dot{\text{H}}$	468. KLIPSTEINITE	$\ddot{\text{Si}}$, $\bar{\text{Mn}}$, $\dot{\text{H}}$
464. CHROME OCHRE	$\ddot{\text{Si}}$, $\bar{\text{Cr}}$, $\dddot{\text{Al}}$, $\bar{\text{Fe}}$, $\dot{\text{H}}$	469. CHAMOISITE	$\ddot{\text{Si}}$, $\dddot{\text{Al}}$, $\bar{\text{Fe}}$, $\dot{\text{Fe}}$, $\dot{\text{H}}$
465. MILOSCHITE	$(\dddot{\text{Al}}, \bar{\text{Cr}})\ddot{\text{Si}} + 3\dot{\text{H}}$	470. ALVITE	
466. PIMELITE	$\ddot{\text{Si}}$, $\dddot{\text{Al}}$, $\dot{\text{Ni}}$, $\dot{\text{H}}$	470A. PICROFLUITE	$\ddot{\text{Si}}$, $\dot{\text{Mg}}$, Ca, F, $\dot{\text{H}}$

I. BISILICATES.

399. TALC. Μαγνῆτις λίθος *Theophr.* Magnetis, *Germ.* Talck, Glimmer, *Agric.*, Foss., 254, Interpr., 466, 1546. Talk, Creta Brianzonia, C. Hispanica, C. Sartoria, Telgsten=Lapis Ollaris, *Wall.*, Min., 133, 134, 1747. Talcum, Tälgsten, Speckſten, Steatites, *Cronst.*, Min., 89, 75, 1758. Talc, Soapstone, Steatite, Potstone. Craie de Briançon, etc. *Fr.* Pyrallolite pt. *Nordensk.*, Schw. J., xxxi. 389, 1820. Rensselaerite *Emmons*, Rep. G. of N. Y., 1837, 152.

Orthorhombic. $I \wedge I = 120°$. Occurs rarely in hexagonal prisms and plates. Cleavage: basal, eminent. Foliated massive; sometimes in globular and stellated groups; also granular massive, coarse or fine; also compact or cryptocrystalline.

H.=1–1·5. G.=2·565–2·8. Lustre pearly. Color apple-green to white, or silvery-white; also greenish-gray and dark green; sometimes bright green perpendicular to cleavage surface, and brown and less translucent at right angles to this direction; brownish to blackish-green and reddish when impure. Streak usually white; of dark green varieties, lighter than the color. Subtransparent—subtranslucent. Sectile in a high degree. Thin laminæ flexible, but not elastic. Feel greasy. Optic-axial plane *i-ī*; bisectrix negative, normal to the base; Descl.

Var.—1. *Foliated, Talc.* Consists of folia, usually easily separated, having a greasy feel, and presenting ordinarily light green, greenish-white, and white colors. G.=2·55–2·78.

2. *Massive, Steatite* or *Soapstone* (Speckstein *Germ.*). (*a*) Coarse granular, gray, grayish-green, and brownish-gray in colors; H.=1–2·5. *Pot-stone* or *Lapis ollaris* (Topfstein) is ordinary soapstone, more or less impure. (*b*) Fine granular or cryptocrystalline, and soft enough to be used as chalk; as the *French chalk* (*Craie de Briançon*), which is milk-white, with a pearly lustre. (*c*) *Rensselaerite*, cryptocrystalline, or wax-like in composition, but often having the form and cleavage of sahlite or pyroxene, and evidently pseudomorphous; colors whitish, yellowish, grayish, greenish-white to very dark, and sometimes pearl-white; H.=3–4; G.=2·874, Beck; 2·757, fr. Grenville, 2·644, fr. Charleston Lake, in Canada, Hunt; usually translucent in pieces a fourth of an inch thick. Some agalmatolite is here included. (*d*) *Indurated talc.* An impure slaty talc, harder than ordinary talc. Talcose slate is a dark, slaty, argillaceous rock, having a somewhat greasy feel, which it owes to the presence of more or less talc.

Pyrallolite is partly pseudomorphous steatite, after pyroxene, like rensselaerite. It varies exceedingly in composition, as shown by Arppe and others, and as recognized by A. E. Nordenskiöld in his Finland Mineralogy, the silica ranging from 49 to 76 p. c. It includes pyroxene, therefore, in various stages of steatitic alteration. Three analyses are given beyond (Nos. 37–39), and others on p. 221, under pyroxene. Anal. 40 is of the same material from Finland, referred by Scheerer to his *pilkarandite*. The true pitkarandite is similar, but afforded 12·71 p. c. of Ḟe and 9·17 Ċa (see anal., p. 221).

Comp.—O. ratio for Ṁg, S̈i=1 : 2½, with a varying amount of water in both talc and steatite, from a fraction of a per cent. to 7 p. c. In some, the ratio for Ṁg, S̈i, Ḣ=1 : 2½ : ¼, corresponding to the formula, the water being basic, (⅘ Ṁg+⅕ Ḣ) S̈i=Silica 62·8, magnesia 33·5, water 3· =100. In the larger part about 1 : 2½ : ⅓=(⅘ Ṁg+⅕ Ḣ) S̈i+$\frac{1}{15}$ Ḣ=Silica 62·0, magnesia 33·1 water 4·9=100. The formula is commonly written Ṁg^6 S̈i^5+2 Ḣ. The water is driven off only at a high temperature, and in some analyses that have been made it has, on this account, no been detected.

Anal. 33–36, by Lychnell, Kersten, Genth, and Senft, afford nearly the formula Ṁg^2 S̈i^3. It may be that free silica (quartz) is sometimes present, and that thence comes an occasional excess o this ingredient.

Analyses: 1, Marignac (Bibl. Univ., 1844); 2, Klaproth (Beitr., v. 60); 3, J. Schneider (J. p Ch., xliii. 316); 4, Hermann (J. pr. Ch., xlvi. 231); 5, 6, v. Kobell (Kastn. Arch. Nat., xii. 29 7, Beck (Min. N. Y., 297); 8, Delesse (Rev. Scientif., etc.); 9, Wackenroder (J. pr. Ch., xxii. 8) 10, Delesse (l. c.); 11, T. S. Hunt (Rep. G. Can., 1857, 454, and 1863, 470); 12–22, Scheerer an Richter (Pogg., lxxxiv. 321); 23–25, T. S. Hunt (l. c., 469, 470); 26, Brandes (Jahresb., iv. 156 27, Scheerer (l. c.); 28, T. S. Hunt (l. c.); 29, Scheerer (l. c.); 30, Tengström (Jahresb., iv. 156) 31–33, Lychnell (Pogg., xxxviii. 147); 34, Kersten (J. pr. Ch., xxxvii. 164); 35, Genth (Am. Sci., II. xxxiii. 200); 36, Senft (ZS. G., xiv. 167); 37, Nordenskiöld (Schw. J., xxxi. 389); 38, 3 Arppe (Finsk. Min., 43, 44, Act. Soc. Sci. Fenn., 1857); 40, Scheerer (Pogg., xciii. 103):

	S̈i	Äl	Ḟe	Ṁg	Ḣ
1. Chamouni, *Fol. talc*	62·58	—	1·98	35·40	0·04=100 Marignac.
2. St. Gothard, "	62·00	—	2·25	30·50	0·50, K̇ 2·75=98·00 Klaproth.
3. China, *Agalmat.*	63·29	0·53	2·27	31·92	0·78, Ṁn 0·23=99·02 Schneider.
4. Slatoust, *Talc*	59·21	—	2·26	34·42	1·00=99·39 Hermann.
5. Katharinenb., "	62·80	0·60	1·10	31·92	1·92=98·34 Kobell.
6. Greiner, "	62·80	1·00	1·60	32·40	2·30=100·10 Kobell.
7. Canton, N. Y., *Renss.*	59·75	—	3·40	32·90	2·85, Ċa 1·00=99·90 Beck.
8. Zillerthal, *Talc*	63·00	—	*tr.*	33·60	3·40=100 Delesse.

	$\ddot{\text{Si}}$	$\ddot{\text{Al}}$	$\dot{\text{Fe}}$	$\dot{\text{Mg}}$	$\dot{\text{H}}$
9. China, *Agalmat.*	61·97	——	0·67	33·03	3·48=99·15 Wackenroder.
10. R. Island, *Talc*	61·75	——	1·70	31·68	3·83=98·96 Delesse.
11. Potton, Can., *Steatite*	59·50	0·40	4·50	29·15	4·40, $\dot{\text{Ni}}$ *tr.*=97·95 Hunt.
12. Tyrol, *Talc*	62·38	——	1·42	31·19	4·73, $\dot{\text{Ni}}$ 0·20=99·92 Scheerer.
13. Gloggnitz, *indur'd*	62·47	0·13	0·47	32·08	4·78=99·93 Scheerer.
14. Wunsiedel, *Pseud.*	62·35	——	1·34	31·32	4·78=99·79 Scheerer.
15. " "	62·07	0·39	1·69	31·13	4·83=100·11 Scheerer.
16. Fenestrelles, "	62·29	0·15	1·22	31·55	4·83=100·04 Scheerer.
17. China, *Agalmat.*	62·30	0·06	1·62	31·32	4·89=100·19 Scheerer.
18. Piedmont	61·96	——	1·47	31·02	4·92=99·37 Scheerer.
19. St. Gothard, *Talc*	60·85	1·71	0·09	32·08	4·95=99·68 Scheerer.
20. Wunsiedel, *Steatite*	62·03	——	1·88	31 44	4·96=100·31 Richter.
21. Parma, "	62·18	*tr*	2·53	30·46	4·97=100·14 Richter.
22. Röraas, *Talc*	61·98	0·04	1·59	30·41	5 04=99·06 Scheerer.
23. Elzivir, Can., *Steatite*	59·10	——	3·51	29·05	5·56=97·32* Hunt.
24. Canton, N. Y., *Renss.*	61·10	——	1·62	31 63	5·60=100·05 Hunt.
25. Grenville, "	61·60	——	1·53	31·06	5·60=99·79 Hunt.
26. Baireuth, *Steatite*	60·12	——	3·02	30·15	5·63=98·92 Brandes.
27. Zöblitz, "	60·31	0·79	2·11	29·94	5·87, $\dot{\text{Ni}}$ 0·30, $\ddot{\text{Fe}}$ 0·45=99·77 Scheerer
28. Charleston L., *Renss.*	61·90	——	1·45	30·42	6·54=100·31 Hunt.
29. Pressnitz, *Talc*	58·46	0·09	1·09	32 83	6·56, $\dot{\text{Ca}}$ 0·61=99 64 Scheerer.
30. Abo, *Steatite*	63·95	0·78	——	28·25	6·65, $\ddot{\text{Fe}}$ 0·6=100·23 Tengström.
31. Mt Caunegou, Pyr., *Steatite*	66·70	——	2·41	30·23	——=99·34 Lychnell.
32. Scotland, "	64·53	——	6·85	27·70	——=99·08 Lychnell.
33. Sala, "	63·13	——	2·27	34·30	——=99·70 Lychnell.
34. Voigtsberg, "	66 02	——	0·81	31·94	0·20, $\dot{\text{Na}}$ ($\dot{\text{K}}$ *tr.*) 0 75=99·72 Kersten.
35. Webster, N. C., *Fol. talc*	64·44	0·48	1·39	33·19	0·34, $\dot{\text{Ni}}$ 0 23=100·07 Genth.
36. Kittelsthal, *Steatite*	66·94	1·05		29·65	1·60=99 24 Senft.
37. Finland, *Pyrall.*	56·62	3·38	0·89	23 38	3·58, $\dot{\text{Ca}}$ 5·58, $\ddot{\text{Mn}}$ 0·99, bit. loss 6·38 N
38. " "	57·49	1·11	1·26	30·05	7·30, $\dot{\text{Mn}}$ 0·69, $\dot{\text{Ca}}$ 2·90=100·80 Arppe.
39. " "	63·87	0·34	2·18	23·19	7·32, $\dot{\text{Ca}}$ 3·74=100·64 Arppe.
40. " *Pitkarand.*	60·06	5·67	1·68	27·13	4·62, $\ddot{\text{Fe}}$ 0·67=99·83 Scheerer.

* After separating about 2·5 p. c. of carbonates of lime and magnesia.

In anal. 3, G.=2 763; 9, G.=2·747; 12, G.=2 69; 13, G.=2·78; 18, G.=2·79; 22, G.=2·78; 33, G.=2·795; 36, G.=2·682. For other analyses see Scheerer, Pogg., lxxxiv. 340–360.

Stromeyer found 0·4 $\dot{\text{Ni}}$ in the talc of Röraas, and 0·43 $\dot{\text{Ni}}$ in that of Sell.

The steatite from Göpfersgrün, in which Klaproth found but 59·5 per cent. of silica, along with $\dot{\text{Mg}}$ 30·5, $\dot{\text{Fe}}$ 2·3, $\dot{\text{H}}$ 5·5 (Beitr., ii. 177), is what has been called *hydrosteatite*. An impure, leek-green, indurated talc, from Bristol, Ct., afforded H. H. Lummis (Am. J. Sci., II. xxxi. 368) $\ddot{\text{Si}}$ 64·00, $\dot{\text{Fe}}$ 4·75, $\dot{\text{Mg}}$ 27·47, $\dot{\text{H}}$ 4·30=98·52. The Fenestrelles (Piedmont) pseudomorph had the cleavage of hornblende; of those of Wunsiedel (from Göpfersgrün), No. 15 was a pseudomorph after quartz, and 14 after dolomite.

Pyr., etc.—In the closed tube B.B., when intensely ignited, most varieties yield water. In the platinum forceps whitens, exfoliates, and fuses with difficulty on the thin edges to a white enamel. Moistened with cobalt solution, assumes on ignition a pale red color. Not decomposed by acids. Rensselaerite is decomposed by concentrated sulphuric acid.

Obs.—Talc or steatite is a very common mineral, and in the latter form constitutes extensive beds in some regions. It is often associated with serpentine, talcose or chloritic schist, and dolomite, and frequently contains crystals of dolomite, breunnerite, asbestus, actinolite, tourmaline, magnetite.

Steatite is the material of many pseudomorphs, among which the most common are those after pyroxene, hornblende, mica, scapolite, and spinel. The magnesian minerals are those which commonly afford steatite by alteration; while those like scapolite and nephelite, which contain soda and no magnesia, most frequently change to pinite-like pseudomorphs. There are also steatitic pseudomorphs after quartz, dolomite, topaz, chiastolite, staurolite, cyanite, garnet, idocrase, chrysolite, gehlenite.

Hunt has shown that talc (or steatite) is a rare mineral in Azoic or præsilurian crystalline rocks. The occurrence of rensellaerite in these rocks in northern New York is no exception, any more than pyrallolite in those of Finland, these being products of subsequent alteration or metamorphism.

Apple-green talc occurs in the Greiner mountain in Saltzburg; in the Valais, and other places above mentioned; also in Cornwall, near Lizard Point, with serpentine; in Scotland, with serpentine, at Portsoy and elsewhere; on Unst, one of the Shetland islands; at Croky Head, Dunglow, Ireland; etc.

In N. America, foliated talc occurs in *Maine*, at Dexter. In *Vermont*, at Bridgewater, handsome green talc, with dolomite; at Athens or Grafton, Westfield, Marlboro, Newfane. In *New Hampshire*, at Francestown, Pelham, Orford, Keene, and Richmond. In *Mass.*, at Middlefield, Windsor, Blanford, Andover, and Chester. In *R. Island*, at Smithfield, delicate green, and white in a crystalline limestone. In *N. York*, near Amity; on Staten Island, near the quarantine, common and indurated; four miles distant, in detached masses made up of folia, snow-white. In *N. Jersey*, at Lockwood, Newton, and Sparta. In *Penn.*, at Texas, Nottingham, Unionville; in South Mountain, ten miles south of Carlisle; at Chestnut Hill, on the Schuylkill, talc and also soapstone, the latter quarried extensively. In *Maryland*, at Cooptown, of green, blue, and rose colors. In *N. Car.*, at Webster, Jackson Co., a variety supposed by Genth to be altered chrysolite. In *Canada*, at Potton, with steatite, in metamorphic Silurian; in the township of Elzivir, an impure grayish var. in Azoic rocks.

The so-called *rensselaerite* occurs in northern New York, in the towns of Antwerp (with the form of pyroxene), Fowler, Dekalb, Edwards (at the iron mine, a white variety, from which inkstands have been made), Russel, Gouverneur, Canton (in small crystals), Hermon (in large masses, crystalline massive); and in Canada, at Grenville, Charleston Lake, near Brockville, Rawdon, and Ramsay. It is often associated with crystalline limestone, and graduates at times imperceptibly into serpentine; its rock-masses are irregular, and are seldom continuous for more than three or four hundred yards.

Slabs of steatite are extensively employed as fire stones in furnaces and stoves. It may be turned in a lathe, or formed into tubes by boring. The fine-grained varieties (including the rensselaerite) are sometimes carved into ornaments, etc. When ground, it is used for diminishing friction. It is also employed in the manufacture of some kinds of porcelain. Venetian talc is used for removing oil stains from woollen cloth, etc.

A white steatite of a silvery-pearly lustre was the *Magnetis* of Theophrastus—a stone, according to this author, of silvery lustre, occurring in large masses, and easily cut or wrought. The word is the origin of the modern *magnesia*. Agricola, in his "Interpretatio Rerum Metallicarum" appended to his works (1546), gives as a German synonym of Magnetis, *Talck;* and he adds, as other synonyms, *Silberweiss* and *Katzensilber*, and also *Glimmer*, the German now for *mica*, evidently confounding the two minerals. He mentions its resistance to fire, and speaks of it as *lapis scissilis.*

Other later writers derive the word *talc* from the Arabic *talk;* and Aldrovandus (1648) states that it is of Moorish introduction, adding, "Hoc nomen apud Mauritanos *stellam* significare dicitur," *Stella Terræ*—Star of the Earth—being one old name of the mineral, given it because "like a star and with silvery lustre it shines." Cæsius ("De Mineralibus," 1636) writes the word in Latin, *Talchus*, but most other writers of that century, *Talcum.*

The word *steatitis* occurs in Pliny as the name of a stone resembling fat; but no further description is given that can with certainty identify it.

Rensselaerite was named after Stephen Van Rensselaer, of Albany, N. Y.

400A. TALCOID *Naumann* (Min., 5th edit., 255, 1859) is a snow-white, broadly-foliated talc of Pressnitz, described by Scheerer as *neutraler kieselsaurer Hydro-talc* (Pogg., lxxxiv. 385); G.=2·48. Analyses by Scheerer and Richter:

	$\ddot{\text{S}}\text{i}$	$\bar{\dddot{\text{A}}}\text{l}$	$\dot{\text{M}}\text{g}$	$\dot{\text{F}}\text{e}$	$\dot{\bar{\text{H}}}$	
1. Pressnitz	67·81	—	26·27	1·17	4·13=99·38	Scheerer.
2. "	67·95	0·24	25·54	1·59	4·14=99·46	Richter.

The oxygen ratio nearly 3 : 10 : 1. It may be only common talc with disseminated quartz. For another analysis of Pressnitz talc, see No. 29, above. The Kittelsthal (Thuringia) steatite (Speckstein, anal. 36, p. 453) is similar, except in the less water.

400. PYROPHYLLITE. Pyrophyllit *Herm.*, Pogg., xv. 592, 1829. Pyrauxit *Breit.*, Handb., 397, 1841. Agalmatolite or Pagodite pt.

Orthorhombic. Not observed in distinct crystals. Cleavage: basal eminent. Foliated, radiated lamellar; also granular, to compact or cryptocrystalline; the latter sometimes slaty.

H.=1—2. G.=2·75—2·92. Lustre of folia pearly, like that of talc; of massive kinds dull or glistening. Color white, apple-green, grayish and brownish-green, yellowish to ochre-yellow, grayish-white. Substransparent to opaque. Laminæ flexible, not elastic. Feel greasy. Optic-axial angle large (about 108°); bisectrix negative, normal to the cleavage-plane.

Var.—(1) Foliated, and often radiated, closely resembling talc in color, feel, lustre, and structure; G.=2·785, Berlin. (2) Compact massive, white, grayish, and greenish, somewhat resembling compact steatite, or French chalk; G.=2·81—2·92, Brush; H.=1·5—3. This compact variety, as Brush has shown, includes part of what has gone under the name of agalmatolite, from China; it is used for slate-pencils, and is sometimes called *pencil-stone.*

Comp.—O. ratio for $\ddot{\bar{\text{A}}}\text{l}$, $\ddot{\text{Si}}$, $\dot{\text{H}}$, mostly, 1 : 2½ : ½, as for much talc, if three-fourths of the water be basic, giving the formula $(\frac{1}{5}\,\dot{\text{H}}^3+\frac{4}{5}\,\ddot{\bar{\text{A}}}\text{l})\,\ddot{\text{Si}}^3+\frac{1}{5}\,\dot{\text{H}}$=Silica 65·0, alumina 29·8, water 5·2=100. The formula usually written $\ddot{\bar{\text{A}}}\text{l}^2\,\ddot{\text{Si}}^5+2\,\dot{\text{H}}=\ddot{\bar{\text{A}}}\text{l}^4\,\ddot{\text{Si}}^{10}+4\,\dot{\text{H}}$.

Anal. 1 and 2 give nearly the formula $\ddot{\bar{\text{A}}}\text{l}\,\ddot{\text{Si}}^3+\dot{\text{H}}$=Silica 59·9, alumina 34·2, water 5·9=100; and if the specimens were not impure, they indicate that two species are here combined. The species *pyrophyllite* was established on the first of these two analyses.

Analyses: 1, Hermann (Pogg., xv. 592); 2, Igelström (B. H. Ztg., xxv. 308); 3, Rammelsberg (Pogg., lxviii. 513); 4, 5, Sjögren (Œfv. Ak. Stockh., 1848, 110); 6–8, Walmstedt (Œfv. Ak. Stockh., 1848, 111); 9, Brush (Am. J. Sci., II. xxvi. 68); 10, S. T. Tyson, 11, O. D. Allen (Am. J. Sci., II. xxxiv. 219); 12, 13, Genth (Am. J. Sci., II. xviii. 410); 14, J. L. Smith (Am. J. Sci., II. xliii. 68).

	$\ddot{\text{Si}}$	$\ddot{\bar{\text{A}}}\text{l}$	$\ddot{\bar{\text{F}}}\text{e}$	$\dot{\text{M}}\text{g}$	$\dot{\text{C}}\text{a}$	$\dot{\text{H}}$
1. Siberia	59·79	29·46	1·80	4·00	——	5·62=100·67 Hermann.
2. Horrsjöberg, Sw.	59·86	33·44	0·77	0·44	*tr.*	7·46=101·97 Igelström.
3. Spaa	66·14	25·87	——	1·49	0·39	5·59=99·48 Rammelsberg.
4. Westana, Sw.	67·77	25·17	0·82	0·26	0·66	5·82, $\dot{\text{M}}\text{n}$ 0·50=101 Sjögren.
5. " "	65·61	26·09	0·70	0·09	0·69	7·08, $\dot{\text{M}}\text{n}$ 0·09=100·35 Sjögren.
6. *China, Pagodite*	65·96	28 58	0·09	0·15	0·18	5·16=100·12 Walmstedt.
7. " "	66·38	27·95	0·06	0·16	0·18	5·20=99 93 Walmstedt.
8. " "	65·65	28·79	0·28	*tr.*	0·23	5·11=100·06 Walmstedt.
9. " "	65·95	28·97		——	0·22	5·48, $\dot{\text{N}}\text{a}$, $\dot{\text{K}}$ 0·25=100·87 Brush.
10. Deep River, N.C., *mass.*	65·93	29·54		——	——	5·40=100·87 Tyson.
11. Carbonton, " "	66·25	27·91	1·08	——	——	5·25=100·49 Allen.
12. Chesterfield, S. C., *fol.*	64·82	28·48	0·96	0·33	0·55	5·25=100·39 Genth.
13. " "	66·01	28·52	0·87	0·18	0·23	5·22=101·03 Genth.
14. Arkansas	65·02	26·11	2·20	——	——	4·98, $\dot{\text{M}}\text{n}$ *tr.*, $\dot{\text{N}}\text{a}$, $\dot{\text{K}}$ 1·18=99·49 S.

Pyr., etc.—Yields water. B.B. whitens, and fuses with difficulty on the edges. The radiated varieties exfoliate in fan-like forms, swelling up to many times the original volume of the assay. Heated with cobalt solution gives a deep blue color (alumina). Partially decomposed by sulphuric acid, and completely on fusion with alkaline carbonates.

Obs.—Compact pyrophyllite is the material or base of some schistose rocks. The foliated variety is often the gangue of cyanite.

Pyrophyllite occurs in the Urals, between Pyschminsk and Beresof; at Westana, Sweden; the Horrsjöberg in Elfdalen, with cyanite; near Ottrez in Luxembourg; in Brazil. Also in white stellate aggregations in Cottonstone Mtn., Mecklenburg Co., N. C.; in Chesterfield Dist., S. C., with lazulite and cyanite; in Lincoln Co., Ga., on Graves Mtn.; in Arkansas, at the Kellogg lead mine, near Little Rock. The compact kind, resembling a slaty soapstone in aspect and feel, is found in large beds at Deep River, N. C., greenish to yellowish-white in color, with G.=2·91; similar at Carbonton, Moore Co., N. C., having G.=2·82.

The compact pyrophyllite of Deep River, N. C., is extensively used for making slate pencils.

Thomson, in an analysis of his *nacrite* (Rec. Gen. Sci., iii. 332) from "Brunswick" (should have been *Unity*), Maine, obtained the composition of a pyrophyllite. But the mineral is actually a green mica; the high silica, *as he says*, was due to mixed quartz.

401. PIHLITE. Pihlit *Sefström*, Svanberg, Ak. H. Stockh., 1839, 155. Cumatolite *C. U. Shepard*, private publication, May 24, 1867. Cymatolite *id.*, Correspondence, Dec. 24, 1867.

Micaceous. Sometimes constituting long prisms, but only as a pseudomorph. Surface of plates sometimes wavy.

H.=1·5. G.=2·72, pihlite, Svanberg; 2·74, cymatolite, Shepard. Lustre pearly, or satin-like. Color white, almost silvery; also yellowish. Laminæ brittle, but separating into thin scales, which are flexible, somewhat elastic, and transparent. Feel soft.

Comp.—$(\dot{R}^3, \bar{\dddot{Al}})\dddot{Si}^3$, from Svanberg's analysis, if the water be basic; from Burton's, if half of the water be basic, $(\frac{1}{3}(\frac{1}{2}\dot{\bar{H}}+\frac{1}{2}\dot{K})+\frac{2}{3}\bar{\dddot{Al}})\dddot{Si}^3$. It is closely related to pyrophyllite, but is unlike that species in its appearance and its alkalies. Analyses: 1, Svanberg (l. c.); 2, 3, B. S. Burton (priv. contrib.):

	$\dddot{Si}$	$\bar{\dddot{Al}}$	$\bar{\dddot{Fe}}$	$\dot{Mg}$	$\dot{Ca}$	$\dot{Na}$	$\dot{Li}$	$\dot{K}$	$\dot{\bar{H}}$
1. Brattstad	63·68	25·12	3·01	1·52	—	—	—	3·76	2·39, F 0·84, Mg 0·58=100·89 Sv.
2. Goshen	61·21	28·01	—	—	0·43	0·53	0·57	4·54	3·83=99·12 Burton.
3. "	61·20	27·27	—	—		*undetermined*			3·78 Burton.

Prof. Shepard, in an imperfect examination (priv. contrib.), obtained $\dddot{Si}$ 59·4, $\bar{\dddot{Al}}$ 33·91, $\dot{Fe}$ with $\dot{Mn}$ 2·50, $\dot{\bar{H}}$ 1·40=97·21.

Pyr., etc.—In a closed tube yields water at a high temperature (Brush). B.B. fuses at 6, or only on the thinnest edges; infusible (Svanberg). Scarcely attacked by acids.

Obs.—From Brattstad, near Sala, Sweden, in granite. Also (cymatolite) from the indicolite locality, Goshen, Mass., and from Norwich; at both places covering crystals of spodumene, sometimes at the latter to a depth of three-fourths of an inch; and also as continuations of spodumene crystals, the foliation, according to Shepard, at right angles to the spodumene; appears to be a result of the alteration of the spodumene.

Named after the Swedish mining director, Pihl. *Cymatolite* is from *κῦμα, wave.*

402. SEPIOLITE. Meerschaum *Germ.*, Wern. Bergm. J., 377, 1788. L'Ecume de Mer *Fr.* Keffekill *Kirw.*, i. 144, 1794. Magnesite pt. *Brongn.*, Min., 1807; Magnesite *id.*, 1824. Sepiolith *Glock.*, Syn., 190, 1847.

Compact, with a smooth feel, and fine earthy texture, or clay-like. H.=2–2·5. Impressible by the nail. In dry masses floats on water. Color grayish-white, white, or with a faint yellowish or reddish tinge. Opaque.

Comp.—O ratio for $\dot{R}$, $\dddot{Si}$, $\dot{\bar{H}}$=1 : 3 : 1, corresponding to $\dot{Mg}^2\dddot{Si}^3+2\dot{\bar{H}}$; or, if half the water is basic, 1 : 2 : ⅓=$(\frac{2}{3}\dot{Mg}+\frac{1}{3}\dot{\bar{H}})\dddot{Si}+\frac{1}{3}\dot{\bar{H}}$=Silica 60·8, magnesia 27·1, water 12·1=100. Analyses: 1, Lychnell (Ak. H. Stockholm, 1826, 175); 3, Schultz (Ramm. Min. Ch., 1000); 2, 4–8, Scheerer & Richter (Pogg., lxxxiv. 361); 9, Damour (Ann. Ch. Phys., III. vii. 316):

	$\dddot{Si}$	$\dot{Mg}$	$\dot{\bar{H}}$
1. Asia Minor	60·87	27·80	11·29, $\bar{\dddot{Fe}}$ and $\bar{\dddot{Al}}$ 0·09=100·05 Lychnell.
2. "	61·33	28·28	9·82, $\dot{Fe}$ 0·09=100·19 Scheerer & Richter.
3. "	60·01	26·78	12·62=99·41 Schultz.
4. Turkey	61·17	28·43	9·83, $\dot{Fe}$ 0·06, $\ddot{C}$ 0·67=100·16 Scheerer.
5. "	61·49	28·13	9·82, $\dot{Fe}$ 0·12, $\ddot{C}$ 0·67, $\dot{Ca}$ 0·60=100·83 Richter.
6. Greece	61·30	28·39	9·74, $\dot{Fe}$ 0·08, $\ddot{C}$ 0·56=100·07 Scheerer.
7. Asia Minor	58·20	27·73	9·64, $\dot{Ca}$ 1·53, $\ddot{C}$ 2·73=99·83 Richter.
8. "	60·45	28·19	9·57. $\dot{Fe}$ 0·09, $\ddot{C}$ 1·74, $\bar{\dddot{Al}}$ 0·11=100·15 Scheerer.
9. Morocco	55·00	28·00	10·35, $\bar{\dddot{Fe}}$ 1·40, $\bar{\dddot{Al}}$ 1·20, $\dot{Ca}$ 1·01, $\dot{K}$ 0·52, sand 1·50=98·98 Dam.

19 to 20 per cent. of water were found by Berthier in meerschaum from Madrid and Coulommiers (Ann. d. M., vii. 313); and by von Kobell in that of Greece (J. pr. Ch., xxviii. 482); as follows:

	$\dddot{Si}$	$\bar{\dddot{Al}}$	$\dot{Mg}$	$\dot{\bar{H}}$
1. Spain	53·8	1·2	23·8	20·0=98·8 Berthier.
2. Coulommiers	54·0	1·4	24·0	20·0=99·4 "
3. Greece	48·0	*tr.*	20·06	19·6, $\bar{\dddot{Fe}}$ 12·40=100·06 Kobell.

Döbereiner also found two atoms of water (instead of 1) in the meerschaum of Asia Minor. Klaproth (Beitr., ii. 172) found in the same 5 per cent. of carbonic acid, which proceeded from intermixed carbonate of magnesia.

A related mineral, found in the serpentine of Zöblitz, a little translucent, white or yellowish, with H.=2·335, afforded Delesse $\dddot{Si}$ 53·5, $\bar{\dddot{Al}}$ 0·9, with $\bar{\dddot{Fe}}$ *tr.*, $\dot{Mg}$ 28·6, $\dot{\bar{H}}$ 16·4=99·4.

Pyr., etc.—In the closed tube yields first hygroscopic moisture, and at a higher temperature gives much water and a burnt smell. B.B. some varieties blacken, then burn white, and fuse with difficulty on the thin edges. With cobalt solution a pink color on ignition. Decomposed by muriatic acid with gelatinization.

Obs.—Occurs in Asia Minor, in masses in stratified earthy or alluvial deposits at the plains of Eskihi-sher, where, according to Dr. J. Lawrence Smith, it has proceeded from the decomposition of carbonate of magnesia, which is imbedded in serpentine in the surrounding mountains. He observes that more or less carbonate of magnesia is often found in the meerschaum (Am. J. Sci., II. vii. 286); also found in Greece; at Hrubschitz in Moravia; in Morocco; at Vallecas in Spain, in extensive beds, affording a light but valuable building stone. The mineral from Morocco, called in French *Pierre de savon de Maroc*, is used in place of soap at the Moorish baths in different places in Algeria.

The word *meerschaum* is German for *sea-froth*, and alludes to its lightness and color. *Sepiolite* Glocker, is from *σήπια*, *cuttle-fish*, the bone of which is light and porous; and being also a production of the sea, "deinde *spumam marinam* significabat," says Glocker.

Brongniart, in the first edition of his Mineralogy (1807), included under *Magnesite* (1) the carbonate, which he calls *Mitchell's magnesite* (see under MAGNESITE); (2) the hydrous silicate or meerschaum; and (3) the siliceous carbonate from Baudissero in Piedmont; he putting "Mitchell's magnesite," the carbonate, *first*. Karsten, in his "Tabellen," published the next year, separated from meerschaum the carbonate, and adopted for it the name *magnesite*, and in this he has been followed by all German and most other mineralogists. The application of the name *magnesite* to the hydrous silicate, done in the later writings of Brongniart and by subsequent French mineralogists, is hence in violation of the law of priority.

403. APHRODITE. Aphrodit *Berlin*, Ak. H. Stockh., 172, 1840.

Soft and earthy like sepiolite.
G.=2·21. Color milk-white. Opaque.

Comp.—O. ratio for $\dot{R}$, $\ddot{Si}$, $\dot{H}$=1 : 2 : $\frac{3}{4}$; $\dot{Mg}\ddot{Si}+\frac{3}{4}\dot{H}$. Berlin obtained (l. c.) Silica 51·65, magnesia 33·72, protoxyd of manganese 1·62, protoxyd of iron 0·59, alumina 0·20, water 13·32.

Obs.—From Longban, Sweden.

Named from ἀφρός, *foam*.

Delesse has analyzed another species, containing Silica 53·5, magnesia 28·6, alumina with trace of sesquioxyd of iron 0·9, water 16·4=nearly $\dot{Mg}\ddot{Si}+\dot{H}$. Occurs in serpentine, of a white or yellowish color, with a waxy lustre, and somewhat translucent. G.=2·335.

Hampshirite is a name applied by Hermann to the steatite of certain steatitic pseudomorphs described and analyzed by Dewey (Am. J. Sci., iv. 274, v. 249, vi. 334, 1822, 1823), who obtained $\ddot{Si}$ 50·60, $\ddot{\bar{Al}}$ 0·15, $\dot{Mg}$ 28·83, $\dot{Fe}$ 2·59, $\dot{Mn}$ 1·10, $\dot{H}$ 15·00. It gives the oxygen ratio for $\dot{R}$, $\ddot{Si}$, $\dot{H}$, 1 : 2 : 1. But the constituents of pseudomorphs are seldom pure species, and without thorough investigation afford no sufficient ground for instituting a new species. They have mostly the form of quartz.

404. CIMOLITE. Κιμωλία *Theophr.* Cimolia *Plin.*, xxxv. 57. Cimolit *Klapr.*, Beitr., i 291, 1795. Pelikanit *Ouchakoff*, Bull. St. Pet., xvi. p. 129, J. pr. Ch., lxxiv. 254. Hunterite *Haughton*, Phil. Mag., IV. xvii. 18, 1859, xxiii. 50.

Terra Lemnia *Dioscor*, *Plin.*, etc. Sphragid *Karst.*, Tab., 28, 88, 1808. Ehrenbergit *Nöggerath*, Verh. nat Ver. Bonn, ix. 378, 1852.

Amorphous, clay-like, or chalky.
Very soft. G.=2·18—2·30. Lustre of streak greasy. Color white, grayish-white, reddish. Opaque. Harsh. Adheres to the tongue.

Comp.—O. ratio for $\ddot{\bar{Al}}$, $\ddot{Si}$, $\dot{H}$=1 : 3 : 1; corresponding to $\ddot{\bar{Al}}^3\ddot{Si}^9+3\dot{H}$; or, if half of the water is basic, $(\frac{1}{3}\ddot{\bar{Al}}+\frac{1}{3}\dot{H}^3)\ddot{Si}^3+\dot{H}$. Analyses: 1, Klaproth (l. c.); 2, Ilimoff (Ann. J. M. Russ., 1841, 336); 3, v. Hauer (Jahrb. geol. Reichs., 1854, 67); 4, Ouchakoff (l. c.); 5, Haughton (l. c.):

	$\ddot{Si}$	$\ddot{\bar{Al}}$	$\ddot{\bar{Fe}}$	$\dot{H}$
1. Argentiera	63·00	23·00	1·25	12·00=99·25 Klaproth.
2. Ekaterinovska	63·52	23·55	—	12·00=99·07 Ilimoff.
3 Near Bilin	62·30	24·23	—	12·34, $\dot{Ca}$ 0·83=99·70 Hauer. G.=2·376.
4. Kiew, *Pelicanite*	65·66	22·84	0·44	9·31, $\dot{Mg}$ 0·56, $\dot{K}$ 0·30, $\dddot{\bar{P}}$ 0·17=99 28 Ouchakoff.
5. *Hunterite*	65·93	20·97	—	11·61, $\dot{Mg}$ 0·45, $\dot{Ca}$ 0·30=99·26 Haughton.

Klaproth, in a later analysis (Beitr., vi. 283), obtained $\ddot{\text{Si}}$ 54·0, $\bar{\dddot{\text{Al}}}$ 26·5, $\bar{\dddot{\text{Fe}}}$ 1·5, $\dot{\text{K}}$ 5·5, $\dot{\text{H}}$ 12. The hunterite, according to the analysis, contains a little excess of silica, probably due to free quartz, as the material was gritty under the pestle.

Pyr., etc.—Yields water. B.B. becomes gray and finally burns white; infusible. With cobalt solution a blue color.

Obs.—From the island of Argentiera (Κιμωλή of the Greeks); Berg Hradischt, near Bilin, Bohemia; also from Ekaterinovska, district of Alexandrovsk, Russia; Government of Kiev, Russia; Nagpur, Central India, with orthoclase in granite.

404A. SPHRAGIDITE. (Λημνία γῆ *Dioscor.* Σφραγὶς λήμνια. Terra Lemnia *Plin.*, xxxvi. Sphragid *Karst.*, Tab., 28, 88, 1808.) Related in composition to cimolite, but contains some alkali. Color yellowish-gray, brownish, or yellowish-white. Sometimes mottled with rust-like spots; harsh to the touch, adheres feebly to the tongue, and forms a paste with water.

Klaproth obtained for its composition (Beitr., iv. 333):

$\ddot{\text{Si}}$	$\bar{\dddot{\text{Al}}}$	$\bar{\dddot{\text{Fe}}}$	$\dot{\text{Mg}}$	$\dot{\text{Ca}}$	$\dot{\text{Na}}$	$\dot{\text{H}}$
66·00	14·50	6·00	0·25	0·25	3·50	8·50

From Stalimeno, the ancient *Lemnos.* It was also called *Terra sigillata.* It was dug for medicinal purposes once a year, cut into spindle-shaped pieces, and *stamped with a seal*, and hence the name *sigillata* in Latin, and *sphragis* in Greek. There was also a *Rubrica Lemnia*, or *Lemnian Reddle*, used by painters, which is confounded by Pliny with the true terra lemnia.

404B. EHRENBERGIT *Nöggerath* (Verh. nat. Ver. Bonn, ix. 378, 1857). Near the preceding in composition, and, like that, containing alkali. It is almost gelatinous in the fresh state, and becomes fragile, pulverulent, and opaque on drying; color rose-red. Analyses: 1, Schnabel (l. c.); 2, G. Bischof (l. c.):

	$\ddot{\text{Si}}$	$\bar{\dddot{\text{Al}}}$	$\bar{\dddot{\text{Fe}}}$	$\dot{\text{Mn}}$	$\dot{\text{Mg}}$	$\dot{\text{Ca}}$	$\dot{\text{Na}}$, $\dot{\text{K}}$	$\dot{\text{H}}$	
1.	56·77	15·77	1·65	0·86	1·30	2·76	3·78	17·11=100	Schnabel.
2.	64·54	6·04	4·56	4·61	0·41	3·96	8·11	7·77=100	Bischof.

Ehrenbergite occurs in clefts in trachyte at the quarries of Steinchen and Wolkenburg, Siebengebirge.

400C. ANAUXITE *Breith.* (J. pr. Ch., xv. 325, 1838). Greenish-white, pearly, granular; with cleavage in one direction. Translucent. H.=2—2·5. G.=2·26. Plattner obtained (l. c.) $\ddot{\text{Si}}$ 55·7, $\dot{\text{H}}$ 11·5, with much $\bar{\dddot{\text{Al}}}$, a little $\dot{\text{Mg}}$ and $\dot{\text{Fe}}$.

From Bilin, Bohemia.

404D. PORTITE *Meneghini & Bechi* (Am. J. Sci., II. xiv. 63). Orthorhombic. In radiated masses; cleavage very distinct parallel to a rhombic prism of 120°. H.=5. G.=2·4. Lustre vitreous. Color white. Opaque.

Comp.—If the protoxyds are not an essential part of the compound, the mineral corresponds to the formula $\bar{\dddot{\text{Al}}}\,\ddot{\text{Si}}^3+2\dot{\text{H}}$. Analysis by Bechi (Am. J. Sci., II. xiv. 63):

$\ddot{\text{Si}}$	$\bar{\dddot{\text{Al}}}$	$\dot{\text{Mg}}$	$\dot{\text{Ca}}$	$\dot{\text{Na}}$	$\dot{\text{K}}$	$\dot{\text{H}}$
58·12	27·50	4·87	1·76	0·16	0·10	7·92=100·43.

Yields water. B.B. intumesces much and affords a milk-white enamel. Dissolves in acids, even in the cold, and gelatinizes. From the gabbro rosso in Tuscany. Named after Mr. Porte of Tuscany.

405. SMECTITE. Fuller's Earth pt.; Terra *or* Creta Fullonum pt.; Walkthon, Walkerde pt., *Germ.*; Terre à Foulon pt. *Fr.* Smectit *Breith.*, Handb., 344, 1841. Malthacit *Breith.*, J. pr. Ch., x. 510, 1837.

Massive. Clay-like.

Very soft. G.=1·9—2·1. Lustre dull; of streak shining. Color white, gray, and various shades of green to mountain-green and olive-green, or brownish. Streak colorless. Unctuous. Does not adhere to the tongue. Softens in water.

Var.—*Fuller's Earth* includes many kinds of unctuous clays, gray to dark-green in color, and is only in part Breithaupt's smectite. Much of it is kaolinite. *Malthacite* is described as occurring in thin laminæ or scales, and sometimes massive, with the color white or slightly yellowish, and thin plates translucent; the original is from basalt, at Steindörfel, in Lausitz; and Beraun in Bohemia is given as another locality. *Smectite* is a mountain-green, oil-green, and grayish-green clay, from Cilley in Lower Styria.

Comp.—O. ratio for $\bar{\bar{\mathrm{R}}}$, $\ddot{\mathrm{S}}\mathrm{i}$, $\dot{\mathrm{H}}$ = 1 : 4 : 4 in anal. 1; whence, if a fourth of the water is basic, $(\frac{1}{2}\,\bar{\bar{\mathrm{A}}}\mathrm{l}+\frac{1}{2}\,\dot{\mathrm{H}}^3)\,\ddot{\mathrm{S}}\mathrm{i}^3+4\frac{1}{2}\,\dot{\mathrm{H}}$.

The chemical species characteristic of these minerals is probably the same—a silicate of alumina related to cimolite, but containing three or four times as much water.

Analyses: 1, Jordan (Pogg., lxxvii. 591); 2, Klaproth (Beitr., iv. 338); 3, O. Meissner (l. c):

	$\ddot{\mathrm{S}}\mathrm{i}$	$\bar{\bar{\mathrm{A}}}\mathrm{l}$	$\bar{\bar{\mathrm{F}}}\mathrm{e}$	$\dot{\mathrm{M}}\mathrm{g}$	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\mathrm{H}}$
1. Cilley, *Smectite*	51·21	12·25	2·07	4·89	2·13	27·89=100·44 Jordan.
2. Riegate, *Fuller's E.*	53·00	10·00	9·75	1·25	0·50	24·00, $\dot{\mathrm{K}}$ *tr.*, Na Cl 0·10=98·60 Klapr.
3. Steindörfel, *Malth.*	50·17	10·66	3·15	—	0·25	35·83=100·06 Meissner.

Pyr., etc.—B.B. the malthacite is infusible; but the smectite and the Riegate fuller's earth, owing to the impurities present, fuse rather easily. Decomposed by muriatic acid.

Obs.—All the kinds have a soapy feel.

RHODALITE *Thomson* (Min., i. 354, 1836) is a rose-red mineral, "seeming to consist of a congeries of small rectangular prisms with square prisms." Earthy; feel soapy; H.=2·0; G.=2·0. Easily scratched and polished with the nail. B.B. not altered.

Composition, according to Richardson (l. c.), $\ddot{\mathrm{S}}\mathrm{i}$ 55·9, $\bar{\bar{\mathrm{A}}}\mathrm{l}$ 8·3, $\bar{\bar{\mathrm{F}}}\mathrm{e}$ 11·4, $\bar{\bar{\mathrm{M}}}\mathrm{n}$ *tr.*, $\dot{\mathrm{M}}\mathrm{g}$ 0·6, $\dot{\mathrm{C}}\mathrm{a}$ 1·1, $\dot{\mathrm{H}}$ 22·0 =99·3. From nodules in amygdaloid, in Antrim, northern Ireland. "It appeared to have been partially acted upon by the rain and weather." Portlock states that the mineral contains less iron than Thomson's analysis gives, and also that it readily fuses.

406. MONTMORILLONITE. *Salvetat*, Ann. Ch. Phys., III. xxi. 376, 1847. Confolensite *Dufr.*, Min., iii. 583, 1856. Delanovit *Kenng.*, Jahrb. G. Reichs., iv. 633, 1853. Delanouite *Dufr.*, Min., iii. 583, 1856. Stolpenit (=Bole of Stolpen) *Kenng.*, Min., 41, 1853. Saponite *Nicklès*, Ann. Ch. Phys, III. lvi. 46, 1859=Pierre a savon (*Germ.* Bergseife) de Plombières. Steargillite *Meillet*, Descl. Min., i 205, 1862. Erinite *Thomson*, Min., i. 341, 1836.

Massive, clay-like.

Very soft and tender. Lustre feeble. Color white or grayish to rose-red, and bluish; also pistachio-green. Softens in water, and for the most part does not adhere to the tongue. Unctuous.

Var.—(1) *Montmorillonite* is rose-red; from Montmorillon, France. *Confolensite* is paler rose-red; fr. Confolens, Dept. of Charente, at St. Jean-de-Côle, near Thiviers. *Delanouite* is similar in color, and is fr. Millac, near Nontron, France; stated by Kenngott to adhere to the tongue.

(2) *Stolpenite* is a clay from the basalt of Stolpen. *Steargillite* is white, yellow, and pistachio-green, subtranslucent, insoluble in acids; and is easily cut into cakes looking like soap or wax; fr. near Virolet on the Rochelle railroad, and at the tunnel of Poitiers. *Saponite* of Nicklès is a soap-like clay from the granite from which issues one of the hot springs of Plombières, France, called *Soap Spring*.

Erinite is a yellowish-red clayey mineral from the Giant's Causeway; G.=2·04; opaque; a little resinous in lustre; unctuous; B.B. infusible but whitens. Named from Erin (Ireland).

Comp.—Like smectite, but containing more alumina. O. ratio for $\bar{\bar{\mathrm{R}}}$, $\ddot{\mathrm{S}}\mathrm{i}$, $\dot{\mathrm{H}}$=1 : $2\frac{1}{4}$: $2\frac{1}{4}$; whence $(\frac{4}{5}\,\bar{\bar{\mathrm{A}}}\mathrm{l}+\frac{1}{5}\,\dot{\mathrm{H}}^3)\,\ddot{\mathrm{S}}\mathrm{i}^3+5\,\dot{\mathrm{H}}$. **Analyses:** 1, 2, Salvetat and Damour (l. c.); 3, Berthier (Tr. d. Ess. v. sèche, i. 58); 4. v. Hauer (Jahrb. G. Reichs., iv. 633) 5, 6, Salvetat (Ann. Ch. Phys., III. xxxi. 120); 7, Rammelsberg (Pogg., xlvii. 180); 8, Meillet (l. c.); 9, Nicklès (l. c.); 10, Berthier; 11, Thomson (l. c.):

		$\ddot{\mathrm{S}}\mathrm{i}$	$\bar{\bar{\mathrm{A}}}\mathrm{l}$	$\bar{\bar{\mathrm{F}}}\mathrm{e}$	$\dot{\mathrm{M}}\mathrm{g}$	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\mathrm{N}}\mathrm{a}$, $\dot{\mathrm{K}}$	$\dot{\mathrm{H}}$
1. Montmorillon, *Mont.*	($\frac{4}{5}$)	49·40	19·70	0·80	0·27	1·50	1·50	25·67=98·84 Salvetat.
2. " "	($\frac{3}{5}$)	50·04	20·16	0·68	0·23	1·46	1·27	26·00=99·84 Damour.
3. Confolens, *Conf.*		49·5	18·0	—	2·1	2·1	—	28·0 =99·7 Berthier.
4. Millac, *Delan.*		50·55	19·15	—	$\dot{\mathrm{M}}\mathrm{n}$ 4·40	0·63	—	24·05=98·78 Hauer.
5. St. J. de Côle, *Conf.*		45·55	22·60	1·05	0·30	1·66	0·10	26 20, $\ddot{\mathrm{S}}\mathrm{i}$ gel. 0·96, qtz. 1·04=99·46 Salvetat.

	$\ddot{\text{Si}}$	$\dddot{\text{Al}}$	$\dddot{\text{Fe}}$	$\dot{\text{Mg}}$	$\dot{\text{Ca}}$	$\dot{\text{Na}}$, $\dot{\text{K}}$	$\dot{\text{H}}$
6. —— ? *rose-red*	45·44	24·00	1·35	0·09	0·83	0·93	26·70=99·35 Salvetat
7. *Stolpenite*	45·92	22·14	——	——	8·90	——	25·86=97·82 Ramm.
8. *Steargillite*	45·30	23·30	$\dot{\text{Fe}}$ 1·21	$\dot{\text{Mn}}$ 1·48	——	1·70	27·00=99·99 Meillet.
9. Plombières, *Saponite*	40·61	18·45	*tr.*	$\dot{\text{Mg}}$ *tr.*	$\dot{\text{Ca}}\ddot{\text{S}}$ 3·53	0·41	37·00=100 Nicklès.
10. " "	46·8	23·4	——	2·1	——	——	26·6=98·9 Berthier.
11. *Erinite*	47·04	18·46	6·36	——	$\dot{\text{Ca}}$ 1·00	——	25·28, Na Cl 0·9=99·04 T.

Salvetat observes that carbonate of soda separates a little gelatinous silica, and sulphuric acid some quartz-silica—a fact of great interest in connection with the earthy hydrous aluminous silicates generally.

Pyr., etc.—B.B. infusible, excepting the stolpenite, which affords a yellowish enamel, probably owing to the 4 p. c. of lime in the state of silicate present as impurity. Montmorillonite loses 6 p. c. of water at 100° C., and delanouite 14 p. c. The *saponite* lost, according to Nicklès, 22 p. c. of water in dry air at 15° C.; 34·5 p. c. at 100° C.; and 37 p. c. at redness. The loss over sulphuric acid was 29 p. c.

Severite, according to the analysis of Pelletier (p. 477), would be identical nearly with the mineral from Confolens.

406A. *Razoumoffskin* of John, a greenish-white clay-like mineral from Kosemütz, in Silesia, is near montmorillonite, except in the less amount of water. Zellner obtained:

$$\ddot{\text{Si}}\ 54{\cdot}50 \quad \dddot{\text{Al}}\ 27{\cdot}25 \quad \dot{\text{Fe}}\ 0{\cdot}25 \quad \dot{\text{Mg}}\ 0{\cdot}37 \quad \dot{\text{Ca}}\ 2{\cdot}00 \quad \dot{\text{H}}\ 14{\cdot}25=98{\cdot}62.$$

A *lithomarge* (Steinmark) from Strimbuly, Transylvania, afforded Hingenau (Jahrb. Min., 1856 690):

$$\ddot{\text{Si}}\ 52{\cdot}40 \quad \dddot{\text{Al}}\ 21{\cdot}80 \quad \dot{\text{Mg}}\ 4{\cdot}28 \quad \dot{\text{Ca}}\ 2{\cdot}50 \quad \dot{\text{K}}, \dot{\text{Na}}\ 1{\cdot}34 \quad \dot{\text{H}}\ [17{\cdot}68]=100.$$

It is, probably, judging from the magnesia and alkalies present, only a mixture.

407. STILPNOMELANE. *Glocker*, ZS. f. Min., Jan., 1828, Handb., 572, 1831. Chalcodite *Shep.*, Rep. Am. Assoc., vi. 232, 1851.

Foliated plates, sometimes hexagonal, sometimes radiated. Also fibrous, or as a velvety coating even or tufted. Cleavage easy in one direction.

H.=3—4, when in solid plates. G.=3—3·4, Glocker; 2·769, Breith.; 2·76, chalcodite, Brush. Lustre of cleavage surface between pearly and vitreous, sometimes submetallic or brass-like. Color black, greenish-black, yellowish-bronze, and greenish-bronze.

Var.—(1) *Ordinary*, in plates or massive.

(2) *Chalcodite*, in velvety coatings of brass-like or submetallic lustre, consisting of minute scales, which are flexible.

Comp.—O. ratio for $\dot{\text{R}}+\dddot{\text{R}}$, $\ddot{\text{Si}}$, $\dot{\text{H}}=3 : 6 : 2$ nearly, from anal. 1 to 3; whence $(\dot{\text{R}}^3, \dddot{\text{R}})\ \ddot{\text{Si}}^3+2\ \dot{\text{H}}$. Brush's analysis, in which the state of oxydation of the iron was determined, gives 13·39 : 24·15 : 8·18, or nearly the same.

Analyses: 1, Rammelsberg (Pogg., xliii. 127); 2, Siegert (Ramm., 5th Suppl., 230, Min. Ch., 880); 3, L. J. Igelström (J. pr. Ch., lxxxi. 396); 4, G. J. Brush (Am. J. Sci., II. xxv. 198):

	$\ddot{\text{Si}}$	$\dddot{\text{Al}}$	$\dddot{\text{Fe}}$	$\dot{\text{Fe}}$	$\dot{\text{Mg}}$	$\dot{\text{Ca}}$	$\dot{\text{K}}$	$\dot{\text{H}}$
1. Obergrund	(¼) 45·96	5·84	——	35·60	1·78	0·19	0·75	8·63=98·75 Ramm.
2. Weilburg	45·07	4·92	41·98	——	0·94	1·67	——	8·47=98·85 Siegert.
3. Nordmark	45·61	5·00	37·70		3·00	——	——	9·14=100·45 Igelström
4. *Chalcodite*	(⅔) 45·29	3·62	20·47	16·47	4·56	0·28	*tr.*	9·22=99·91 Brush.

Brush ascertained the identity of chalcodite with stilpnomelane; Mallet analyzed it (Am. J. Sci., II. xxiv. 113), but, as he states, he had too little of the mineral for reliable results.

Pyr., etc.—Yields much water. B.B. fuses easily to a black, shining, magnetic globule. With the fluxes gives the reactions for iron. Chalcodite is completely decomposed by muriatic acid.

Obs.—Stilpnomelane occurs at Obergrund and elsewhere in Silesia, with calcite and quartz, sometimes intermixed with pyrite and magnetite. Also in Moravia, near Brokersdorf; near Sternberg, in a bed of limonite, in a clay slate, probably of the Devonian age, and often associated with chlorite, magnetite, and calcite; at Frederic mine near Weilburg, Nassau, in a bed of iron ore; at

Pen Mine, Nordmark, Sweden, radiated foliated with actinolite, in veins sometimes 4 inches thick Chalcodite occurs at the Sterling Iron mine, in Antwerp, Jefferson Co., N. Y., coating hematite and calcite, and sometimes constituting pseudomorphs, having the form of hollow rectangular tables, the yellow variety resembles in color mosaic gold.

Named *Stilpnomelane* from στιλπνός, *shining*, and μέλας, *black;* and *Chalcodite*, from χαλκός, *brass* or *bronze*.

408. CHLOROPAL. *Bernhardi & Brandes*, Schw. J., xxxv. 29, 1822. Unghwarit *Glocker*, Grundr., 1839, 537. Nontronite *Berthier*, Ann. Ch. Phys., xxxvi. 22, 1827. Pinguite *Breith.*, Schw. J., lv 303, 1829. Fettbol *Freiesleben*, Mag. Orykt. Sachsen, v. 136. Gramenite *Krantz*, Ges. Nat. Heil-kunde, Bonn, March, 1857, C. Bergemann, Jahrb. Min., 1857, 395.

Compact massive, with an opal-like appearance; earthy.

H.=2·5–4·5. G.=1·727, 1·870, earthy varieties, the second a conchoidal specimen; 2·105, Thomson, a Ceylon chloropal. Color greenish-yellow and pistachio-green. Opaque—subtranslucent. Fragile. Fracture conchoidal and splintery to earthy. Feebly adhering to the tongue, and meagre to the touch.

Var.—*Chloropal* has the above-mentioned characters, and was named from the Hungarian mineral occurring at Unghwar, whence Glocker's name Unghwarite. It is described as breaking into parallelopipeds, having opposite magnetic polarity at opposite angles.

Nontronite is pale straw-yellow or canary-yellow, and greenish, with an unctuous feel; flattens and grows lumpy under the pestle, and is polished by friction; from Nontron, Dept. of Dordogne, France.

Pinguite is siskin and oil-green, extremely soft, like new-made soap, with a slightly resinous lustre, not adhering to the tongue; the original from Wolkenstein in Saxony.

Fettbol has a liver-brown color, a slightly greasy lustre, shining streak, conchoidal fracture, and G.=2·249, Breith., and is from Halsbrücke near Freiberg.

Gramenite has a grass-green color (whence the name), and occurs at Menzenberg, in the Siebengebirge, in thin fibrous seams, or as a feather of delicate lamellæ; H.=1; G.=1·87, after drying at 212° F.; lustre and feel somewhat greasy, as in pinguite.

Comp.—A hydrated silicate of iron, with probably the general formula $\overline{\text{Fe}}\,\ddot{\text{Si}}^3+4\tfrac{1}{2}\dot{\text{H}}$=Silica 42·7, sesquioxyd of iron 38·0, water 19·3=100; or $(\dot{\text{Fe}}^3, \overline{\text{Fe}})\,\ddot{\text{Si}}^3+4\tfrac{1}{2}\dot{\text{H}}$. The water and silica both vary much. The Hungarian chloropal occurs mixed with opal, and graduates into it, and this accounts for the high silica of some of its analyses.

Analyses: 1, 2, Bernhardi & Brandes (l. c.); 3, 4, Hiller (Jahresb., 1857, 671); 5, Thomson (Min., i. 464); 6, v. Hauer (Ber. Ak. Wien, xii. 161, 1854); 7, Berthier (Ann. Ch. Phys., xxxv. 92); 8, Dufrénoy (Ann. d. M., III. iii. 393); 9, Jacquelin (Ann. Ch. Phys., xlvi. 101); 10, Biewend (J. pr. Ch., xi. 162); 11, 12, Mehner (J. pr. Ch., xlix. 382); 13, H. Müller, 14, E. Uricoechea (this Min., 1854, 337); 15, Kersten (Schw. J., lxvi. 9); 16, Bergemann (l. c.); 17, Kersten (Schw. J., lxvi. 31):

		$\ddot{\text{Si}}$	$\overline{\text{Fe}}$	$\overline{\text{Al}}$	$\dot{\text{Mg}}$	$\dot{\text{H}}$
1.	Unghwar, *compact*	46	33	1	2	18=100 Bernhardi & Brandes.
2.	" *earthy*	45·00	32·00	0·75	2·00	20·0=99·75 Bernhardi & Brandes.
3.	Steinberg, *comp.*	71·6	16·3	2·1	1·5	8·3=99·8 Hiller.
4.	" *earthy*	39·7	28·0	3·7	2·4	26·1=99·9 Hiller.
5.	Ceylon	53·00	26·04	1·80	1·40	18·00=100·24 Thomson.
6.	*Unghwarite*	(½) 57·76	$\dot{\text{Fe}}$ 20·86	——	——	19·78, $\dot{\text{Ca}}$ 1·77=100 Hauer.
7.	Nontron, *Nontronite*	44·0	29·0	3·6	2·1	18·7, clay 1·2=98·6 Berthier.
8.	Villefrance, "	40·68	30·19	3·96	2·37	23·00=100·20 Dufrénoy.
9.	Montmort, "	41 31	35·69	8·31	——	18·63, $\dot{\text{Ca}}$ 0·19, $\dot{\text{Cu}}$ 0·9=100·3 J.
10.	Andreasberg, "	41·10	37·30	——	——	21·56 Biewend.
11.	" *gnh.*	40·50	33·71	1·09	——	21·82, $\dot{\text{Fe}}$ 2·26, $\dot{\text{Ca}}$ 1·11=100·48 Mehn.
12.	" *bk.*	46·21	36·32	——	*tr.*	20·38=102·91 Mehner.
13.	Tirschenreuth, *Nontr.*	47·1	35·75	7·15	*tr.*	10·00=100 Müller.
14.	" "	47·59	42·49		0·13[a]	9·79=100 Uricoechea.
15.	Wolfenstein, *Pinguite*	36·90	29·50	1·80	0·45	25·10, $\dot{\text{Fe}}$ 6·10, $\dot{\text{Mn}}$ 0·15=100 Kerst.
16.	*Gramenite*	38·39	25·46	6·87	0·75	23·36, $\dot{\text{Fe}}$ 2·80, $\dot{\text{Mn}}$ 0·67, $\dot{\text{Ca}}$ 0·56, $\dot{\text{K}}$ 1·14 =100 Bergemann
17.	*Fettbol*	46·40	23·50	3·01	——	24·50=97·41 Kersten.

[a] With some potash.

Kobell found, after expelling the water (J. pr. Chem., xliv. 95):

	$\ddot{Si}$	$\dddot{\overline{Fe}}$	$\dddot{\overline{Al}}$	$\dot{Ca}$	$\dot{Mg}$
1. Haar	52·10	40·60	3·00	1·60	1·08=98·33.
2. Hungary	52·33	43·34	2·32	0·93	0·73=99·65.

This chemist regards the chloropal as a mixture of $\dddot{\overline{Fe}}\,\ddot{Si}^3+2\dot{H}$ and *opal;* and he writes the same formula for nontronite and pinguite.

Pyr. etc.—Yields water. B.B. infusible, but turns black and becomes magnetic. With the fluxes gives reactions for iron. Chloropal is partially decomposed by muriatic acid; pinguite is completely decomposed, with separation of pulverulent silica, while nontronite gelatinizes with muriatic acid.

Obs.—Localities are mentioned above. The locality of *chloropal* at Meenser Steinberg (anal. 3 is near Göttingen; *pinguite* occurs also at Sternberg in Moravia.

Named from χλωρός, *green*, and *opal*.

Chloropal also occurs (Church, Chem. News, 1866, ii. 71) in a china-stone quarry, near the old tin mine known as Carclase, not far from St. Austell, in Cornwall, associated with fluor; it is the variety which has been named *gramenite*.

409. GLAUCONITE. Glaukonit *Keferstein*, Deutsch. geol. dargest., v. 510, 1828, *Glocker*, Handb., 832, 1831. Grünerde pt. *Germ.* Green Earth pt. Terre verte pt. *Fr.* Chlorophänerit *Jenzsch*, Jahrb. Min., 798, 1855.

Amorphous, and resembling earthy chlorite. Either in cavities in rocks, or loosely granular massive.

H.=2. G.=2·2–2·4. Lustre dull, or glistening. Color olive-green, blackish-green, yellowish-green, grayish-green. Opaque.

Comp., Var.—Essentially a hydrous silicate of iron and potash; but the material is mostly, if not always, a mixture, and consequently varies much in composition. In most of the analyses the state of oxydation of the iron was not determined. Haushofer, who examined this point, gives as the most common oxygen ratio for $\dot{R}$, $\dddot{\overline{R}}$, $\ddot{Si}$, $\dot{H}$, 1 : 3 : 9 : 3, and writes the formula $\dot{R}\,\ddot{Si}+\dddot{\overline{R}}\,\ddot{Si}^2+3\dot{H}$=(if $\dot{R}=\frac{1}{2}\dot{Fe}+\frac{1}{2}\dot{K}$, and $\dddot{\overline{R}}=\frac{4}{5}\dddot{\overline{Fe}}+\frac{1}{5}\dddot{\overline{Al}}$) Silica 49·3, alumina 3 6, sesquioxyd of iron 22·7, protoxyd of iron 6·3, potash 8·3, water 9·6. The ratio is that of a hornblende, and especially acmite, excepting the water and the presence of potash in place of soda, this ratio between the bases and silica being 1 : 2¼. Differs from celadonite in being decomposed by muriatic acid.

The kinds of glauconite are:

1. Green earth of cavities in eruptive rocks: to which the *chlorophanerite* of G. Jensch may perhaps be added.

2. Green grains of sand beds or rocks, as of the green sand of the chalk formation, rarely found in limestones; called *glauconite* (in allusion to the green color). H.=2; G.=2·29–2·35; color olive-green to yellowish-green.

Analyses: 1, Delesse (Bib. Univ. Gen. 1848, June, 106); 2, 3, Waltershausen (Vulk. Gest., 301); 4, G Jenzsch (l. c.); 5, S. L. Dana (Hitchcock's G. R. Mass., 93, 1841); 6–8, Rogers (G. Rep N. J., 201–204); 9, Fisher (Am. J. Sci., II. ix. 83); 10, Berthier (Ann. d. M., xiii.); 11, D. H. von Dechen (Verh. nat. Ver. Bonn, 1855, 176); 12, W. van der Marck (ib., 1855, 263); 13–15 Mallet (Am. J. Sci., II. xxiii. 181); 16–18, T. S. Hunt (Rep. G. Can., 1863, 486–488); 19, 20 Berthier; 21–27, Haushofer (J. pr. Ch., xcvii. 353); 28, id. (ib., cii. 38); 29, H. Wurtz (Am. J Sci., II. x. 326):

1. *From eruptive rocks.*

	$\ddot{Si}$	$\dddot{\overline{Al}}$	$\dddot{\overline{Fe}}$	$\dot{Fe}$	$\dot{Mg}$	$\dot{Ca}$	$\dot{Na}$	$\dot{K}$	$\dot{H}$	
1. Mt. Baldo	51·25	7·25	——	20·72	5·98	——	1·92	6·21	6·49=100	Delesse.
2. Berufiord, Icel'd	52·04	4·93	——	25·54	4·26	1·38	——	6·03	5·19=99·37	Waltersh.
3. Eskifiord, "	60·09	5·28	——	15·72	4·96	0·09	2·51	5·04	4·44=98·13	Waltersh.
4. *Chlorophanerite*	59·4	*undet.*	——	12·3		*undetermined*			5·7	Jenzsch.

2. *Glauconite, from sedimentary beds; or, rarely, from limestone strata.*

5. Gay Head, Mass.	56·70	13·32	——	20·10	1·18	1·62	——	——	——=99·92	Dana.
6. Cauley's Pits, Woodstown, N.J.	48·45	6·30	——	24·31	——	*tr.*	——	12·01	8·40=99·47	Rogers.
7. Sculltown, N. J.	51·50	6·40	——	24·30	*tr.*	——	——	9·96	7·70=99·86	Rogers.

		S̈i	A̶l	F̶e	Ḟe	Ṁg	Ċa	Ṅa	K̇	Ḣ
8.	Poke Hill, Burlingt. Co., N.J.	50·75	6·50	——	22·14	——	——	——	12·96	7·50=99·85 Rogers.
9.	S. E. of Phil. in N. J.	53·26	3·85	——	24·15	1·10	1·73	1·60	5·36	10·12=101·12 Fisher.
10.	Germany	52·1	6·2	——	22·1	4·3	——	——	6·0	10·0 Berthier.
11.	Essen, Westph.	58·17	10·09	——	18·75	3·37	——	——	3·37	6·25=100 Dechen.
12.	Werl, Westph.	53·46	5·00	——	21·78	6·21	——	——	8·79	[4·76]=100 Marck.
13.	Coal Bluff, Ala. (½)	57·56	6·56	——	20·13	1·70	1·04	——	4·88	8·17=100·04 Mallett.
14.	" "	58·91^b	5·48	——	19·24	0·87	0·71	——	4·58	8·17, pyrites 1·46=99·42 Mallet.
15.	Gainesville, Ala. R.	58·74^a	4·71	——	21·06	1·48	0·92	——	3·26	9·79=99·96, F̶e *tr.* Mall.
16.	New Jersey	50·70	8·03	——	22·50	2·16	1·11	0·75	5·80	8·95=100 Hunt.
17.	Orleans Id., Can.	50·7	19·8	——	8·6	3·7	——	0·5	8·2	8·5=100 Hunt.
18.	Red Bird, Miss.	46·58	11·45	——	20·61	1·27	2·49	0·98	6·96	9·66=100 Hunt.
19.	Havre	49·7	6·9	——	19·5	——	——	——	10·6	12·0=98·7 Berthier.
20.	Glaris	52·3	5·6	——	23·0	——	4·9	——	3·0	8·5=98·3 Berthier.
21.	Kressenberg	49·5	8·2	22·2	6·8	——	——	——	8·0	9·5=99·2 Haushofer.
22.	Roding	50·2	1·5	28·1	4·2	——	——	——	5·9	8·6=98·5 Haushofer.
23.	" (⅔)	49·4	7·1	20·07	8·8	——	——	——	5·75	12·75=98·87 Haushofer.
24.	Benedictbeuern	47·6	4·2	21·6	8·0	1·4	2·4	——	4·6	14·7=99·5 Haushofer.
25.	Ortenburg	48·99	6·4	25·8	4·8	*tr.*	0·78	——	5·18	8·98=100·98 Haushofer.
26.	Sorg	50·8	6·7	21·8	3·1	4·2	*tr.*	——	3·1	9·8=99·5 Haushofer.
27.	Bayreuth (½)	49·1	7·05	23·6	8·25	——	——	——	5·75	10·1=98·85 Haushofer.
28.	Havre, France	50·62	3·80	21·03	6·02	——	——	——	7·14	9·14, Ṁg, Ċa, C̈ 1·11=99·86 Haushofer.
29.	Shrewsb'y, N. J. (½)	48·03	33·94			1·30	——	——	5·66	11·50=99·93 Wurtz.

^{a} 11·85 p. c. of Si O^2 insol. in carb soda. ^{b} 28·89 p. c. of Si O^2 insol. in carb. soda.

Anal. 3, G.=2·166; 13, G.=2·297; 15, G.=2·349; 16, 17, fr. Lower Silurian rocks of the Quebec Group; 18, fr. Lower Magnesian Limestone, Lower Silurian; 21–25, 28, 29, Cretaceous; 26, Jurassic; 27, Triassic (Muschelkalk). In 29, 4·81 out of the 11·50 Ḣ called hygroscopic.

Pyr., etc.—Yields water. Fuses easily to a dark magnetic glass. Some varieties are entirely decomposed by muriatic acid, while others are not appreciably attacked.

A green calcite from Central India contains a skeleton of glauconite—separable by acids—constituting about 14 p. c. of the whole, which afforded S. Haughton, on analysis (Phil Mag., IV. xvii. 6), S̈i 54·59, A̶l 4·74, Ḟe 22·84, Mg 4·90, Ca 0·94, Ḣ and loss 11·99. He names the rock, which is a mixture of calcite and glauconite, *Hislopite.* An analysis by Haushofer of a glauconitic limestone (muschelkalk) from Würzburg is given in J. pr. Ch., xcix. 237.

The glauconite grains are most abundant in the "green sand" of the chalk formation, sometimes constituting 75 to 90 p. c. of the whole. They are often casts of the shells of Rhizopods. The material has also been found in Silurian rocks, and beds of other geological periods, and even in the shells of recent Rhizopods, and in fragments of coral obtained in deep sea soundings (Am. J. Sci., II. xxii. 281). The glauconite of the Silurian, analyzed by Hunt, contains less iron and more alumina than that of the chalk formation.

The following are analyses of material usually called "green earth." It occurs often in the form of pseudomorphs; that of Fassa having the form of pyroxene; of Framont, lining pyroxene crystals and filling cavities among them, as if a result of their alteration. 1, 2, Rammelsberg (Min. Ch., 489); 3, Delesse (Ann. d. M., IV. iv. 351):

		S̈i	A̶l	F̶e	Ḟe	Ṁg	Ċa	Ṅa	K̇	Ḣ
1.	Fassa, *pseud.*	45·87	11·18	24·63		0·28	1·50		5·52	9·82 Rammelsberg.
2.	" "	39·48	10·31	8·94	15·66	1·70	——		4·41	4·24, Ċa C̈ 15·26 Rammelsberg.
3.	Framont	43·50	16·61	8·88	11·83	6·66	——	0·69	3·14	7·15, Ṁn 0·80=99·26 Delesse.

410. CELADONITE. Terre verte de Verone *de Lisle*, Crist., ii. 502, 1783. Grünerde *Hoffm.*, Bergm. J., 519, 1788. Green Earth pt.; Green Earth of Verona. Seladonit *Glock.*, Syn., 193, 1847. Celadonite *Fr.*

Earthy or in minute scales, forming nodules or filling cavities in eruptive rocks. Very soft. Color deep olive-green, celandine-green, apple-green. Feel more or less greasy.

Comp.—Analysis by Klaproth (Beitr., iv. 239):

Mt. Baldo $\ddot{\text{Si}}$ 53 $\dddot{\text{F}}\text{e}$ 28 $\dot{\text{Mg}}$ 2 $\dot{\text{K}}$ 10 $\dot{\text{H}}$ 6 = 99.

Pyr., etc.—According to Klaproth, and also later, von Kobell, *not* acted on by muriatic acid.

Obs.—From cavities in amygdaloid at Mt. Baldo near Verona.

Named in allusion to the ordinary color of the mineral, *celadon-green*, equivalent in French to sea-green (written *Seladon* in German), for which term the English substituted *celandine-green*.* Celadon is the name of one of the characters in a French romance by d'Urfé, entitled Astrée, published in 1610. He was a weak verdant lover of insipid tenderness, and thence the application to the above variety of green. D'Urfé borrowed the name from Ovid; it comes originally from κελάδωι, *burning*.

II. UNISILICATES.

411. SERPENTINE. 'Οφίτης pt. *Dioscor.*, v. 161. Ophites pt. *Vitruv.*, *Plin.* Ophites, Serpentaria, *Agric.*, Foss., 304, 309, 1546. Marmor Serpentinum, M. Zeblicium, Serpenstein Germanice, Lapis Serpentinus, *B. de Boot*, 1636, pp. 502, 504. Telgsten pt., Ollaris pt., Marmor Serpentinum, M. Zöblizense, Lapis Colubrinus, *Wall.*, 135, 1747. Serpentine *Fr. Tr.* Wall., 1753. Serpentin, Zöblitzer S., *Cronst.*, 76, 1758.

Orthorhombic? In distinct crystals, but only as pseudomorphs. Sometimes foliated, folia rarely separable; also delicately fibrous, the fibres often easily separable, and either flexible or brittle. Usually massive, fine granular to impalpable or cryptocrystalline; also slaty.

H.=2·5—4, rarely 5·5. G.=2·5—2·65; some fibrous varieties 2·2—2·3; retinalite, 2·36—2·55. Lustre subresinous to greasy, pearly, earthy; resin-like, or wax-like; usually feeble. Color leek-green, blackish-green; oil and siskin-green; brownish-red, brownish-yellow; none bright; sometimes nearly white. On exposure, often becoming yellowish-gray. Streak white, slightly shining. Translucent—opaque. Feel smooth, sometimes greasy. Fracture conchoidal or splintery. Polarization in crystals, none, or only irregular colors, as in amorphous or cryptocrystalline substances; usually apparent in laminated and fibrous varieties, with the bisectrix negative and normal to the plane of lamination or to that of the fibrous structure.

Var.—Many unsustained species have been made out of serpentine, differing in structure (massive, slaty, foliated, fibrous), or, as supposed, in chemical composition; and these now, in part, stand as varieties, along with some others based on variations in texture, hardness, etc.

A. MASSIVE. (1) *Ordinary massive.* (*a*) *Precious* or *Noble Serpentine* (Edler Serpentin *Germ.*) is of a rich oil-green color, of pale or dark shades, and translucent even when in thick pieces; and (*b*) *Common Serpentine*, when of dark shades of color, and subtranslucent. The former has a hardness of 2·5—3; the latter often of 4 or beyond, owing to impurities.

2. *Resinous.* *Retinalite* Thomson (Min., i. 201, 1836) is massive serpentine, having honey-yellow to light oil-green colors, and waxy or resin-like lustre and aspect. H.=3·5; G.=2·47—2·52, Grenville, Hunt, 2·36—2·38, Calumet Id., Hunt. It much resembles deweylite. It affords, on analysis, 3 p. c. more of water than ordinary serpentine; and it is probable that the mineral is a mixture of serpentine and deweylite. Named from ῥητίνη, *resin*, and from specimens obtained at Grenville, C. W. *Vorhauserite* Kenngott (Min. Forsch., 1856–57, 71) is the same, though brown to greenish-black in color. H.=3·5; G.=2·45. From the Fleims valley, Tyrol.

3. *Porcellanous; Porcellophite.* The "meerschaum" of Taberg & Sala is a soft earthy serpen-

---

* Jameson has *seladon-green* (from Werner) in his Treatise on the External Characters of Minerals, 1805; and *celandine-green* in his System of Mineralogy, i. 466, 1816.

tine, resembling meerschaum in external appearance (Berlin, Ak. H. Stockh., 1840). This variety is sometimes very soft when first taken out. A variety resembling compact lithomarge occurs at Middletown, Delaware Co., Pa. (anal. 37). It has a smooth, porcelain-like fracture; H.=3·5, G.=2·48.

4. *Bowenite* Dana (Min., 265, 1850, Nephrite *Bowen*, Am. J. Sci., v. 346, 1822) is massive, of very fine granular texture, and much resembles nephrite, and was long so called. It is apple-green or greenish-white in color; G.=2·594—2·787, Bowen; and it has the unusual hardness 5·5—6, which is some evidence that this variety may be a good species, although proved by Smith & Brush to be identical with serpentine in composition. From Smithfield, R. I.

B. LAMELLAR.

5. *Antigorite* Schweizer (Pogg., xlix. 595, 1840) is thin lamellar in structure, easily separating into translucent or subtransparent folia; H.=2·5; G.=2·622; color brownish-green by reflected light, and leek-green by transmitted; feel smooth, but not greasy. Polarizes light, according to Haidinger. Named from the locality, Antigorio valley, Piedmont.

6. *Williamsite* Shepard (Am. J. Sci., II. vi. 249, 1848) is a lamellar impure serpentine, of apple-green color, with H.=4·5 and G.=2·59—2·64, from Texas, Pa. Does not doubly refract, Descl. Graduates into a massive granular variety.

C. THIN FOLIATED.

7. *Marmolite* Nuttall (Am. J. Sci., iv. 19, 1822, but shown to be a variety of serpentine by Vanuxem, J. Acad. Sci. Philad., iii. 133, 1823) is thin foliated; the laminæ brittle but easily separable, yet graduating into a variety in which they are not separable (which variety has sometimes been called in the United States *kerolite*). G.=2·41; lustre pearly; colors greenish-white, bluishwhite, to pale asparagus-green. From Hoboken, N. J. Folia from Hoboken without polarization, according to Websky; feebly polarizing, according to Descloizeaux.

8. *Thermophyllite* A. Nordenskiöld (Beskrifn. Fin. Min., 160, 1855, Hermann, J. pr. Ch., lxxiii. 213). Occurs in small scaly crystals aggregated into masses, with an amorphous steatite-like base. B.B. crystals exfoliate like vermiculite or pyrophyllite. H.=2·5; G.=2·61, Nord.; 2·56, Herm. Lustre of cleavage surface pearly; color light brown to silver-white and yellowish-brown. Optically biaxial; the axial angle 22° 20′; bisectrix negative, normal to plane of cleavage, Miller. From Hopansuo, Finland.

D. FIBROUS.

9. *Chrysotile* v. Kobell (J. pr. Ch., ii. 297, 1834, xxx. 467, 1843; Schillernder Asbest; Amianthus pt.) is delicately fibrous, the fibres usually flexible and easily separating; lustre silky, or silky metallic; color greenish-white, green, olive-green, yellow, and brownish; G.=2·219. Often constitutes seams in serpentine. It includes most of the silky *amianthus* of serpentine rocks. The original chrysotile was from Reichenstein.

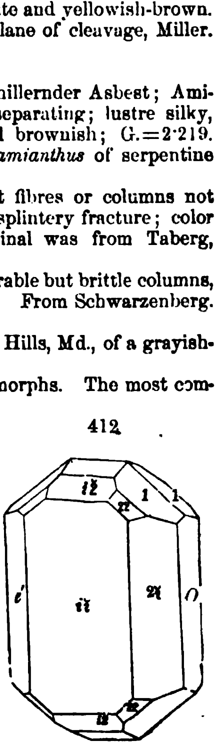
10. *Picrolite* Hausmann (Moll's Efem., iv. 401, 1808) is columnar, but fibres or columns not easily flexible, and often not easily separable, or affording only a long splintery fracture; color dark green to mountain-green, greenish, gray, and brown. The original was from Taberg, Sweden.

Metaxite Breithaupt (Char., 113, 326, 1832) is picrolite, consisting of separable but brittle columns, of a greenish-white color, and weak pearly lustre; H.=2—2·5; G.=2·52. From Schwarzenberg. Passes into a laminated variety.

Baltimorite Thomson (Phil. Mag., xxii. 191, 1843) is picrolite from Bare Hills, Md., of a grayish-green color; silky lustre, opaque, or subtranslucent, with H.=2·5—3.

E. CRYSTALLIZED SERPENTINE. The observed crystals are all pseudomorphs. The most common have the form of chrysolite, and the annexed figure represents one of this kind. Rose has observed some crystals which were still partly chrysolite. Delesse states that the serpentine of Odern graduates into feldspar, and appears to have been derived from the alteration of that mineral. Other kinds are pseudomorphs after pyroxene, amphibole, spinel, chondrodite, garnet, phlogopite, sphene, and chromic iron. Even the foliated and fibrous kinds may be partly pseudomorphous. If *marmolite* or *thermophyllite* is truly crystallized serpentine, as seems probable, the crystallization of the species is actually *micaceous*, like that of chlorite and talc.

412



F. SERPENTINE ROCKS. Serpentine often constitutes rock-masses. It frequently occurs mixed with more or less of dolomite, magnesite, or calcite, making a rock of clouded green, sometimes veined with white or pale green, called *verd-antique*, or *ophiolite*. Ophiolite is styled by Hunt (1) *dolomitic*, (2) *magnesitic*, or (3) *calcitic*, according as the serpentine is mixed with dolomite, magnesite, or calcite. Serpentine rock is sometimes mottled with red, or has something of the aspect of a red porphyry; the reddish portions containing an unusual amount of oxyd of iron. Any serpentine rock cut into slabs and polished, is called *serpentine marble.*

Comp.—O. ratio for $\dot{Mg}$, $\ddot{Si}$, $\dot{H}$=3 : 4 : 2, corresponding to 2 $\ddot{Si}$, 3 $\dot{Mg}$, 2 $\dot{H}$=Silica 44·14, magnesia 42·97, water 12·89. Formula, as commonly written, 2 $\dot{Mg}$ $\ddot{Si}$ + $\dot{Mg}$ $\dot{H}^2$. But as chrysolite is especially liable to the change to serpentine, and chrysolite is a *unisilicate*, and the change consists in a loss of some $\dot{Mg}$, and the addition of water, it is probable that part of the water takes the place of the lost $\dot{Mg}$, so that the mineral is essentially a hydrated chrysolite of the formula $(\frac{3}{4}\dot{Mg} + \frac{1}{4}\dot{H})^2 \ddot{Si} + \frac{1}{2}\dot{H}$. The relation in O. ratio to kaolinite and pinite corresponds with this view of the formula.

Analyses: A. *Massive Serpentine.* 1, Hartwall (Jahresb., ix. 204); 2, Scheerer (Pogg., lxviii. 328); 3, Hermann (J. pr. Ch., xxxii. 499); 4, Genth (Am. J. Sci., II. xxxiii. 201); 5, Kersten (J. pr. Ch., xxxvii. 167); 6, Hisinger (Afhandl., iv. 341); 7, Lychnell (Ak. H. Stockh, 1826. 175); 8, Jordan, 9, Marchand (J. pr. Ch., xxxii. 499); 10, Mosander (Ak. H. Stockh., 1825, 227); 11, Lychnell (l. c.); 12, 13, 14, Schweizer (J. pr. Ch., xxxii. 378); 15, Haughton (Phil. Mag., IV. x. 253); 16, Lychnell (l. c.); 17, C. W. Hultmark (J. pr. Ch., lxxix. 378); 18, A. E. Arppe (Act. Soc. Fenn., vi., and Verh. Min. St. Pet., 1862, 149); 19, 20, Haughton (l. c.); 21, v. Merz (Nat. Ges. Zurich, 1861); 22, Vanuxem (J. Ac. Sci. Philad., iii. 133); 23, Lychnell (l. c.); 24–27, T. S. Hunt (Rep. G. Can., 1851, 1857, 1863); 28, 29, C. T. Jackson (Proc. Bost. Soc. N. Hist., 1856); 30, Sharples (Am. J. Sci., II. xlii. 272); 31–33, T. S. Hunt (l. c.); 34, E. A. Manice (priv. contrib.); 35, Œllacher (Jahrb. G. Reichs, 1857, 358); 36, Smith & Brush (Am. J. Sci., II. xv. 212); 37, B. S. Burton (priv. contrib.).

B. *Lamellar Serpentine.* 38, Brush (Am. J. Sci., II. xxiv. 128); 39. Stockar-Escher (Kenng. Uebers., '56–'57, 72); 40, H. v. Gilm (Ber. Ak. Wien, xxiv. 287); 41, Ivanof (Jahresb., xxv. 344); 42, 43, Schweizer (l. c.); 44, v. Merz (l. c.); 45, 46, Smith & Brush (Am. J. Sci., II. xv. 212); 47, Hermann (J. pr. Ch., liii. 31); 48, Delesse (Ann. d. M., IV. xiv. 78).

C. *Thin-foliated Serpentine.* 49, Garrett (this Min., 1850, 692); 50, Lychnell (l. c.); 51, Shepard (Min., i. 292, 1835); 52, 53, Vanuxem (J. Acad. Sci. Philad., iii. 133); 54, Hermann (J. pr. Ch., xlvi. 230); 55, Arppe (Anal. finska Min., 27); 56, Hermann (J. pr. Ch., lxxiii. 213); 57, Northcote (Phil. Mag, IV. xvi. 263, J. pr. Ch., lxxvi. 253).

D. *Fibrous or columnar varieties.* 58, Stromeyer (Unters., 365); 59, List (Ann. Ch. Pharm., lxxiv. 241); 60, Lychnell (l. c.); 61, Rammelsberg (3d Suppl., 107); 62, Brewer (this Min., 1850, 692); 63, v. Kobell (J. pr. Ch., ii, 297); 64, Brush (this Min., 1854, 283); 65, Reakirt (Am. J. Sci., II. xviii. 410); 66, Delesse (l. c.); 67, Hultmark (J. pr. Ch., lxxix. 378); 68, Schaffgotsch (Rose, Reise Ural, i. 245); 69, Gilm (Ber. Ak. Wien, xxiv. 287); 70, Schweizer (l c.); 71, Kühn (Ann. Ch. Pharm., lix. 369); 72, Plattner (Prob. Loth., 2d edit., 211); 73, Kühn (l. c.); 74, Delesse (Thèse Anal., 24); 75, T. S. Hunt (Rep. G. Can., 1866, 205); 76. Hunt (ib., 1863, 472); 77, Thomson (Phil. Mag., xxii. 193); 78, E. Schmidt (J. pr. Ch., xlv. 14)

A. *Massive Serpentine.*

		$\ddot{Si}$	$\ddot{\bar{A}}l$	$\dot{Fe}$	$\dot{Mg}$	$\dot{H}$
1.	Snarum, *Pseud.-Chrys.*	42·97	0·87	2·28	41·66	12·02=100 Hartwall.
2.	" "	40·71	2·39	2·43	41·48	12·61=99·62 Scheerer.
3.	L. Auschkul, "	40·21	1·82	9·13	35·08	13·75=100 Hermann.
4.	Webster, N. C. "	43·87	0·31	7·17	38·62	9·55, $\dot{Mn}$ *tr.*, $\dot{Ni}$ 0·27, $\dot{Ca}$ 0·02, chromic iron 0·57=100·88 Genth
5.	Schwarzenberg, *Pseud.-Garnet*	41·50	—	4·10	40·34	12·87, $\dot{Mn}$ 0·5, $\dot{Na}$ 0·42, $\dot{Ca}$, bit. *tr* =99·73 Kersten
6.	Fahlun, *precious S.*	43·07	0·25	1·17	40·37	12·45, $\dot{Ca}$ 0·50=97·81 Hisinger.
7.	" "	41·95	0·37	2·22	40·64	11·68, $\ddot{C}$, bit. 3·42=100·28 Lychn
8.	" "	40·32	—	3·33	41·76	13·54=98·95 Jordan.
9	" "	40·52	0·21	3·01	42·05	13·85, bit. 0·3=99·94 Marchand.
10.	Wermland	42·34	—	0·18	44·20	12·38, $\ddot{C}$ 0·89=99·97 Mosander.
11.	Sjögrube	41·58	*tr.*	2·17	42·41	11·29, $\ddot{C}$, bit. 3·42 Lychnell.
12.	Zermatt, *yw.-gn.*	43·66	0·64	1·96	41·12	13·57=100·95 Schweizer.
13.	" "	43·60	—	2·09	40·46	14·73=100·88 Schweizer.
14.	Wallis Alps, *bkh.-gn.*	44·22	0·36	4·90	36·41	13·11=100 Schweizer.
15.	Zermatt, *pale gn.*	42·88	—	3·80	40·52	12·64=99·84 Haughton.
16.	Sala	42·16	—	2·03	42·26	12·33, $\ddot{C}$ 1·03 Lychnell.
17.	"	41·02	1·84	1·81	42·21	12·91, $\ddot{C}$ 0·48 Hultmark.
18.	Lupikko, Finland	42·40	0·30	3·81	39·91	12·79, $\dot{K}$ 0·48=99·69 Arppe.
19.	Galway	40·12	*tr.*	3·47	40·04	13·36, $\ddot{C}$ 2·00=98·99 Haughton
20.	Syria	41·24	—	7·41	36·28	14·16=99·09 Haughton.
21.	Zermatt, Findel Gl., *wh., gyh.-gn.*	42·13	—	2·23	42·90	13·60=100·86 v. Merz.
22.	Newburyport, *precious*	42	—	1	40	14·38=97·38 Vanuxem.
23.	Massachusetts	43·20	—	5·24	40·09	11·42=99·95 Lychnell.
24.	Orford, Can., *olive-gn.*	40·30	—	7·02	[39·07]	13·35, $\dot{Ni}$ 0·26, $\ddot{\bar{C}}r$ *tr.*=100 Hun

	$\ddot{Si}$	$\bar{\dddot{Al}}$	$\dot{Fe}$	$\dot{Mg}$	$\dot{H}$
25. Orford, Can., *bkh.-gn.*	42·90	—	7·47	36·28	13·14, $\dot{Ni}$ 0·15, $\bar{\dddot{Cr}}$ 0·25=100·19 H.
26. Ham, Can., *gnh.-w.*	43·40	—	3·60	40·00	13·00=100 Hunt.
27. Syracuse, N. Y.	40·67	5·18	8·12	32·61	12·77=99·30 Hunt.
28. Roxbury	42·60	—	8·30	35·50	13·00, $\dot{Ca}\ddot{C}$ 0 60=100 Jackson.
29. Lynnfield	37·5	—	2·5	41·0	15·0, $\dot{Ca}\ddot{C}$ 4·0=99 Jackson.
30. E. Goshen, Pa., *precious*	43·89	—	1·38	40·48	13·45=99·20 Sharples.
31. Grenville, *Retinalite*	39·34	—	$\bar{\dddot{Fe}}$ 1·80	43·02	15·09=99·25 Hunt.
32. " "	40·10	—	" 1·90	41·65	15·00=99·55 Hunt.
33. Calumet Id., "	41·20	—	0·80	43·52	15·40=100·92 Hunt.
34. Montville, "	42·52	—	1·96	42·16	14·22=100·86 Manice.
35. Monzoni, *Vorhauserite*	41·21	—	1·72	39·24	16·16, $\dot{Mn}$ 0·30, $\dot{Ca}^3\bar{P}$ & Ca Cl 0·96=99·59 Œllacher
36. Smithfield, *Bowenite*	(¾) 42·29	*tr.*	1·21	42·29	12·96, $\dot{Ca}$ 0·63=99·38 S. & B.
37. Middletown, *Porcell.*	(¾) 44·08	0·30	1·17	40·87	13·70, $\dot{Ca}$ 0·37=100·49 Burton.

B. *Slaty Serpentine.*

38. *Antigorite*	41·58	2·60	7·22	36·80	12·67, $\dot{Ni}$, $\dot{Cr}$ *tr.*=100·87 Brush.
39. "	40·83	3·20	5·84	36·26	12·37=98·86 S.-Eschor.
40. Kalser Valley, Tyrol	42·42	0·65	5·71	38·05	12·91=99·74 Gilm.
41. Talovsk, Ural	40·80	3 02	2·20	40·50	12·02, $\dot{Mn}$ 0·20, $\dot{Ca}$ 0·42=97·16 Iv.
42. Canton Wallis, *leek-gn.*	44·22	1·10	5·44	37·14	12·43=100 Schweizer.
43. Zermatt, *bh.-gn.*	43·78	2·24	10·87	28·21	14·60=99·70 Schweizer.
44. " *pale ywh.-gn.*	42·45	—	2·12	42·56	13·70=100·83 v. Merz.
45. *Williamsite*	41·60	*tr.*	3·24	41·11	12·70, $\dot{Ni}$ 0·50=99·15 S. & B.
46. "	42·60	*tr.*	1·62	41·90	12·70, $\dot{Ni}$ 0·40=99·22 S. & B.
47. "	(?) 44·50	0·75	1·39	39·71	12·75, $\dot{Ni}$ 0 90=100 Hermann.
48. Villa Rota, *gyh.-gn.*	41·34	3·22	5·54	37·61	12 06=99·77 Delesse.

C. *Thin-foliated Serpentine.*

49. Hoboken, *Marmolite*	42·32	0·66	1·28	42·23	13·80=100·29 Garrett.
50. " "	41 67	—	$\bar{\dddot{Fe}}$ 1·64	41·25	13·80, $\ddot{C}$, bit. 1·37=99·73 L.
51. Blanford, "	40·00	—	$\dot{Fe}$ 2·70	41·40	15·37, $\dot{Ca}$ 0·93=100·70 Shepard.
52. Hoboken, "	40·	—	$\bar{\dddot{Fe}}$ 0·90	42·	16·45=99·35 Vanuxem.
53. Bare Hills, "	42·69	—	" 1·16	40·	16 11=99·6 Vanuxem.
54. Finland	40·0	—	1·8	42·4	15·8 =100 Hermann.
55. " *Thermophyllite*	(⅔) 41·20	1·71	1·20	39·58	10·84, $\dot{K}$ 3·19, $\dot{Na}$ 0·46=99·18 A.
56. " "	43·12	4·91	$\bar{\dddot{Fe}}$ 1·99	34·87	13·14, $\dot{Na}$ 1·33=99·36 Hermann.
57. " "	(½) 41·48	5·49	1·59	37 42	10·88, $\dot{Na}$ 2·84=99·70 Northcote.

D. *Fibrous or Columnar Varieties.*

58. Wermland, *Picrolite*	41·66	—	4·05	37·16	14·72, $\bar{\dddot{Mn}}$ 2·25=99·84 Stromeyer.
59. Reichenstein, "	44·61	—	2·63	39·75	12·57=99·56 List.
60. Taberg, "	40·98	0·73	8·94	33·44	12·86, $\ddot{C}$ 1·73=98·68 Lychnell.
61. Texas, Pa., "	43·79	—	2·05	41·03	12·47=99·34 Rammelsberg.
62. " "	44·25	4·90	3·67	34·00	12·32, $\dot{Ni}$ 0·69=99·83 Brewer.
63. Reichenstein, *Chrysotile*	43·50	0·40	2·08	40·00	13·80=99·78 Kobell.
64. N. Haven, Ct., "	44·05	—	2·53	39·24	13·49=99·31 Brush.
65. Montville, N. J., "	42·62	0·38	0·27	42·67	14·25=100·19 Reakirt.
66. Vosges, "	41·58	0·42	1·69	42·61	13·70=100 Delesse.
67. Sala, "	41·03	1·43	1·25	42·31	13·72, $\dot{Mn}$, $\ddot{C}$ *tr.*=99·74 Hultm.
68. Gornoschit	43·73	0·81	6·11	37·72	11·63=100 Schaffgotsch.
69. Pregratten, Tyrol	42·81	0·62	5·98	38·71	12 54=100·04 Gilm.
70. Zillerthal	41·69	1 56	2·07	40·38	12·82=98·47 Schweizer.
71. Schwarzenberg, *Metaxite*	43·48	—	2·20	41·00	12·95=99·63 Kühn.
72. " "	43 60	6·10	$\bar{\dddot{Fe}}$ 2·80	34·24	12·67=99·41 Plattner.
73. Reichenstein, "	44·48	—	2·84	40·60	12·35=99·77 Kühn.
74. " "	42·1	0·4	3·0	41·9	13·06=100 Delesse.
75. Petite Nation, Can.	43·65	—	1·46	41·57	13·48=100·16 Hunt.
76. Bolton, Canada	43·70	—	3·51	40·68	12·45=100·34 Hunt.
77. Bare Hills, *Baltimorite*	40·95	1·50	10·05	34·74	12·60=99·80 Thom[illegible]
78. Zöblitz, *Asbestus*	43·70	2·76	10·03	29·96	12·27, $\dot{Na}$ 1·98=10[illegible] Schm[illegible]

In anal. 3, G.=2·57; 12, G.=2·546—2·553; 18, G.=2·547; 24, G.=2·597; 26, G.=2·546, 40, G.=2·593; 41, G.=2·55; 44, H.=3·5; 48, G.=2·644; 64, G.=2·49; 76, G.=2·6[illegible]7. No. 34 accompanies the chrysotile of No. 65.

On composition of *serpentine rocks*, and of the carbonate mixed with serpentine in verd-antique marble, see *Jackson* in Proc. N. H. S. Bost., 1856, and Am. J. Sci., II. xxiii. 123; *T. S. Hunt*, Am. J. Sci., II. xxvi. 234, and Logan's Rep., 1863, p. 609; also *Haughton*, Phil. Mag., IV. x. 253, where he gives the composition of the red base of a "serpentine porphyry," so called because of its aspect; *C. Schmidt*, Ann. Ch. Pharm., cii. 190, on the rock near the Tuscan boric acid fumaroles.

An impure *serpentine* from Aker, Sudermannland, transparent and yellowish, afforded Lychnell (Ak. H. Stockh., 1826) $\ddot{\mathrm{Si}}$ 35·28, $\dddot{\bar{\mathrm{Al}}}$ 13·73, $\dot{\mathrm{Fe}}$ 1·79, $\dot{\mathrm{Mg}}$ 35·35, $\dot{\mathrm{H}}$ 7·33, $\ddot{\mathrm{C}}$ and bitumen 6·28=99·76. Berzelius referred it to pyrosclerite.

Von Hauer analyzed a mineral from near Baltimore, which he calls *baltimorite*, that afforded him (Jahrb. G. Reichs., 1853) $\ddot{\mathrm{Si}}$ 27·15, $\dddot{\bar{\mathrm{Al}}}$ 18·54, $\dot{\mathrm{Ca}}$ 15·08, $\dot{\mathrm{Mg}}$ 26·00, $\dot{\mathrm{H}}$ 13·23=100. G. J Brush found in the *metaxite* of Schwarzenberg (priv. contrib.) only 0·78 p. c. of $\dddot{\bar{\mathrm{Al}}}$, with 45·03 $\ddot{\mathrm{Si}}$, and 2·98 $\dot{\mathrm{Fe}}$.

Nuttall gave the following incorrect analysis of the marmolite of Hoboken in connection with his first description of the mineral (Am. J. Sci., iv. 21, 1822): $\ddot{\mathrm{Si}}$ 36·0, $\dot{\mathrm{Mg}}$ 46·0, $\dot{\mathrm{Ca}}$ 2·0, $\dot{\mathrm{Fe}}$ and $\dddot{\bar{\mathrm{Cr}}}$ 0·5, $\dot{\mathrm{H}}$ 15·0.

Stromeyer found of oxyd of nickel 0·32 to 0·45 p. c. in the serpentine of Roraas; 0·30 in that of Sundal; and 0·22 in that of Saxony. Lynchnell obtained 2·24 p. c. from one serpentine. Hunt has detected it in the serpentine of the Green Mountains generally, that of Roxbury, Vt., of New Haven, Ct., of Hoboken, N. J., of Cornwall, Eng., of Banffshire, Scotl., of the Vosges, Fr.; but none in the ophiolites of the Azoic (Laurentian) rocks of Canada, or the serpentine of Easton, Pa., or of the wax-yellow variety of Montville, N. J., or an olive-green from Phillipstown, N. Y., or a yellowish-green from Newburyport, Mass., having G.=2·551. See also anal. 4, 45–47, 62.

Pyr., etc.—In the closed tube yields water. B.B. fuses on the edges with difficulty. F.=6. Gives usually an iron reaction. Decomposed by muriatic and sulphuric acids. Chrysotile leaves the silica in fine fibres.

Obs.—Serpentine often constitutes mountain masses. It is a metamorphic rock, it resulting from the alteration of other rocks, and mostly of those of sedimentary origin; and is of various periods in origin, from the Azoic age upward.

Crystals of serpentine (pseudomorphous) occur in the Fassa valley, Tyrol; near Miask at Lake Auschkul, Barsovka, Katharinenburg, and elsewhere; in Norway, at Snarum; etc. Fine precious serpentines come from Fahlun and Gulsjö in Sweden, the Isle of Man, the neighborhood of Portsoy in Aberdeenshine, in Cornwall, Corsica, Siberia, Saxony, etc. The names of many localities are given above.

In N. America, in *Maine*, at Deer Isle, precious serpentine of a light green color. In *Vermont*, at New Fane, Cavendish, Jay, Roxbury, Troy, Westfield. In *Mass.*, fine at Newburyport; at Blanford with schiller spar, and the marmolite variety; also at Westfield, Middlefield, Lynnfield, Newburyport, and elsewhere. In *R. Island*, at Newport: the bowenite at Smithfield. In *Conn.*, near New Haven and Milford, at the verd-antique quarries. In *N. York*, at Phillipstown in the Highlands; at Port Henry, Essex Co.; at Antwerp, Jefferson Co., in crystals; at Syracuse, east of Major Burnet's, interesting varieties; in Gouverneur, St. Lawrence Co., in crystals, and also in Rossie, two miles north of Somerville; at Johnsburg in Warren Co.; Davenport's Neck, Westchester Co., affording fine cabinet specimens; in Cornwall, Monroe, and Warwick, Orange Co., sometimes in large crystals at Warwick; and from Richmond to New Brighton, Richmond Co. In *N. Jersey*, at Hoboken, with brucite, magnesite, etc., and the marmolite variety; also at Frankfort and Bryan; at Montville, Morris Co., silky fibrous (chrysotile) and retinalite, with common serpentine. In *Penn.*, massive, fibrous, and foliated, of various colors, purple, brown, green, and gray, at Texas, Lancaster Co.; also at Nottingham and West Goshen, Chester Co.; at Westchester, Chester Co., the *williamsite;* at Mineral Hill, Newtown, Marple, and Middletown, Delaware Co.; a variety looking like meerschaum or lithomarge at Middletown; at Easton, pseudomorphous after pyroxene and amphibole. In *Maryland*, at Bare Hills; at Cooptown, Harford Co., with diallage; also in the north part of Cecil Co. In *Canada*, at Orford, Ham, Bolton, etc. In *N. Brunswick*, at Crow's Nest in Portland.

Serpentine admits of a high polish, and may be turned in a lathe, and is sometimes employed as a material for ornaments, vases, boxes, etc. At Zöblitz in Saxony, Bayreuth, and in Franconia several hundred persons are employed in this manufacture. Verd-antique marble is clouded with green of various shades, and is a beautiful material for table and ornamental indoor work. Exposed to the weather it wears uneven, owing to its unequal hardness, and soon loses its polished surface.

The names *Serpentine*, *Ophite*, *Lapis colubrinus*, allude to the green serpent-like cloudings of the pentine marble. *Retinalite* is from *ῥητίνη*, *resin;* *Picrolite*, from *πικρός*, *bitter*, in allusion to the magnesia (or Bittererde) present; *Thermophyllite*, from θέρμη, *heat*, and φύλλον, *leaf*, on account of the exfoliation when heated; *Chrysotile*, from χρυσός, *golden*, and τίλος, *fibrous*; *Metaxite*, from μέταξα, *silk*; *Marmolite*, from μαρμαίρω, *I shine*, "in allusion to its pearly and somewhat metallic lustre" (Nuttall).

Artif.—Formed by A. Gages in a transparent amorphous mass, by placing a solution of gelatinous silicate of magnesia in a dilute solution of potash. It is deposited after some months' standing. (Rep. Brit. Assoc., 1863, 203.)

412. **BASTITE, or SCHILLER SPAR.** (Talkart *v. Trebra*, Erfahr. Inn. Gebirge, 97, 1785. Schillerspath (fr. Baste) *Heyer*, Crell's Ann., 1786, i. 335, ii. 147. Schillerstein *Wern.*, 1800, Ludw., 50, 1803. Diallage pt. *H.*, Tr., 1801. Metalloidal diallage pt. Bastit *Haid.*, Handb., 523, 1845.) Bastite is an impure foliated serpentine, occurring imbedded in serpentine rock, and is supposed to be a result of the alteration of a foliated mineral of the Pyroxene group, as long since announced by G. Rose. That of Baste, the original locality, was derived, according to Streng, from the enstatite (protobastite) of the region (see ENSTATITE, p. 208). It has H.=3·5—4; G.=2·5—2·76; lustre metallic pearly, bronze-like (to which the German name *schiller* alludes), to vitreous, and color leek-green to olive- and pistachio-green, and pinchbeck-brown. Besides the direction of perfect cleavage, there are two inclined to one another about 87° (Naumann), which is the cleavage of enstatite and hypersthene. According to Descloizeaux, it is probably orthorhombic, and has a negative bisectrix, which is normal to the plane of cleavage, and gives for the axial divergence 60° to 70°. A kind from Todtmoos in the Schwarzwald is thin foliated cleavable, and has a dark green color, but is metallic pearly on the cleavage-face; H.=3·4; G.=2·55; and shows under the microscope in polarized light that it is not homogeneous.

Analyses: 1, 2, Köhler (Pogg., xi. 192); 3, W. Hetzer (C. E. Weiss, Pogg., cxix. 446):

	$\ddot{\mathrm{Si}}$	$\ddot{\mathrm{\overline{Al}}}$	$\ddot{\mathrm{\overline{Cr}}}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Mn}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{K}}$, $\dot{\mathrm{Na}}$	$\dot{\mathrm{H}}$
1. Baste, *cryst.*	43·90	1·50	2·37	10·78	0·55	26·00	2·70	0·47	12·42=100·69.
2. " *massive*	42·36	2·17	—	13·27[a]	0·85	28·90	0·63	—	12·07=100·25.
3. Todtmoos (½)	43·77	6·10	—	7·14	—	30·92	1·17	2·79[b]	8·51=100·40.

[a] With some $Cr^2 O^3$.

[b] 1·67 $C O^2$ plus 1·12 org. subst.

In the closed tube it affords ammoniacal water. B.B. becomes brown and is slightly rounded on the thin edges. With borax reactions of iron. Imperfectly decomposed by muriatic acid, completely so by sulphuric. A mineral resembling schiller spar occurs in serpentine in Middletown, Delaware Co., Pa.

Phästine (Phästin *Breith.*, Char., 29. 180, 1823, 115, 1832) resembles somewhat schiller spar, and, according to Breithaupt, is altered bronzite. It is foliated, but the cleavage is not very easy; H.=1—1½; G.=2·825; lustre pearly; color yellowish-gray; feel greasy, talc-like. It is from Kupferberg in the Fichtelgebirge, and occurs distributed through serpentine. It has not been analyzed.

413. **DEWEYLITE.** *Emmons*, Man. Min. and Geol., 1826. Gymnite *Thomson*, Phil. Mag., xxii. 191, 1843.

Amorphous, and having some resemblance to gum arabic, or a brownish or yellow resin.

H.=2—3·5. G.=2·246, Middlefield, Shepard; 2·19—2·31, Bare Hills, Tyson; 2·216, ib., Thomson; 1·936—2·155, Tyrol, Œllacher. Lustre greasy. Color whitish, yellowish, wine-yellow, greenish, reddish. Translucent. Brittle, and often much cracked.

Comp.—O. ratio for $\dot{\mathrm{R}}$, $\ddot{\mathrm{Si}}$, $\dot{\mathrm{H}}$=2 : 3 : 3. Formula $(\frac{2}{3}\dot{\mathrm{Mg}}+\frac{1}{3}\dot{\mathrm{H}})\ddot{\mathrm{Si}}+\frac{4}{3}\dot{\mathrm{H}}$=Silica 40·2, magnesia 35·7, water 24·1=100.

Analyses: 1, Shepard (Am. J. Sci., xviii. 31, 1830, analysis imperfect); 2, Brush (this Min., 286, 1854), 3, Thomson (Phil. Mag., 1843, 191); 4, Œllacher (ZS. G., iii. 222); 5, v. Kobell (Münch. gel. Anz., 1851, xxxiii. 1); 6, Widtermann (Jahrb. G. Reichs., iv. 525, 1853); 7, Haushofer (J. pr. Ch., xcix. 240):

	$\ddot{\mathrm{Si}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{H}}$	$\dot{\mathrm{Fe}}$
1. Middlefield	40	40	20	—=100 Shepard.
2. Texas, Pa.	43·15	35·95	20·25	—, $\ddot{\mathrm{\overline{Al}}}$ *tr.*=99·35 Brush.

		$\ddot{\mathrm{Si}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{H}}$	$\dot{\mathrm{Fe}}$
3.	Bare Hills, Md.	40·16	36·00	21·60	1·16, $\dot{\mathrm{Ca}}$ 0·80, $\ddot{\bar{\mathrm{Al}}}$ *tr.*=99·72 Thomson.
4.	Tyrol, Fleims Val.	40·40	35·85	22·60	0·38, apatite 0·78=100 Œllacher.
5.	" " "	41·50	38·30	20·50	——=100·30 Kobell.
6.	" " " (½)	40·82	36·06	21·72	0·42, $\ddot{\mathrm{C}}$ 0·59=99·61 Widtermann.
7.	Passau	45·5	34·5	20·0	——=100ᵃ Haushofer.

ᵃ After separation of 4·78 $\mathrm{Cu\,O\,C\,O^2}$, 0·85 $\mathrm{Fe^2\,O^3}$.

G. of anal. 6=2·186; of anal. 7, 2·107.

Pyr., etc.—In the closed tube gives off much water. B.B. becomes opaque, and fuses on th edges. Decomposed by hydrochloric acid.

Obs.—Occurs with serpentine at the localities above mentioned.

Named after Prof. Chester Dewey. The gymnite of Thomson, named from *γυμνός*, *naked*, in allusion to the locality at Bare Hills, Md., is the same species.

Thomson found in another mineral from the United States, labelled Deweylite (G.=2·0964), $\ddot{\mathrm{Si}}$ 50·70, $\dot{\mathrm{Mg}}$ 23·65, $\dot{\mathrm{H}}$ 20·60, $\ddot{\bar{\mathrm{Al}}}$ 8·55, $\dot{\mathrm{Fe}}$ 1·70 (Am. J. Sci., xxxi. 173); and in another allied mineral, $\ddot{\mathrm{Si}}$ 41·42, $\dot{\mathrm{Mg}}$ 23·53, $\dot{\mathrm{Na}}$ 6·25, $\dot{\mathrm{H}}$ 19·86, $\ddot{\bar{\mathrm{Al}}}$ 4·47, $\dot{\bar{\mathrm{Ce}}}$ 3·57, $\dot{\mathrm{Fe}}$ *tr.*

Artif.—Formed by A. Gages by the method mentioned under SERPENTINE (p. 465).

414. CEROLITE. Kerolith *Breithaupt*, Char., 145, 254, 1823. Cerolith *Glock.*, 1831. Kerolite.

Massive, reniform, compact or lamellar.

H.=2—2·5. G.=2·3—2·4. Lustre vitreous or resinous. Color greenish or yellowish-white, yellow, reddish. Streak uncolored. Transparent—translucent. Feel greasy. Fracture conchoidal. Does not adhere to the tongue.

Comp.—O. ratio for $\dot{\mathrm{R}}$, $\ddot{\mathrm{Si}}$, $\dot{\mathrm{H}}$=1 : 2 : 1½; formula, if two-thirds of the water is basic, (½ $\dot{\mathrm{H}}$ + ½ $\dot{\mathrm{Mg}}$) $\ddot{\mathrm{Si}}$+½ aq; making it thus a unisilicate like deweylite, which species cerolite closely resembles in physical characters. It differs in composition from aphrodite, however, only in containing half more water. Analyses: 1, 2, Kühn (Ann. Ch. Pharm., lix. 368):

		$\ddot{\mathrm{Si}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{H}}$
1.	Silesia	47·34	29·84	21 04=98·22 Kühn.
2.	"	46·96	31·26	21·22=99·44 Kühn.

Maak obtained (Schw. J., lv. 1829) for the same mineral $\ddot{\mathrm{Si}}$ 37·95, $\ddot{\bar{\mathrm{Al}}}$ 12·18, $\dot{\mathrm{Mg}}$ 18·02, $\dot{\mathrm{H}}$ 31·0 =99·15. But Kühn states that he and his laboratory pupils found no alumina, and that Maak's analysis must be incorrect. Kühn dried his mineral at 100° C. before the analysis, and hence the less water.

Pyr., etc.—B.B. blackens, but does not fuse.

Obs.—From Frankenstein in Silesia, associated with serpentine, and also, according to Kühn, brucite. Breithaupt unites deweylite to cerolite.

Melling obtained for a mineral from Zöblitz, similar to the above, $\ddot{\mathrm{Si}}$ 47·13, $\dot{\mathrm{Mg}}$ 36 13, $\dot{\mathrm{H}}$ 11·50, $\ddot{\bar{\mathrm{Al}}}$ 2·57, $\dot{\mathrm{Fe}}$ 2·92=100·25 (Ramm., 1st Suppl., 79). Hermann obtained for an apple-green variety from Lake Itkul (Bull. Soc. Nat. Mosc., xxxviii. 481), $\ddot{\mathrm{Si}}$ 47·06, $\dot{\mathrm{Ni}}$ 2·80, $\dot{\mathrm{Mg}}$ 31·81, $\dot{\mathrm{H}}$ 18·33=100. G.=2·27.

The name Cerolite is from *κηρός*, *wax*, and *λίθος*.

415. HYDROPHITE. *Svanberg*, Ak. H. Stockh., 1839, Pogg., li. 525. Jenkinsite *Shepard*, Am. J. Sci., II. xiii. 392, 1852. Eisengymnit.

Massive; sometimes in fibrous crusts.

H.=2·5—3·5. G.=2·65, hydrophite; 2·4—2·6, jenkinsite. Lustre feeble, subvitreous. Color mountain-green to blackish-green. Streak paler. Translucent to opaque.

Comp.—Same as for deweylite, except a replacement of part of the magnesia by protoxyd o iron. Analyses: 1, L. Svanberg (l. c.); 2, 3, Smith & Brush (Am. J. Sci., II. xvi. 369):

	$\ddot{\rm Si}$	$\ddot{\rm Al}$	$\dot{\rm Fe}$	$\dot{\rm Mn}$	$\dot{\rm Mg}$	$\dot{\rm H}$
1. *Hydrophite*	36·19	2·90	22·73	1·66	21·08	16·08, $\dddot{\rm V}$ 0·115=100·755 Svanberg.
2. *Jenkinsite*	38·97	0·53	19·30	4·36	22·87	13·36=99·39 S. & B.
3. "	37·42	0·98	20·60	4·05	22·75	13·48=99·28 S. & B.

Smith & Brush find in jenkinsite the oxygen ratio for the protoxyds, silica, and water, 3 : 4 : 2½, and they mention the nearness to both hydrophite and serpentine. Websky regards hydrophite as impure *metaxite* (ZS. G. Ges., x. 284).

Pyr., etc.—In the closed tube gives off water. B.B. blackens, and fuses at about 3 to a black magnetic globule. With the fluxes gives reactions for iron and manganese. Decomposed by acids.

Obs.—Hydrophite occurs at Taberg in Smaland; and jenkinsite at O'Neil's mine in Orange Co., N. Y., as a fibrous incrustation on magnetite.

Named *Hydrophite* in allusion to the water present; and *Jenkinsite* after J. Jenkins of Monroe.

415A. DERMATIN *Breithaupt*, Char., 104, 1832. Massive, reniform, or in crusts on serpentine, of a resinous lustre and green color. Feel greasy; odor, when moistened, argillaceous.

Composition, according to Ficinus (Min. Ges. zu Dresden, ii. 215):

	$\ddot{\rm Si}$	$\ddot{\rm Al}$	$\dot{\rm Fe}$	$\dot{\rm Mn}$	$\dot{\rm Mg}$	$\dot{\rm Ca}$	$\dot{\rm Na}$	$\dot{\rm H}$, $\ddot{\rm C}$
1.	35·80	0·42	11·33	2·25	23·70	0·83	0·50	25·20=100·08.
2.	40·17	0·83	14·00	1·17	19·33	0·83	1·33	22·00, $\dddot{\rm S}$ 0·43=100·09.

Formula $(\dot{\rm Mg}, \dot{\rm Fe})^3 \ddot{\rm Si}^2 + 6\dot{\rm H}$?, but probably a mixture. B.B. blackens and cracks.

From Waldheim in Saxony. The name is from *δέρμα*, *skin*, alluding to its occurrence as an incrustation.

416. GENTHITE.

Nickel-Gymnite *Genth*, Kell. & Tiedm. Monatsb., iii. 487, 1851. Genthite *Dana*, Am. J. Sci., II. xliv. 256, 1867.

Amorphous, with a delicately hemispherical or stalactitic surface, incrusting.

H.=3—4; sometimes (as at Michipicoten) so soft as to be polished under the nail, and fall to pieces in water. G.=2·409. Lustre resinous. Color pale apple-green, or yellowish. Streak greenish-white. Opaque to translucent.

Comp.—O. ratio for $\dot{\rm R}$, $\ddot{\rm Si}$, $\dot{\rm H}$=2 : 3 : 3, or the same as for deweylite; formula $(\frac{3}{4}(\dot{\rm Ni}, \dot{\rm Mg})+\frac{1}{4}\dot{\rm H})^2 \ddot{\rm Si}+\frac{4}{3}\dot{\rm H}$, being a nickel-gymnite. Analyses: 1, Genth (l. c.); 2, T. S. Hunt (Rep. G. Can., 1863, 507):

	$\ddot{\rm Si}$	$\dot{\rm Ni}$	$\dot{\rm Fe}$	$\dot{\rm Mg}$	$\dot{\rm Ca}$	$\dot{\rm H}$
1. Texas, Pa.	35·36	30·64	0·24	14·60	0·26	19·09=100·19 Genth.
2. Michipicoten Id.	33·60	30·40	2·25	3·55	4·09	17·10, $\ddot{\rm Al}$ 8·40=99·39 Hunt.

After drying at a temperature above 100° C., Hunt obtained (l. c.) $\ddot{\rm Si}$ 35·80, $\dot{\rm Ni}$ 32·20, $\dot{\rm H}$ 12·20.

Pyr., etc.—In the closed tube blackens and gives off water. B.B. infusible. With borax in O.F. gives a violet bead, becoming gray in R.F. (nickel). Decomposed by muriatic acid without gelatinizing.

Obs.—From Texas, Lancaster Co., Pa., in thin crusts on chromic iron; and from Webster, Jackson Co., N. C., with chromic iron in serpentine, as an amorphous, reniform, apple-green incrustation; on Michipicoten Id., Lake Superior, of a greenish-yellow to apple-green color. Also reported from near Malaga, Spain, with chromite and talcose schist; and by Wiser, from Saasthal in the Upper Valais.

Röttisite Breith. (B. H. Ztg., xviii. 1, 1859) may be essentially the above. It occurs with phosphate of nickel at Röttis in Voigtland, in amorphous masses and reniform incrustations, apple-green or emerald-green, of little lustre, translucent to subtranslucent, but opaque when earthy, with H.=2—2·25, and G.=2·358—2·370. Winkler deduces the formula $\dot{\rm Ni}\,\ddot{\rm Si}+\frac{1}{3}\dot{\rm H}$; and publishes as the result of his analysis (l. c.) $\ddot{\rm Si}$ 39·15, $\ddot{\rm Al}$ 4·68, $\ddot{\rm Fe}$ 0·81, $\dot{\rm Ni}$ 35·87, $\dot{\rm H}$ 11·17, with $\dot{\rm Co}$ 0·67, $\dot{\rm Cu}$ 0·40, $\dddot{\rm P}$ 2·70, $\dddot{\rm As}$ 0·80. But his summation of these numbers is 100·79, or 4·54 more than they foot up; and there is here an unexplained error. The mineral, as Brush has observed, is probably nickel-gymnite.

417. SAPONITE. Terra porcellanea particulis impalpabilibus mollis, pt., Brianzoner Krita pt. Smectis, *Engelsk* Walklera, *a* hwit (Landsend i Cornwall), *Cronst.*, 75, 1758. Seifenstein (fr Cornwall) *Klapr.*, Schrift. nat. Ges. Berlin, vii. 168, 1787, Beitr., ii. 180, v. 22. Steatite of Cornwall *Kirw.*, Min., i. 152, 1794. Soapstone pt. Pierre à Savon *H.* Saponit *Svanberg*, Ak. H. Stockh., 1840, 153. Piotine *Svanberg*, Pogg., liv. 267, 1841, lvii. 165. Thalite *Owen*, J. Ac. Philad., II. ii. 179, 1852.

Massive. In nodules, or filling cavities.

Soft, like butter or cheese, but brittle on drying. G.=2·266. Lustre greasy. Color white, yellowish, grayish-green, bluish, reddish. Does not adhere to the tongue.

Comp.—A hydrous silicate of magnesia and alumina; but analyses give, naturally, no uniform results for such an amorphous material. Supposing the alumina present as *kaolinite*, the rest, according to most of the analyses, is a silicate allied to *aphrodite*, as if the mineral were a mixture of the two. Analyses: 1, Klaproth (l. c.); 2, Svanberg (l. c.); 3, Haughton (Phil. Mag.. IV. x. 253); 4, Svanberg (l. c.); 5, 6, Smith & Brush (Am. J. Sci., II. xvi. 368); 7, 8, Reakirt and Keyser (Am. J. Sci., II. xvii. 180):

		S̈i	A̶l	F̶e	Ṁg	Ċa	Ṅa	K̇	Ḣ
1.	Cornwall	45·00	9·25	1·00	24·75	—	—	0·75	18·00=98·75 Klaproth.
2.	"	46·8	8·0	0·4	33·3	0·7	—	—	11·0=100·2 Svanberg.
3.	" (¾)	42·28	7·21	—	29·70	—	—	—	18·92 Haughton.
4.	*Piotine*	50·89	9·40	2·06	26·52	0·78	—	—	10·50=100·15 Svanberg.
5.	*Thalite*	45·60	4·87	2·09	24·10	1·07	0·45		20·66=98·84 Smith & Brush.
6.	"	48·89	7·23	2·46	24·17	—	0·81		15·66=99·22 Smith & Brush.
7.	"	44·07	4·72	1·70	21·49	3·75	*undet.*		19·96 Reakirt.
8.	"	44·66	7·79		26·60[a]	—	0·16	0·12	*undet.* Keyser.

[a] Contains some lime.

The oxygen ratio for Ṙ, R̶, S̈i, Ḣ, in 1, is about 2 : 1 : 5 : 3½; in 2, 3½ : 1 : 6⅓ : 2½; in 3, 3⅜ : 1 : 7 : 5⅓; in 4, 2 : 1 : 5⅓ : 2; in 5, 3½ : 1 : 8⅓ : 6⅓; in 6, 2½ : 1 : 6⅓ : 3⅓; in 7, 5 : 1 : 11⅜ : 9.

Pyr., etc.—B.B. gives out water and blackens; thin splinters fuse with difficulty on the edges. Decomposed by sulphuric acid.

Obs.—Occurs at Lizard's Point, Cornwall, in veins in serpentine; in the geodes of datolite at Roaring Brook, near New Haven, Ct.; in the trap of the north shore of Lake Superior, between Pigeon Point and Fond du Lac, in amygdaloid (*thalite* of Owen); at Svärdsjö in Dalarne (*piotine* and *saponite*).

Saponite is from *sapo*, *soap*; and piotine from πιότης, *fat.*

Another similar mineral, associated with chalilite of Thomson in amygdaloid at Antrim, Ireland, afforded von Hauer (Kenngott's Min. Not., No. 11) S̈i 44·11, A̶l 10·90, Ḟe 1·05, Ṁg 13·01, Ċa 6·74, Mn and K̇ *tr.*, ign. 24·07=99·88; oxygen ratio nearly 4½ : 3 : 13½ : 12; or for Ṙ+R̶ and S̈i, 1 : 1·8. It has H.=2, and is fragile; lustre waxy; color isabella-yellow, or brownish. Softens or slacks in water. Soluble in muriatic acid, affording pulverulent silica.

418. PHOLERITE. Pholerite *Guillemin*, Ann. d. M., xi. 489, 1825. Pholerite pt. *of many authors.* Pholerite, Pelitische Felsittuffe von Chemnitz, *A. Knop.*, Jahrb. Min., 1859, 540.

Orthorhombic. In rhombic and hexagonal scales, like those of kaolinite. Occurs clay-like and compact massive, consisting of an aggregation of scales.

H.=1–2·5. G.=2·35—2·57. Lustre of scales pearly. Color white, grayish-white, greenish-white, yellowish, reddish-brown, violet. Doubly refracting, Knop.

Comp.—O. ratio for R̶, S̈i, Ḣ=3 : 3 : 2; $\bar{\mathrm{A}}\mathrm{l}^2\ddot{\mathrm{S}}\mathrm{i}^2+4\dot{\mathrm{H}}$=Silica 19·3, alumina 45·0, water 15·7=100. Analyses; 1, 2, Guillemin (l. c.); 3, A. Knop (Jahrb. Min., 1859, 540); 4, J. L. Smith (Am. J. Sci., II. xi. 58); 5, Mallet (Shep. Min., 1857, Suppl. to Append., p. iv.):

	$\ddot{\mathrm{Si}}$	$\ddot{\bar{\mathrm{A}}}\mathrm{l}$	$\ddot{\bar{\mathrm{F}}}\mathrm{e}$	$\dot{\mathrm{M}}\mathrm{g}$	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\mathrm{K}}$	$\dot{\mathrm{H}}$
1. Fins	42·93	42·07	——	——*	——	——	15·00=100 Guillemin.
2. "	41·65	43·35	——	——	——	——	15·00=100 Guillemin.
3. Chemnitz	39·34	45·90		——	——	——	14·76=100 Knop.
4. Schemnitz	42·45	42·81	——	tr.		——	12·92=98·18 Smith.
5. Jacksonville, Ala.	42·19	41·30	0·82	——		1·09	14·20=99·60 Mallot.

Pyr., etc.—Yields water. B.B. infusible. Gives a blue color with cobalt solution. Insoluble in acids

Obs.—The pholerite of Guillemin was from nodules of iron ore in the coal mines of Fins, Dept of Allier, France. The Chemnitz mineral is from Niederrabenstein (and also at Zeisigwald, etc.), where it constitutes a rock called by Naumann *pelitische felsittuffe* in the Lower Coal formation; it is various in color, but is shown to consist of crystalline, colorless, doubly refracting scales. The Schemnitz is the gangue of diaspore, and it may be kaolinite impure with diaspore. The Jacksonville is a kaolin, and may be kaolinite; the analysis afforded 4·86 of free silica, and 0·90 of undecomposed material which above is excluded.

The analyses of *kaolinite* have been referred to pholerite under the idea that Guillemin's analysis was incorrect. But the analysis by Knop appears to show that there is a species with the pholerite composition, but not differing from kaolinite in its physical or crystallographic characters.

Named from φολίς, *a scale.*

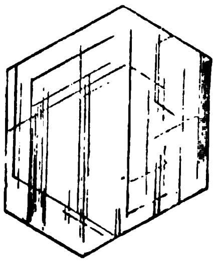
418A. *Teratolite* Glocker (Grundr., 544, 1839; Terra miraculosa Saxoniæ *C. Richter*, 1732; Saxonische Wundererde *of old Germ. authors;* Eisensteinmark *Breith.*, Char., 147, 1823, 301, 1832). A. Knop holds (Jahrb. Min., 1859, 546) that the teratolite is an impure lithomarge-like pholerite, closely related to the mineral from Chemnitz. It is described as having H.=2—2½, and G.=2·49—2·5; color varied with lavender and other shades of blue, and spots of red. and rarely pearl-gray. It is from an amygdaloidal rock overlaid by coal strata at Planitz near Zwickau in Saxony, It contains much oxyd of iron; but, according to Knop, probably is a mixture of pholerite with some free quartz, pulverized feldspar, hydrate of iron, carbonate of lime, and magnesia. The following is the analysis of Schuler (Freiesleb. Orykt. Sachs., Heft 5):

	$\ddot{\mathrm{Si}}$	$\ddot{\bar{\mathrm{A}}}\mathrm{l}$	$\ddot{\bar{\mathrm{F}}}\mathrm{e}$	$\dot{\mathrm{M}}\mathrm{n}$	$\dot{\mathrm{M}}\mathrm{g}$	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\mathrm{K}}$	$\dot{\mathrm{H}}$
1. Planitz	41·66	22·85	12·98	1·68	2·55	3·04	0·93	14·20 Schuler.

419. KAOLINITE. Talkerde von schuppigen Theilen (fr. Sonne Adit, Halsbrucke, near Freiberg) *Wern.*, Ueb, 218, 1780. Erdiger Talk *Hofmann*, Bergm. J., 160, 1789; *Karst.*, Tab., 32, 1800. ? Talc granuleux *H.*, Tr., iii. 1801. Nacrite pt. *Brongn.*, Min., i. 505, 1807. Schuppiger Thon *Karst*, Tab., 91, 1808. Nakrit *Breith.*, Char., 94, 318, 1832. Pholerite pt. *many authors.* Kaolinite *S. W. Johnson*, Am. J. Sci., II. xliii. 351, 1867.

Medulla Saxi, *Germ.* Steinmarck, pt., *Agric.*, Interpr., 466, 1546 = Lithomarge pt. Karnat *Breith.*, Handb., ii. 359, 1841 = Steinmark von Rochlitz *Klapr.*, vi. 285, 1815. Terra Samia, Collyrium, Aster, *Plin.*, xxxv. 53. Marga porcellana, Leucargilla, pt., *Wall.*, 22, 1747. Terra Porcellanea *Cronst.*, 73, 1758. Porcelain Clay. Kaolin. Porzellanerde, Porzellanthon, *Germ.* Argiles à porcelaine *Fr.* Terre à foulon pt. *Fr.* = Fuller's Earth.

413



Orthorhombic. $I \wedge I = 120°$. In rhombic, rhomboidal, or hexagonal scales or plates; sometimes in fan-shaped aggregations; usually constituting a clay-like mass, either compact, friable, or mealy; base of crystals lined (f. 413), arising from the edges of superimposed plates. Cleavage: basal, perfect. Twins: the hexagonal plates made up of six sectors.

H.=1−2·5. G.=2·4−2·63. Lustre of plates, pearly; of mass, pearly to dull earthy. Color white, grayish-white, yellowish, sometimes brownish, bluish, or reddish. Scales transparent to translucent. Scales flexible, inelastic; usually unctuous and plastic. Optically biaxial; axial plane normal to the base, and to a side of the hexagon; axes quite divergent; bisectrix negative; Descl.

Var.—1. *Argilliform.* Soft, clay-like; ordinary kaolinite; under the microscope, if not without, showing that it is made up largely of pearly scales. The constituent of most, if not all, pure kaolin. G.=2·627, fr. Freiberg, Breith.; 2·6, fr. Schneckenstein, Clarke.

2. *Fariniform.* Mealy, hardly coherent. consisting of pearly angular scales, anal. 3–6, 9.

3. *Indurated; Lithomarge* (*Steinmark* Germ.). Firm and compact; H.=2—2·5. When pulverized, often shows a scaly texture (anal. 17–24). G.=2·6, fr. Cainsdorf, solid var., anal. 23. *Tuesite* of Thomson is a lithomarge from Scotland, used sometimes for slate pencils; H.=2·5; G.=2·43—2·56; color milk-white.

4. *Ferruginous; Carnat* Breith. A firm lithomarge of a reddish-white or flesh-red color; the color owing to the presence of some oxyd of iron replacing the alumina; H.=2—3; G.=2·543. Streak colorless; smooth to the touch (anal. 15, 16). Also brownish-red (anal. 21).

Comp.—O. ratio for $\overset{\dots}{\mathrm{R}}$, $\ddot{\mathrm{Si}}$, $\dot{\mathrm{H}}$=3 : 4 : 2; whence, if half the water be basic, $(\frac{1}{4}\dot{\mathrm{H}}^3+\frac{3}{4}\overset{\dots}{\mathrm{Al}})^2\ddot{\mathrm{Si}}^3$; (as usually written, $\overset{\dots}{\mathrm{Al}}\ddot{\mathrm{Si}}^2+2\dot{\mathrm{H}}$)=Silica 46·3, alumina 39·8, water 13·9=100.

Analyses: 1, W. S. Clarke (Ann. Ch. Pharm., lxxx. 122); 2, Pisani (C. R., liii. 1072); 3, R. Müller (B. H. Ztg., xxiv. 386); 4, Genth (Am. J. Sci., II. xxviii. 251); 5, 6, Johnson, Burton (Am. J. Sci., II. xliii. 354, 358); 7, A. Knop (Jahresb., 789, 1859); 8, R. Richter (Pogg., xc. 320); 9, Stolba (J. pr. Ch., xciv. 116); 10, Smith (Am. J. Sci., II. xi. 58); 11, Boussingault (Ann. d. M., III. v. 554); 12, T. S. Hunt (Rep. G. Can. 1863, 495); 13, Klaproth (Beitr., vi. 275); 14, Baur (Ber. Ak. Wien, xxii. 693); 15, Klaproth (Beitr., vi. 285); 16, Nascholz (Ber. Isis Dresden. 1866, 138); 17, Rammelsberg (Min. Ch., 576); 18–21, v. Hauer (Jahrb. G. Reichs., vii. 129, 362); 22, 23, Fikenscher (J. pr. Ch., lxxxix. 461); 24, Rammelsberg (l. c.); 25, 26, R. D. Thomson and Richardson (Thom. Min., i. 244):

			$\ddot{\mathrm{Si}}$	$\overset{\dots}{\mathrm{Al}}$	$\overset{\dots}{\mathrm{Fe}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{H}}$
1.	Schneckenstein		46·76	39·59	—	0·94	—	13·42=100·71 Clark.
2.	Lodève, Fr.		47·0	39·4	—	—	—	14·4=100·8 Pisani.
3.	Freiberg, Sax.		46·74	39·48	—	—	—	14·06=100·28 Müller.
4.	Tamaqua, Pa.		(⅔) 46·90	39·60	—	—	—	13·80, $\dot{\mathrm{Na}}$ 0·17=100·47[a] Genth.
5.	Summit Hill, Pa.		45·93	39·81	—	—	—	14·02=99·76 Johnson.
6.	Richmond, Va.		48·56[b]	35·61	—	—	—	12·88, undet. 2·95=100 Burton.
7.	Zeisigwald. Sax.		49·91	35·23	—	—	—	[14·86]=100 Knop.
8.	Altenberg, Sax.		45·63	39·89	—	—	0·60	13·70=99·82 Richter.
9.	Schlan, Bohem.		47·93	36·78	—	—	—	15·29=100 Stolba.
10	Naxos		44·41	41·20	—	—	1·21	13·14=99·96 Smith.
11.	N. Grenada		45·0	40·2	—	—	—	14·8=100 Boussingault.
12.	Chaudière Falls		46·05	38·37	—	0·63	0·61	14·00=99·66 Hunt.
13.	Aue,	*Kaolin*	46·00	39·00	0·25	—	—	14·50=99·75 Klaproth.
14.	Zettlitz,	"	48·61	38·90	—	—	—	12·47=99·98 Bauer.
15.	Rochlitz.	*Carnat*	45·25	36·50	2·75	—	—	14·00=98·50 Klaproth.
16.	"	"	45·09	38·13	1·79	0·19	—	14·29, alk. 0·21=99·67 Naschold.
17.	Rumpelsberg,	*Lithom.*	47·33	40·23	—	1·44		12·36=100·36 Ramm.
18.	Reuc, Bohem.,	"	43·13	39·60	*tr.*	—	*tr.*	15·71=98·44 Hauer.
19.	Saszka, *white*,	"	45·19	37·92	—	—	0·93	15·01=99·05 Hauer.
20.	" *yellow*,	"	44·37	39·70	*tr.*	—	0·95	15·58=100·55 Hauer.
21.	" *bnh.-red*,	"	44·54	33·00	5·35	—	0·51	15·90=99·30 Hauer.
22.	Cainsdorf, *w. friable*,	"	45·82	39·42	—	—	—	14·26=99·50 Fikenscher.
23.	" " *solid*,	"	46·20	39·72	—	—	—	13·80=99·72 Fikenscher.
24.	Schlackenwald,	"	43·46	41·48	—	0·37[c]	1·20	13·49=100 Ramm.
25.	Tweed, *Tuesite*,	"	44·30	40·40	—	0·50	0·75	13·50=99·45 Thomson.
26.	" "	"	43·80	40·10	0·94	0·55	0·64	14·21=100·24 Richardson.

[a] After separating oxyd of iron 0·18, Ca O 0·98 by muriatic acid (Genth). [b] Contains some free silica. [c] Na O.

Pyr., etc.—Same as for pholerite.

The mineral from Chaudière Falls exfoliates in white cauliflower-like shapes (Hunt).

Obs.—Ordinary kaolin is a result of the decomposition of aluminous minerals, especially the feldspars of granitic and gneissoid rocks and porphyries. In some regions where these rocks have decomposed on a large scale, the resulting clay remains in vast beds of *kaolin*, usually more or less mixed with free quartz, and sometimes with oxyd of iron from some of the other minerals present. Pure kaolinite in scales often occurs in connection with iron ores of the Coal formation. It sometimes forms extensive beds in the Tertiary formation, as near Richmond, Va. Also met with accompanying diaspore and emery or corundum.

Occurs in the coal formation at Cache-Aprés in Belgium; also in the same at Schlan in Bohemia and at Röhe; in argillaceous schist at Lodève, Dept. of Hérault, France; at the Einigkeit mine at Brand, near Freiberg, and elsewhere in Saxony; as kaolin at Diendorf (Bodenmais) in Bavaria;

at Zeisigwald near Chemnitz; as the gangue of topaz at Schneckenstein; with emery and margarite at Naxos; as the gangue of diaspore at Schemnitz; as the material of pseudomorphs after prosopite at Altenberg (anal. 8), showing well the hexagonal scales (Johnson & Blake); with fluor at Zinnwald, a white powdery substance consisting of hexag. scales; at Rochlitz (*carnat*) in a porphyritic rock; in seams in an argillaceous rock on the Tweed (*tuesite*), the Latin name of which place is *Tuesis*. At Yrieix, near Limoges, is the best locality of kaolin in Europe (a discovery of 1765); it affords material for the famous Sèvres porcelain manufactory. The dark-colored clay of Stourbridge, England, is made up in large part of transparent laminæ (J. & B.).

In the U. States, kaolin occurs at Newcastle and Wilmington, Del.; at various localities in the limonite region of Vermont (at Brandon, etc.), Massachusetts, Pennsylvania; Jacksonville, Ala.; Edgefield, S. C.; near Augusta, Ga.; and Johnson & Blake observed transparent hexagonal scales abundantly in a blue fire-clay from Mt. Savage, Md.; in the white clay of Brandon, Vt., Beekman, N. Y., Perth Amboy, N. J., Reading, and a locality in Chester Co., Pa., Long Island, and in white and colored clays of various other places. Near Richmond, Va., the mealy constitutes a bed of considerable extent in the Tertiary formation; at Tamaqua and Summit Hill in Carbon Co., Pa., it occurs in the Coal formation; in a sandstone of the Quebec group, just below the Chaudière Falls, filling seams or fissures, often ½ in. thick, having an unctuous feel, and consisting of minute soft scales.

The characters of this species have been well defined, and its relation to kaolin explained, in an article by Johnson & Blake (l. c.), by whom the name *kaolinite* was proposed. They show that Forchammer's formula for kaolin is the true formula, and also that of kaolinite; and that the two are one in species chemically and physically. They point out that much lithomarge should be included, and that the hexagonal scales, which the massive mineral presents under the microscope, may be detected in all kaolin, and also in some dark-colored fire-clays, although much mixed with impurities. They also show that the plasticity of the kaolinite depends on the fineness of the material, and that kinds not plastic in water may be rendered so by fine trituration. They suggest that the distinction of kaolinite and pholerite may disappear on further chemical investigation.

The earliest recognition of the mineral distinctively is by Werner in 1780 (l. c.), who placed it under talc. It afterward took the name of *earthy talc*, as used by Hoffmann in 1789 (l. c.). The acute Karsten pronounced it a *scaly clay* (*schuppige Thon*), and arranged it accordingly in 1808 (l. c.); but no author of the next twenty years fully adopted his view. In 1807 Brongniart made the species *nacrite* (l. c.), for a *fusible*, anhydrous, pearly *potash-mica*, analyzed by Vauquelin (affording $\ddot{S}i$ 50, $\ddot{\bar{A}}l$ 26, $\ddot{\bar{F}}e$ 5, $\dot{C}a$ 1·5, $\dot{K}$ 17·5), and referred to it doubtingly the *earthy talc*, in a note, without any knowledge of it. Hausmann, in 1813 (Handb., 500), says that the *schuppige Talc* of Andreasberg in the Harz (which he says is wrongly called *buttermilchsilber*) may *perhaps* be *schuppige Hydrargillite* (hydrate of alumina) or *Thon*, but an analysis was needed to decide it. Hoffmann, in 1815 (Handb., ii. b, 268), makes it his *first* variety of talc, but queries its nature, and cites an analysis by John of a hydrate of alumina.

In 1832 (l. c.) Breithaupt gave the Saxon mineral the name *nacrite* (nakrit), without any apparent reference in the place to Brongniart's or Vauquelin's previous use of this name. But he at the same time questions whether it may not be identical with *pholerite* (which had been described in 1825). Since then the species has been united to pholerite, under the idea that pholerite was incorrectly analyzed by Guillemin (which may still be true); and Breithaupt, in 1841 (Handb., 391), adopts this view, putting pholerite of Guillemin under *nacrite;* and, moreover, he attributes his name *nacrite* to Vauquelin. This was the state of the question when the description of kaolinite by Johnson and Blake appeared.

Breithaupt, in 1832, stated that the scales were hexagonal; and again in his account of the "nakrit" of Brand near Freiberg. A. Knop, in 1859 (Jahrb. Min. 1859, 594), describes with detail the crystallization of the Schneckenstein mineral; he makes it rhombic, with the planes *I*, *O*, *i-i*, and gives the angle $I \wedge I = 118°$. Descloizeaux, in his Mineralogy (1862), shows that optically the scales from Brand, near Freiberg, are orthorhombic, and makes the angles 120° and 60°; and Johnson & Blake give the same angles as a mean of their measurements of various kaolinites.

The name *Kaolin* is a corruption of the Chinese *Kauling*, meaning *high-ridge*, the name of a hill near Jauchau Fu, where the material is obtained; and the petuntze (peh-tun-tsz) of the Chinese, with which the kaolin is mixed in China for the manufacture of porcelain, is a quartzose feldspathic rock, consisting largely of quartz (S. W. Williams). The word *porcelain* was first given to the china-ware by the Portuguese, from its resemblance to the nacre of the sea-shells *Porcellana* (Cypræas), they supposing it to be made from egg-shells, fish-glue, and fish scales (S. W. Williams).

420. HALLOYSITE. Halloysite *Berthier*, Ann. Ch. Phys., xxxii. 332, 1826. Galapektit, Gummit, *Breith.*, Char., 99, 1832. Glagerit *Breith.*, Handb., 357, 1841. Smectite *Salvetat*, Ann. Ch. Phys., III. xxxi. 102, 1851. Steinmark or Lithomarge pt., Pseudo-Steatite pt., Glossecollite, *Shep.*, Min., 1857, App. to Suppl., p. iii.

? Lenzinit *John.*, Chem. Schrift., v. 193, 1816. ? Severite *Beud.*, Tr., 1824, in Index, and ii. 36, 1832. ? Nertschinskite *Razoumovski.* Bole pt.

Massive. Clay-like or earthy.

H.=1–2. G.=1·8–2·4. Lustre somewhat pearly, or waxy, to dull. Color white, grayish, greenish, yellowish, bluish, reddish. Translucent to opaque, sometimes becoming translucent or even transparent in water, with an increase of one-fifth in weight. Fracture conchoidal. Hardly plastic.

Var.—1. *Ordinary.* Earthy or waxy in lustre, and opaque massive. *Galapectite* is the halloysite of Anglar. *Pseudosteatite* of Thomson & Binney is an impure variety (anal. 8, 9), dark green in color, with H.=2·25, G.=2·469. *Glagerite*, from Bergnersreuth in Bavaria (anal. 10, 11), is proved to be halloysite by Fikenscher; it is white to yellowish-white; G.=2·35—2·382; H.=2—2·5.

2. *Smectite* of Salvetat is greenish, and in certain states of humidity appears transparent and almost gelatinous; it is from Condé, near Houdan, France. Breithaupt's *Gummite* (Char., 99, 1832) is a "gum-like halloysite," not adhering to the tongue, from Anglar, though in his Handbuch, where the same locality is mentioned, he quotes Berthier's analysis of *collyrite* from the Pyrenees. *Glossecollite* is milk-white and earthy, but becomes translucent on the edges and a little opaline in water. It forms a seam 1 in. thick in a siliceous Silurian rock in Rising Fawn, Dade Co., Georgia.

3. *Lenzinite* is earthy, compact, white, translucent, and somewhat opaline, from Kall in the Eifel; and brownish, from rifts in pegmatite at La Vilate, near Chanteloube, in France. Leonhard considered it (Handb., 1826) a decomposed semiopal. It is described as not gelatinizing in acids. Named after the German mineralogist Lenz. *Nertschinskite* of Razoumovski, a whitish or bluish earth from Nertschinsk, has been referred to lenzinite. *Severite*, or lenzinite of St. Sever, was first noticed in 1818, and analyzed in that year by Pelletier (J. de Phys., lxxxvi. 251, 1818). It has sometimes the semitransparency of opal, a soft feel, adheres strongly to the tongue, and makes no paste with water; it is from the upper arenaceous stratum in the gypsiferous Tertiary at St. Sever in France. It is not clear whether it belongs here or to kaolinite.

4. *Bole*, in part, may belong here; that is, those colored, unctuous clays containing more or less oxyd of iron, which also have about 24 p. c. of water; the iron gives it a brownish, yellowish, or reddish color; but more investigation is needed before it is known that they are not mere mixtures. *Oropion* of Glocker (Syn., 188, 1847) is a dark brown to black bole; it is the *Bergseife* of Werner (Ueb. Cronst., 189, 1780), having a greasy feel and streak, and H.=1—2; the color is attributed to bituminous matters present. It is from Olkutsch in Poland. Where it belongs is doubtful. The analysis below by Bucholz is of a similar kind from Thuringia; but its identity with Werner's Polish *Bergseife* is not certain.

Comp.—O. ratio for $\bar{R}$, $\ddot{S}i$, $\dot{H}$=3 : 4 : 3; $(\frac{1}{4}\dot{H}^3+\frac{3}{4}\ddot{\bar{A}}l)^2\,\ddot{S}i^2+3\dot{H}$ or $(\ddot{\bar{A}}l\,\ddot{S}i^2+3\dot{H})$=Silica 43·3, alumina 37·7, water 19·0=100. Analyses: 1, 1A, 2, Berthier (Ann. Ch. Phys., l. c., Ann. d. M. III. ix. 500); 3, Dufrénoy (ib., iii. 393); 4, Oswald (J. pr. Ch., xii. 173); 5, Monheim (Verh. nat. Ver. Bonn, v. 41, Ramm., 4th Suppl., 221); 6, Sauvage (Ann. de M., IV. x. 77); 7, Salvetat (Ann. Ch. Phys., III. xxxi. 102); 8, 9, Thomson and Binney (Ed. N. Phil. J., xvi. 55); 10, 11, Fikenscher (J. pr. Ch., lxxxix. 459); 12, v. Hauer. (Jahrb. G. Reichs., 826, 1853); 13, Pisani (C. R., [illegible] 310); 14, John (l. c.); 15, Salvetat (l. c.); 16, 17, Löwig ("Leonh. Orykt.," but not found in it by the author); 18, Wackenroder (Kastn. Archiv., xi. 466); 19, Zellner (Jahrb. Min., 1835, 467); 20, Bucholz (Gehlen's N. J., iii. 597):

	$\ddot{S}i$	$\ddot{\bar{A}}l$	$\bar{F}e$	$\dot{M}g$	$\dot{C}a$	$\dot{N}a$	$\dot{K}$	$\dot{H}$
1. Anglar	39·5	34·0	——	——	——	——	——	26·5=100 Berthier.
1A. " dried at 100° C.	44·94	39·06	——	——	——	——	——	16·00=100 Berthier.
2. Housscha	46·7	36·9	——	——	——	——	——	16·0=99·15 Berthier.
3. La Voulte	40·66	33·66	——	——	——	——	——	24·83=99·15 Dufrénoy.
4. Miechowitz, Silesia	40·25	30·00	——	——	——	——	——	24·25, $\dot{M}g$ 0·25=99·50
5. Altenberg	40·31	33·23	——	——	——	——	——	23·69, Zr 1·23=98·46 M.
6. Ecogne	42	30	——	——	——	——	——	24=100 Sauvage.
7. Condé, *Smectite*	43·0	32·5	$\dot{F}e$ 1·20	0·03	1·02	0·4		21·7, $\ddot{S}i$ gel. 1·5=10[illegible]·62 S.
8. Blackburn	41·89	22·05	6·62	6·16	2·42	——	——	20·22 $\dot{M}n$ *tr.*=99·36 T.
9. "	42·78	22·53	6·31	6·76	2·54	——	——	18·68 $\dot{M}n$ *tr.*=99·60 B.
10. *Glagerite, compact*	42·85	36·14	——	——	——	——	——	20·54=99·53 Fikensch.
11. " *earthy*	37·12	41·27	——	——	——	——	——	21·16=99·55 Fikensch.
12. St. Sever, *Severite*	44·42	36·00	——	——	0·65	——	——	18·40=99·47 Hauer.
13. Georgia, *Glossec.*	40·4	37·8	——	0·5	——	——	——	21·8=100·5 Pisani.

		$\ddot{\mathrm{Si}}$	$\overline{\mathrm{Al}}$	$\overline{\mathrm{Fe}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Na}}$	$\dot{\mathrm{K}}$	$\dot{\mathrm{H}}$
14. Eifel,	*Lenzinite*	37·5	37·5	——	——	——	——	——	25·0=100 John.
15. Chanteloube,	"	36·36	36·00	1·95	0·18	——	0·50		21·50, $\ddot{\mathrm{Si}}$ gel. 2·0, quartz 1·64=100·13 Salvetat.
16. Ettinghausen,	*Bole*	42·00	24·14	10·03	0·43	0·52	——	——	24·03=101·05 Löwig.
17. C. de Prudelles,	"	41·05	25·03	8·09	0·50	0·45	——	——	24·02=99·14 Löwig.
18. Sasebuhl,	"	41·9	20·9	12·2	——	——	——	——	24·9=99·9 Wackenroder
19. Striegau,	"	42·00	20·12	8·53	2·01	2·81	——	0·50	24·00=99·97 Zellner.
20. Thuringia,	*Oropion.*	44·0	26·5	8·0	——	0·5	——	——	20·5=99·5 Bucholz.

Pelletier obtained for the *severite* (l. c.) $\ddot{\mathrm{Si}}$ 50, $\overline{\mathrm{Al}}$ 22, $\dot{\mathrm{H}}$ 26=98. Shepard made the *glossecollite* erroneously a hydrated silica containing 17 p. c. of water.

Pyr., etc.—Yields water. B.B. infusible. A fine blue with cobalt solution. Decomposed by acids.

Glossecollite is decomposed by hot sulphuric acid, Pisani.

Obs.—Occurs often in veins or beds of ore, as a secondary product; also in granite and other rocks, being derived from the decomposition of some aluminous minerals. The *Halloysite* of Housscha is derived from graphic granite.

APPENDIX TO CLAYS.

The following are other earthy hydrous aluminous silicates, all of doubtful character:

420A. **SINOPITE** *Hausm.*, Handb., 1847; Σινωπις? *Theophr.*; Rubrica *Vitruv.*; Sinopis *Pliny*, Sinopische Erde *Klapr.*, Beitr., iv. 345; Bol de Sinopis *Beud.* A clayey earth of a brick-red color dotted with white, adhering to the tongue. The material analyzed by Klaproth was from Anatolia, Asia Minor. The sinopic earth of the ancients was brought from Cappadocia, and used as a red paint, and may have been a red ochre. Theophrastus speaks of two other kinds of sinopic earth, one whitish, the other between the red and white in color, and called the pure kind because it was used without mixing; besides also an artificial kind make by burning a clay—the clay becoming red owing to the hydrated oxyd of iron present, which was freed from its water by the heat.

420B. **MELINITE** *Glocker* (Syn., 186, 1847; Gelb-Erde pt. *Wern.*, Hoffm. Min., ii. b, 210; Argile ocreuse jaune pt. *H.*; Yellow ochre pt.) is a yellow clayey material, looking like yellow ochre, more or less lamellar in structure, shining in streak, adhering to the tongue, and soiling the fingers; G.=2·24. The kind analyzed, and to which the name especially belongs, is that from Amberg in Bavaria. Other reported localities are Münden and Schoningen in Hanover; Wehrau, Prussia; Robschütz, Saxony; Vierzon (whence sometimes called *Vierzonite*), Dept. of Cher, and Pourrain, Dept. of Yonne, France.

420C. **OCHRAN** *Breith.*, Char., 100, 1832. A kind of "bole" of a yellow color from Orawitza, a little greasy in feel, with H.=1—2, and G.=2·4—2·5; streak pale yellow to colorless.

PLINTHITE *Thom.* (Min., i. 323) is a brick-red clay from Antrim, Ireland, having G.=2·342, and H.=2·75, and not adhering to the tongue.

Analyses: 1, Klaproth (l. c.); 2, Thomson (l. c.); 3, Kersten (Schw. J., lxvi. 31); 4, Kühn (Schw. J., li. 466):

	$\ddot{\mathrm{Si}}$	$\overline{\mathrm{Al}}$	$\overline{\mathrm{Fe}}$	$\dot{\mathrm{Ca}}$	Na Cl	$\dot{\mathrm{H}}$
1. *Sinopite*	32·0	26·5	21·0	—	1·5	17·0=98·0 Klaproth.
2. *Melinite*	33·23	14·21	37·76	$\dot{\mathrm{Mg}}$ 1·38	—	13·24=99·82 Kühn.
3. *Plinthite*	30·88	20·76	26·16	2·60	—	19·60=100 Thomson.
4. *Ochran*	31·3	43·0	1·2	—	—	21·0=96·5 Kersten.

These ochreous clays are probably only mixtures. Von Hauer obtained from a "melinite" of unknown locality (Jahrb. G. Reichs., 1858, 428) $\ddot{\mathrm{Si}}$ 46·50, $\overline{\mathrm{Al}}$, $\overline{\mathrm{Fe}}$ 40·82 (in one trial $\overline{\mathrm{Fe}}$ 14·92), $\dot{\mathrm{Ca}}$ 0·39, $\dot{\mathrm{H}}$ 11·50=100.

420D. **ORAVITZITE** *Breith.*, Handb., 366, 1841. Massive and in nodules, and resembling halloysite, but heavier. H.=2—2½; G.=2·701; lustre waxy; color greenish-white; unctuous. It is supposed to be a hydrous aluminous silicate containing oxyd of zinc. In the glass tube yields much water. B.B. yields, according to Plattner, with soda and borax on charcoal, a slag which is yellow while hot and white on cooling. The oxyd of zinc is probably present as a mixture in the clay.

From Orawitza, Transylvania, with calamine.

420E. HVERLERA *Forchhammer* (Jahresb., xxiii. 265, 1848). A white or reddish clay resulting from the action of sulphuric and carbonic acids on the ferriferous clays of Krisuvig, Iceland. Composition $\ddot{S}i$ 50·99, $\overline{\ddot{A}}l$ 7·39, $\overline{\ddot{F}}e$ 21·21, $\dot{M}g$ 19·96, $\ddot{T}i$ 0·46=100·01.

420F. KEFFEKILITE (Keffekilith *Fischer*, Mem. Soc. Nat. Moscou, i. 60, 1811). A pearl-gray to grayish-white lithomarge, from the Crimea, having a greasy feel, and somewhat adhering to the tongue, with G.=2·40, John. John obtained (l. c.) $\ddot{S}i$ 45·00, $\overline{\ddot{A}}l$ 14·00, $\overline{\ddot{F}}e$ 12·25, $\dot{C}a$ 2·25, Na Cl 1·50, $\dot{H}$ 22·00, manganese, chrome (?), magnesia, and loss 3·00. Becomes hard enough to scratch glass by calcination. It is evidently merely a clayey mixture.

Keffekil Tartarorum (of the Tartars) was, according to Cronstedt (Min., 79, 1758), a yellowish-white lithomarge from Tartary, used there as a substitute for soap. It has been referred to sepiolite by some.

420G. MELOPSITE *Breith.* (Handb., ii. 360, 1841). Melopsite is translucent, white, yellowish, grayish, or greenish, has a small conchoidal fracture, adheres a little to the tongue, and resembles in texture the flesh of an apple (whence the name from μῆλον, *apple*, and ὄψον, *meat, etc.*) According to Plattner, it consists of silica, alumina, a little magnesia and oxyd of iron, with ammonia, water, and some bitumen. It affords in a glass tube "less water than glagerite."

420H. ACHTARAGDITE *Russian*, before 1847 (Glocker's Syn., 305, 1847. Achtarandit *bad orthog.*). Massive; earthy. Soiling the fingers like chalk. Also in tetrahedral crystals, or combinations of a dodecahedron and tetrahedron, but evidently pseudomorphous. Color grayish-white to greenish-gray; lustre none; fracture earthy. On the Achtaragda, a tributary to the Wilui river, at a locality of idocrase, and containing crystals of idocrase imbedded in it; also 7 m. distant, near Wilui on Mt. Uegernat, with grossularite. Contains silica, alumina, oxyd of iron, lime, magnesia, and water. Supposed by Breithaupt (B. H. Ztg., 1853, 370) to be pseudomorphous after helvite.

421. SAMOITE. *Dana*, Min., 288, 1850; and Geol. Rep. Expl. Exp., 324, 1849.

Stalactitic, with a lamellar structure.

H.=4—4·5. G.=1·7—1·9. Lustre resinous in the fracture. Color white, grayish, or yellowish. Translucent to subtranslucent, not adhering to the tongue nor plastic, being too hard.

Comp.—Analyses: B. Silliman (l. c.):

	$\ddot{S}i$	$\overline{\ddot{A}}l$	$\dot{M}g$	$\dot{N}a$	$\dot{H}$	$\dot{C}a\ddot{C}$	
1.	31·25	37·21	0·06	0·06	30·45	0·01=99·04.	G.=1·69—1·813.
2.	35·14	31·95	1·05	*tr.*	30·80	1·21=100·15.	G.=1·894.

Anal. 1 gives the O. ratio 3 : 3 : 5, and formula $\overline{\ddot{A}}l^2\ddot{S}i^3+10\dot{H}$. No. 2 corresponds nearly to $\overline{\ddot{A}}l^3\ddot{S}i^3+10\dot{H}\,[+\frac{2}{3}\dot{H}\ddot{S}i]$. The mode of origin of the mineral renders quite probable the presence of some opal-silica.

Pyr., etc.—B.B. infusible. In nitric or muriatic acid gelatinizes, leaving a portion of silica in flakes.

Obs.—Forms stalactites and stalagmites; the former low conical; the latter flattened hemispherical in shape, with a width of 3 inches or so, smooth at surface. They consist within of a series of thin plates closely adhering. When fresh they were soft enough to be cut with a knife, but hardened on exposure. They occur in a lava cavern on the south side of the extinct volcanic island of Upolu, of the Navigator or Samoa group; the cavern was a passage some hundreds of yards long, entered about a mile and a half from the sea by a perpendicular descent of 25 feet, and extending toward and beneath the sea, and also up the mountain to an unascertained distance. Its sides and bottom were in places covered with the samoite, which had been formed from the percolating waters. The overlying rock was about 15 feet thick.

Samoite of Silliman, Jr. (Dana's Expl. Exp. Geol. Rep., 732), is a kind of feldspar incorrectly analyzed; probably labradorite.

422 PINITE.

Amorphous; granular to cryptocrystalline; usually the latter. Also in crystals, and sometimes with cleavage, but only because pseudomorphs, the form and cleavage being those of the minerals from which derived. Rarely a submicaceous cleavage, which may belong to the species.

H.=2·5—3·5. G.=2·6—2·85. Lustre feeble, waxy. Color grayish-white, grayish-green, pea-green, dull green, brownish, reddish. Translucent—opaque. Acts like a gum on polarized light; Descl.

Comp., Var.—Pinite is essentially a hydrous alkaline silicate. Being a result of alteration, and amorphous, the mineral varies much in composition, and numerous species have been made of the mineral in its various conditions. If crystals of staurolite may vary 20 p. c. in the proportion of silica, much more should a massive mineral which has been made by the metamorphism of other minerals. Variations would naturally exist from the presence of some of the unaltered original mineral, or of some of its ingredients in an uncombined state; and in the case of rock masses, from mixture with free quartz, partially altered or unaltered feldspar, or other substances.

The varieties of pinite here admitted agree closely in physical characters, and in the amount of potash and water present, and their variations are such as are reasonably attributed to the above causes.

The O. ratio for the bases, silica, and water, deduced from the mean of the analyses, is 3 : 4 : 1, whence the formula $(\frac{1}{4}\dot{H}^3+\frac{3}{4}(\dot{R}^3, \ddot{\ddot{R}}))^2\ddot{Si}^3$=. if $\dot{R}=\dot{K}$ and $\dot{R}^3 : \ddot{\ddot{R}}=1 : 8$, Silica 46·0, alumina 35·1, potash 12·0, water 6·9=100; or, if $\dot{R}=\frac{1}{4}\dot{Mg}+\frac{3}{4}\dot{K}$ and $\dot{R}^3 : \ddot{\ddot{R}}=1 : 5$, =Silica 45·9, alumina 32·7, magnesia 2·5, potash 12·0, water 6·9=100; or, if $\dot{Mg} : \dot{K}=5 : 7$ and $\dot{R}^3 : \ddot{\ddot{R}}=1 : 5$, =Silica 46·2, alumina 33·0, magnesia 3·3, potash 10·6, water 6·9=100. The mineral is related chemically, as it is also physically, to *serpentine* (which has the O. ratio 3 : 4 : 2); and it is an alkali-alumina serpentine, as pyrophyllite is an alumina talc.

The different kinds are either pseudomorphous crystals after (1) iolite; (2) nephelite; (3) scapolite; (4) some kind of feldspar; (5) spodumene; or (6) other aluminous mineral; or (7) disseminated masses resembling indurated talc, steatite, lithomarge, or kaolinite, also a result of alteration; or (8) the prominent or sole constituent of a metamorphic rock, which is sometimes a *pinite schist* (analogous to, and often much resembling, *talcose schist*, and still more closely related to *pyrophyllite schist*). As argillaceous shale often consists of pulverized feldspar, its conversion into pinite schist would be wholly similar to the pseudomorphism of a feldspar crystal into pinite. It is not possible to arrange all the varieties under the above heads. The following are the names that have been introduced, and the characters of the substances to which they are applied:

Var 1. PINITE. Speckstein [fr. the Pini mine at Aue, near Schneeberg] *Hoffmann*, Bergm. J., 156, 1789; Kieselerde + Thonerde, etc., *Klapr*, ib., 227, 1790. Pinit *Karsten*, Tab., 28, 73, 1800.) The original pinite is in 6- to 9-sided prisms; color brown. Occurs in granite, and is supposed to be pseudomorphous after iolite. Also found at St. Pardoux in Auvergne, at the Puy de Dome, in decomposing feldspar porphyry; at Mühlenthal, near Elbingerode, the prisms 12-sided, lustreless, with H.=2—3. Anal. 1-7.

2. GIESECKITE (fr. Greenland, *Allan*, Ann. Phil., ii. 1813). In 6-sided prisms, probably pseudomorphous after nephelite. H.=3·5. G.=2·78—2·85. Color grayish-green, olive-green, to brownish. Brought by Giesecké from Akulliardsuk and Kangerdluarsuk, Greenland, where it occurs in compact feldspar Also of similar characters from a pyroxene rock at Diana, N. Y., the prisms often large, and with the basal edges replaced by a plane inclined about 135° to the base. Anal. 8-11.

(*b*) *Lythrodes* Karsten (Mag. Ges. Fr. Berlin, iv. 78, 1810; John, Ch. Unt., i. 171; Splittriger Wernerit *Hausm.*, 520, 1813) has a little less silica and more alumina than the above (anal. 12), but is otherwise essentially the same; it is imperfectly lamellar, scaly in fracture, greasy in lustre; yellow, flesh red, brownish-red, or spotted with greenish and yellowish; G.=2·51; and is from the zircon-syenite of Fredericksvärn and Laurvig. It is regarded as altered nephelite. Of like composition and origin is the (*c*) *Liebenerite* Marignac (Bibl. Univ., vi. 293, 1848), from a porphyritic feldspathic rock of Mt. Viesena, in Fleimsthal (anal. 13-15); it occurring in 6-sided prisms without cleavage; H.=3·5; G.=2·814, v. Hauer; 2·806, Breith.; lustre somewhat greasy; color greenish-gray; and without double refraction.

(*d*) *Dysyntribite* Shepard (Proc. Am. Assoc., 311, 1851, Am. J. Sci., II. xii. 209) is essentially the same with the gieseckite from Diana and elsewhere, Lewis Co., N. Y.; it constitutes masses or a rock, sometimes slaty in structure, and somewhat resembles serpentine, though more waxy in aspect (anal. 18, 19); H.=3—3·5; G =2·76—2·81; colors often mottled, usually greenish, sometimes reddish or spotted with red. Associated with phlogopite, etc.

(*e*) *Parophite* T. S. Hunt (Rep. G. Can., 1852, 1863) is similar to dysyntribite, but less pure;

the analyses vary considerably (anal. 20–23), it being, as regarded by Hunt, a rock, and not a simple mineral; the name alludes to a resemblance to serpentine; H.=2·5—3, and it cuts like massive talc; G.=2·7—2·784; 2·90, fr. Pownal; colors greenish, yellowish, reddish, grayish. It constitutes a schistose rock at St. Nicholas and Famine R., Can., being an altered shale of the Lower Silurian (Quebec group); also occurs in Stanstead, Can., on the E. shore of L. Memphremagog, with chloritic schist; and at Pownal, Vermont, as a bluish-gray schist, that had been considered a talcose or magnesian schist.

(*f*) A *green mineral* from the Grindelwald glacier (anal. 24), having H.=3·5—4, and G.=2·85, a somewhat waxy lustre, resembling a compact green talc, and described by Fellenberg (Ber. N Ges. Berne, 1866) is very similar to parophite.

(*g*) *Pinitoid*, described by A. Knop (Jahrb. Min. 1859, 558) as a rock, is like dysyntribite in characters, and a schist called "*pinitoid schist*" approaches parophite. *Pinitoid* (anal. 25) has H.=2·5; G.=2·788; color leek-, oil-, and grayish-green. Occurs in the region between Freiberg and Chemnitz, Saxony, pseudomorphous after feldspar, in a half-decomposed granitic porphyry, constituting about 25 p. c. of the rock.

3. WILSONITE *T. S. Hunt* (Rep. G. Can., 1853, 1863) is a pinite pseudomorph, with the form and cleavage of *scapolite*; H.=3·5; G.=2·76—2·78; lustre somewhat pearly; color rose-red; fragments translucent; anal. 16, 17. It is from Bathurst, Can., where it was first found by Dr. Wilson; also St. Lawrence Co, N. Y. *Terenite* (p. 323), from Antwerp, St. Lawrence Co., may be the same.

4. POLYARGITE and ROSITE of Svanberg (Ak. H. Stockh., 1840) are close to the preceding in composition. *Rosite* (anal. 28) is a granular red mineral, occurring in granular limestone at Aker in Södermanland; H.=2·5; G.=2·72. G. Rose and others make it *altered anorthite*. *Polyargite* (anal. 26, 27) occurs in reddish lamellar masses at Tunaberg, Sweden; H.=4; G.=2·768; named from πολύς, *much*, and ἀργός, *sparkle*. The name *Pyrrholite* has been given to a reddish lamellar mineral from Tunaberg, which is very similar to polyargite (Descl. Min., i. 302, 1862); it has H.=3—4; and cleavage surfaces inclined together about 87°; and is apparently anorthite less altered than in rosite and polyargite. It is optically biaxial. The "pinitoid" of Sasbachwald, Duchy of Baden (anal. 35), is *altered oligoclase*, according to Sandberger; H.=2·5.

5. KILLINITE *Thomson* (Min., i. 330, 1836), from Killiney Bay, Ireland, has been stated to have the form and cleavage of spodumene, a mineral that occurs in the vicinity. It has H.=4; G.=2·56—2·66, Thomson; 2·678—2·688, Galbraith; lustre weak vitreous; color greenish-gray, brownish, or yellowish; anal. 29–33.

6. Other pinite has passed under the name of *lithomarge* (Steinmark *Germ.*). That of Zorge (anal. 36) is green, and has G.=3·086, Ramm. The Schemnitz mineral (anal. 37) occurs with dillnite and kaolinite as the gangue of diaspore, and is gray or greenish-gray in color, with H.=2·5—3, G.=2·735. Anal. 47 is of a *lithomarge* from Schlackenwald. That of Ems (anal. 48) is green to white, and *kaolin-like* in consistence, and occurs in clefts in the Spirifer sandstone.

The *compact talc* of Klammberg, Tyrol, is probably pinite or agalmatolite in constitution.

7. AGALMATOLITE (Agalmatolithus, Bildstein (fr. China), *Klapr.*, Beitr., ii. 184, 1797. Pagodite *Napione*, J. de Phys., xlvi. 220, 1798). Like ordinary massive pinite in its amorphous compact texture, lustre, and other physical characters, but contains more silica, so as to afford the formula of a bisilicate, or nearly, and it may be a distinct species. Yet, as above observed, the excess of silica is possibly from free quartz or feldspar as impurity. The Chinese has H.=2—2·5; G.=2·785—2·815, Klapr. Colors same as for pinite, usually grayish, grayish-green, brownish, yellowish. Anal. 38–41.

A similar mineral in composition comes from Nagyag in Transylvania, and Ochsenkopf near Schwarzenberg in Saxony (anal. 44). *Agalmatolite* was named from ἄγαλμα, *an image*, and *pagodite* from *pagoda*, the Chinese carving the soft stone into miniature pagodas, images, etc. Part of the so-called agalmatolite of China is true pinite in composition, another part is compact pyrophyllite (p. 455), and still another steatite (p. 453). (Brush, Am. J. Sci., II. xxvi. 64.)

Oncosin v. Kobell (J. pr. Ch., ii. 295, 1834) is related in composition (anal. 45), and has H.=2; G.=2·8; color apple-green to grayish or brownish; translucent; it occurs in roundish masses imbedded in dolomite with mica, at Passecken near Tamsweg, in Salzburg. (*c*) *Oösite* (Oösit *Marx*, ib., iii. 216, 1834), another related compound (anal. 48), is white to reddish or brownish-red, and occurs in 6- and 12-sided prisms; it is from the Oös valley, duchy of Baden, occurring in what is called pinite-porphyry.

(*d*) *Gongylite* (Gongylit *Thoreld*, Act. Soc. Sci. Fenn., iii. 815, A. Nord., Beskrifn. Finl. Min., 146, 1855) is yellowish or yellowish-brown, and has cleavage in two directions: with H.=4—5; G.=2·7; anal. 42. From a schist called talcose schist at Kimsamo in Finland.

O. ratio for Ṙ, R̶, S̈i, Ḣ, for *agalmatolite*, about 1 : 9 : 18 : 3; for *oncosin*, 1 : 5 : 10 : 1½; for *oosite*, 1 : 10 : 24 : 6; for *gongylite*, 1 : 3 : 8 : 1½.

The following may be impure pinite:

8. *Gigantolite* Nord. (Act. Soc. Sci. Fenn., i. 2, 377, 1840). From gneissoid granite of Tammela, Finland, in large 6- and 12-sided prisms, with basal cleavage; H.=2·5; G.=2·862—2·878: lustre somewhat waxy; color greenish to dark steel-gray, sometimes approaching submetallic in lustre

owing to the alteration of the original iolite and the presence of uncombined oxyd of iron. (*b*) *Iberite* Svanberg (Œfv. Ak. Stockh., i. 219, 1844), from Montalvan, near Toledo, Spain, is the same mineral in characters; H.=2·5; G.=2·89. Both are a result of the alteration of iolite, and are between pinite and *fahlunite* (p. 484) in composition.

Analyses: 1, 2, Rammelsberg (3d Suppl., 94, Min. Ch., 835); 3–5, Marignac (J. Pharm. Ch., III xii. 150); 6, Rammelsberg (Min. Ch., 836); 7, A. Streng (B. H. Ztg., xx. 266); 8, Stromeyer (Gel. Anz. Gött., iii. 1993, 1819); 9, Pfaff (Schw. J., xlv. 103, 1825); 10, v. Hauer (Jahrb. G. Reichs., 1854, 76); 11, G. J. Brush (Am. J. Sci., II. xxvi. 64); 12, John (Chem. Unt, i. 171); 13, Marignac (l. c.); 14, v. Hauer (l. c., 1853, 147); 15, Œllacher (ZS. Ferdinandeums, 1844, 2); 16, T. S. Hunt (Rep. G. Can., 1863, 483); 17, E. W. Root (Am. J. Sci., II. xlv. 47); 18, 19, Smith & Brush (Am. J. Sci., II. xvi. 50); 20–23, T. S. Hunt (Rep. G. Can., 1852, 95, 1863, 484); 24, Fellenberg (Ber. Nat. Ges. Berne, 1866); 25, A. Knop (Jahrb. Min, 1859, 558); 26, 28, A. Svanberg (Pogg., liv. 269, Ak. H. Stockh., 1840); 27, A. Erdmann (Ak. H. Stockh., 1848); 29, 30, Lehunt & Blythe (Thomson's Min., i. 330); 31, Mallet (Ramm. 5th Suppl. 148); 32, 33, J. A. Galbraith (J. G. Soc. Dublin, vi. 165); 34, A. Streng (l. c.); 35, Seidel (Beschr. Baden, Carlsruhe, 55, 1861); 36, Rammelsberg (Pogg., lxii. 152); 37, Karafiat (Pogg., lxxviii. 575); 38, Vauquelin (Ann. de Ch., xlix. 88); 39, 40, Klaproth (Beitr., v. 19, 21); 41, John (Chem. Unt., i. 126); 42, Thoreld (Act. Soc. Sci. Fenn., iii. 815); 43, Nessler (Beschr. Baden, Carlsruhe, 32, 1861, Jahresb., 1861); 44, John (Ann. Phil., iv. 214); 45, v. Kobell (J. pr. Ch., ii. 295); 46, John (Chem. Unt., l. c.); 47, Krieg (Ramm. Min. Ch., 576); 48, Herget (Jahresb., 1863, 822):

	$\ddot{\text{Si}}$	$\overline{\dddot{\text{Al}}}$	$\overline{\dddot{\text{Fe}}}$	$\dot{\text{Fe}}$	$\dot{\text{Mg}}$	$\dot{\text{Ca}}$	$\dot{\text{Na}}$	$\dot{\text{K}}$	$\dot{\text{H}}$
1. Aue, *Pinite*	46·83	27·65	8·71	——	1·02	0·49	0·40	6·52	7·80=99·42 Ramm.
2. Penig, "	47·00	28·36	7·86	——	2·48	0·79	1·07	10·74	3·83=102·13 Ramm.
3. Saxony, "	46·10	32·46	4·27	——	2·26	——	0·46	9·00	5·45=100 Marignac.
4. Chamouny, "	44·70	31·64	6·57	——	2·86	——	0·95	7·89	5·39=100 Marignac.
5. St. Pardoux, "	47·50	31 80	3·92	——	——	0 92	1·78	9·05	5·03=100 Marignac.
6. " "	48·92	32·29	3·49	——	1·30	0·51	——	9·14	4·27, Mn 0·11=100·03 R.
7. Elbingerode, "	47·51	31·17	——	1·85	1·55	1·24	0·15	7·23	9·02 (with $\ddot{\text{C}}$)=99·72 S.
8. Greenland, *Gieseck.*	46·08	33·83	3·36	——	1·20	——	——	6·20	4·89, $\dot{\text{M}}$n 1·15=96·71 S.
9. " "	48·0	32·5	4·0	——	1·5	——	——	6·5	5·5=98·0 Pfaff.
10. " " ($\frac{2}{7}$)	45·88	26·93	——	6·30	7·87	——	——	4·84	6·82=98·64 Hauer. [B.
11. Diana, " ($\frac{3}{8}$)	45·67	31·51	0·27	0·77	3·48	2·20	0·88	8·21	6·97, $\dot{\text{C}}$a $\ddot{\text{C}}$ 0·32=100·28
12. Norway, *Lythrodes*	44·62	37·36	1·00	——	*tr.*	2·75	8·00	——	6·00=99·73 John.
13. Fleims, *Liebener.* ($\frac{3}{8}$)	44·67	36·51	——	1·75	1·40	——	0·92	9·90	5·05=100·19 Marignac.
14. " "	44·45	38·75	2·26		*tr.*	1·58	2·79	6·45	[4·75]=101·08 Hauer.
15. " "	45·13	36·50	2 63	——	1·56		0·42	8·07	4·70=99·01 Œllacher.
16. Bathurst, *Wilsonite* ($\frac{3}{2}$)	47·60	31·19	——	——	4·19	0·95	0·89	9·30	5·43=99·55 Hunt.
17. S. Lawrence Co., "	47·46	30·51	——	——	3·63	0·53	2·48	8·78	6·09=99·43 Root.
18. Jefferson Co., *Dys.*	44·80	34·90	3·01	——	0·42	0·66	3·60	6·87	5·38, $\dot{\text{M}}$n 0·30=99·94 Smith & Brush.
19. " " "	46·70	31·01	3·69	——	0·50	*tr.*	*tr.*	11·68	5·30=98·88 S. & B.
20. St. Nicholas, *Par.* ($\frac{3}{2}$)	48·46	27·55	——	5·08	2·02	2·05	2·35	5·16	7·14=99·81 Hunt.
21. " "	48·10	28·70	——	4·80	1·41	2·10	1·53	4·49	8·40=99·53 Hunt.
22. St. Francis, "	50·50	33·40	——	*tr.*	1·00	*tr.*	0·63	8·10	5·36=98·99 Hunt.
23. Stanstead, "	50·30	32·60	——	*tr.*	1·20	——	*undet.*		6·50 Hunt.
24. Grindelwald Gl.	46·81	35·15	——	1·43	0·65	0·99	0·49	9·68	5·25=100·99 Fellenberg.
25. Chemnitz, *Pinitoid*	47·77	32·65	——	8·94	0·49	——	1·50	5·86	4·19=101·40 Knop.
26. Tunaberg, *Polyarg.*	44·13	35·12	0·96	——	1·43	5·56	——	6·73	5·29, $\overline{\ddot{\text{M}}}$n 0·30=99·22 S.
27. " "	45·12	35·64	0·14	——	0·26	5·88	0·67	6·93	4·62, $\overline{\ddot{\text{M}}}$n 0·19=99·56 E.
28. Aker, *Rosite*	44·90	34·50	0 69	——	2·45	3·59	*tr.*	6·63	6·53, $\dot{\text{M}}$n 0·19=99·48 S.
29. Killiney, *Killinite*	49·08	30·60	——	2·27	1·08	0 68	——	6·72	10·00=100·43 Lehunt.
30. " "	47·93	31·04	——	2·33	0·46	0·72	——	6·06	10·00, $\dot{\text{M}}$n 1·26=99·80 B.
31. " "	52·89	33·24	——	3·27	——	1·45	——	4·94	3·67, $\dot{\text{L}}$i 0·46=99·92 M.
32. " "	50·45	30·13	——	3·58	1·09	——	0·95	4·81	7·58=98·54 Galbraith.
33. Dalkey, "	50·11	29·37	——	2·23	1·03	0·34	0·60	6·71	8·03=98 42 Galbraith.
34. Auerberg, *Pinite*	50·95	30·62	——	2·48	0·35	0·35	0·12	9·74	5·25=99·86 Streng.
35. Sasbachwald, "	50·43	28·89	——	——	3·48	——	3·68	5·12	5·84=97·44 Seidel.
36. Zorge, *Lithomarge*	49·75	29·88	6·61	——	1·47	0·43	——	6·35	5·48=99·97 Ramm.
37. Schemnitz	49·50	27·45	——	1·03	0·72	5·56	10·20		5·10 Karafiat.
38. China, *ywh.*, *Agalm.*	56	29	1	——	——	2	——	7	5 =100 Vauquelin.
39. " *green*, "	54·50	34·00	0·75	——	——	——	——	6·25	4·00=99·50 Klaproth.
40. Nagyag, " "	55·0	33·0	0·5	——	——	——	——	7·0	3·0=98·5 Klaproth.
41. China, *red* "	55·50	31·00	1·25	——	——	2·00	——	5·25	5·00=100 John.
42. Finland, *Gongylite* ($\frac{1}{4}$)	55·22	21·80	4·80	——	5·90	0·77	0·45	4·46	5·77, $\dot{\text{M}}$n 0·32=99·49 T

	S̈i	A̶l	F̶e	Ḟe	Ṁg	Ċa	Ṅa	K̇	Ḣ
43. Baden, *Oösite*	58·69	22·89	—	4·09	0·22	—	1·14	4·94	8·30=100·27 Nessler
44. Ochsenkopf	55·00	30·00	1·00	—	—	1·75	—	6·25	5·50=99·50 John.
45. Tamsweg, *Oncosin*	52·52	30·88	—	0·80	3 82	—	—	6·38	4·60=99·60 Kobell.
46. Saxony	51·50	32·50	—	1·58	—	3·00	—	6·00	5·13, Ṁn 0·12=99·83 J
47. Schlackenwald, *Lith.*	52·40	31·94	1·23	—	1·44	—	1·73	5 41	5·00=99·16 Krieg.
48. Ems, Nassau, *green*	53·15	33·56	—	—	0·17	0·21	—	[4·70]	8·21=100 Herget.

In a so-called *pinitoid schist* of the valley of Raibl, apple-green in color, Tschermak found (Ber. Ak. Wien, lii. 443): S̈i 62·0, A̶l 18·1, Ḟe 4·1, Ṁg 1·6, Ċa 1·5, Ṅa 1·0, K̇ 4·1, Ḣ 6·2, C̈ 0·4=99. There is a large excess of silica, which may be due to free silica, if the rock is not rather a *pyrophyllite schist.*

A pinite-like mineral from the phyllite of Petit-Cœur in the Tarentaise, Savoy, afforded A. Terreil (C. R., liii. 120) S̈i 50·00, A̶l 36·45, F̶e 0·37, Ċa, Ṁg 0·45, K̇ 5·01, Ṅa *tr.*, P̈ *tr.*, Ḣ 7·96=100·24. The composition is the same with that of the containing schist.

Gmelin obtained (Kastn. Arch., i. 226) for the Auvergne pinite, S̈i 55·96, A̶l 25·48, etc.; but the later analyses (Nos. 5, 6, above) show that his results are erroneous. The Neustadt red pinite is an anhydrous mineral; it gave Ficinus (Schw. J., xxvi. 280) S̈i 54·6, A̶l 23·6, Ḟe 7·8, M̶n 1·6, Ṁg 0·8, K̇ 11·2, Ḣ 1·2=100·8; and Massalin (Trommsdorff's N. J., iv. 2, 324) S̈i 45·0, A̶l 30·0, F̶e 12·6, K̇ 12·4=100.

The following are analyses of *gigantolite* and *iberite:* 1, Wachtmeister (Pogg., xlv. 558); 2, Marignac (J. Pharm. Ch., III. xii. 150, Ramm. Min. Ch., 836); 3, Komonen (Nord. Beskrifn. Finl. Min., 151); 4, Norlin (Œfv. Ak. Stockh., 1844, 219):

	S̈i	A̶l	F̶e	Ṁn	Ṁg	Ċa	Ṅa	K̇	Ḣ
1. Tamela, *Gigant.*	46·27	25·10	15·60	0·89	3·80	—	1·20	2 70	6·00, F *tr.*, Wachtm.
2. " "	42·59	26·62	15·73	0·95	2·63	—	0·86	5·44	5·89=100·71 Mar.
3. " "	45·5	26·7	13·8	0·9	2·4	—	—	5·8	6·2=101·3 Komon.
4. Montalvan, *Iberite*	40·90	30·74	17·18	1·33	0·80	0·40	0·04	4·57	5·57=101·53 Norlin.

Pyr., etc.—In the closed tube gives off water, which frequently reacts alkaline. B.B. some varieties fuse easily with intumescence, while others fuse quietly and with more difficulty. Appreciably attacked by strong muriatic acid.

Obs.—Gieseckite has been attributed by many authors to the alteration of nephelite (elæolite). Pisani (C. R., lxii. 1324) has found the latter mineral from Brevig, Norway, partly altered to a brick-red material which is true gieseckite in nature and composition. On the same specimen is found true translucent elæolite, affording only 1·3 p. c. of water on calcination, and entirely soluble in dilute acids; by the side of this, red spots where alteration has commenced; and beyond, the mineral changed to a brick-red uniform material, mostly opaque, with some translucent spots of unaltered elæolite. This red material afforded 5·9 p. c. of water, and dissolved only partially in dilute nitric acid, leaving an abundant red deposit. On separating the insoluble portion by treatment with cold dilute nitric acid, this afforded, on analysis, S̈i 46·95, A̶l 34·65, F̶e 1·86, Ṁg 0·58, Ċa 0·68, Ṅa, Li 0·71, K̇ 8·71, Ḣ 5·58=99·72, thus showing that, besides taking up water, the soda of the elæolite had been replaced almost wholly by potash.

423A. *Neurolite* Thomson (Min., i. 354, 1836) is greenish-yellow, imperfectly foliated in texture, consisting of thin fibres of some breadth but rather obscure, but "not the least appearance of crystallization." H.=4·25. G.=2·476. B.B. whitens, but does not fuse. Composition, according to Thomson, S̈i 73·00, A̶l 17·35, F̶e 0·40, Ṁg 1·50, Ċa 3·25, Ḣ 4·30=99·8. From Stanstead, Lower Canada. It has been doubtful what mineral Dr. Thomson had in hand in making his description. But according to T. S. Hunt (Rep. G. Can., 1863, 485), neurolite is a quartzose variety of woodlike agalmatolite. His analysis afforded (l. c.):

S̈i	A̶l	Ḟe	Ṁg	Ṅa, K̇	Ḣ
50·30	32·60	*tr.*	1·20	*undet.*	6·50

It occurs at Stanstead, forming a belt 150 feet wide; in some places granular and nearly pure, in others schistose and containing quartz. A thin layer has a banded structure, ligneous in appearance, with a shiny satin lustre. It is translucent, of a wax or amber-yellow color; feel unctuous.

423B. A mineral near pinite in composition has been described by Descloizeaux (Bull. G. Soc., II. xxii. 25). It occurs in rounded grains, of a waxy structure and greenish color, distributed in the anhydrite of Modane. Thin plates without double refraction, according to Descloizeaux. H.=3·

G.=2·66. Yields water in closed tube. B.B. fuses with intumescence to a white enamel. Scarcely attacked by muriatic acid. Pisani obtained (Bull. G. Soc., l. c.):

$\ddot{\mathrm{Si}}$ 48·20 $\bar{\mathrm{Al}}$ 19·70 $\dot{\mathrm{Fe}}$ 3·38 $\dot{\mathrm{Mg}}$ 12·80 $\dot{\mathrm{Ca}}$ 1·64 $\dot{\mathrm{K}}$, $\dot{\mathrm{Na}}$, $\dot{\mathrm{Li}}$ (by loss) 7·22 $\dot{\mathrm{H}}$ 7·06=100.

423. CATASPILITE. Kataspilit *Igelström*, Œfv. Ak. Stockh., 1867, 14.

Pseudomorphous after iolite, and presenting its forms.

H.=2·5. Lustre pearly. Color ash-gray. Subtranslucent.

Comp.—Near pinite. O. ratio for $\dot{\mathrm{R}}$, $\bar{\mathrm{R}}$, $\ddot{\mathrm{Si}}$, $\dot{\mathrm{H}}=3:5:8:1$; $(\frac{3}{8}\dot{\mathrm{R}}^3+\frac{5}{8}\bar{\mathrm{Al}})^2\ddot{\mathrm{Si}}^3+\frac{3}{4}\dot{\mathrm{H}}$. Analysis: Igelström (l. c.):

$\ddot{\mathrm{Si}}$ 40·05 $\bar{\mathrm{Al}}$, with some $\bar{\mathrm{Fe}}$, 28·95 $\dot{\mathrm{Mg}}$ 8·20 $\dot{\mathrm{Ca}}$ 7·48 $\dot{\mathrm{Na}}$ 5·25 $\dot{\mathrm{K}}$ 6·90 ign. 8·22

G. J. Brush found in a pale greenish pagodite from China (priv. contrib.) $\ddot{\mathrm{Si}}$ 41·50, $\bar{\mathrm{Al}}$, with little $\bar{\mathrm{Fe}}$, 31·30, $\dot{\mathrm{Mg}}$ 12·25, $\dot{\mathrm{Na}}$ 0·60, $\dot{\mathrm{K}}$ 6·42, $\dot{\mathrm{H}}$ 7·50=99·67, approaching the above, but affording the O. ratio 3 : 6 : 9 : 3=1 : 2 : 3 : 1. Igelström obtained but 1 p. c. of water in one trial, and in his formula makes the cataspilite anhydrous.

Pyr., etc.—Fuses on charcoal rather easily to an enamel-like bead. Decomposed by muriatic acid with a separation of flocculent silica.

Obs.—From a gray chlorite rock at Longban, in Wermland, Sweden, distributed through it in druses as large as peas. Named from κατασπιλάζω, in allusion to this mode of occurrence.

424. BIHARITE. Agalmatolith (fr. Retzbanya) *Haid.*, Ber. Min. d. k. k. Hofk., Wien, 1848. Biharit *K. F. Peters*, Ber. Ak. Wien, xliv. 132, 1861.

Massive; fine granular or microcrystalline.

H.=2·5. G.=2·737, yellow var. Lustre greasy, inclined to pearly. Color yellowish to green, brownish, dull wine-yellow, oil-green, leek-green. Translucent to hardly subtranslucent. Feel a little greasy. Optically doubly refracting.

Comp.—O. ratio for $\dot{\mathrm{R}}$, $\bar{\mathrm{R}}$, $\ddot{\mathrm{Si}}$, $\dot{\mathrm{H}}=2:1:3:\frac{2}{3}$, nearly; whence $(\frac{2}{3}(\dot{\mathrm{Mg}},\dot{\mathrm{Ca}})^3+\frac{1}{3}\bar{\mathrm{Al}})^2\ddot{\mathrm{Si}}^3+1\frac{1}{3}\dot{\mathrm{H}}$. Analysis: Soltész (l. c.), after removing 4·68 $\dot{\mathrm{Ca}}\ddot{\mathrm{C}}$:

$\ddot{\mathrm{Si}}$	$\bar{\mathrm{Al}}$	$\bar{\mathrm{Fe}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Na}}$	$\dot{\mathrm{K}}$	$\dot{\mathrm{H}}$
41·74	13·47	*tr.*	28·92	4·27	*tr.*	4·86	4·46=97·72.

Pyr., etc.—In the tube yields water. B.B. infusible (the green var.), or only fusing on the thinnest edges (yellow).

Obs.—Occurs imbedded in a fine granular limestone in the Biharberg, near Retzbanya.

425. PALAGONITE. Palagonit *Sartorius v. Waltershausen*, Subm. Vulk. Ausbr. Val di Noto, etc. Gött., 1846; Vulk. Gest., 1853. Bunsen, Ann. Ch. Pharm., lxi. 265, 1847, Pogg., lxxxiii. 219, 1851. Melanhydrit *A Krantz*, Verh. nat. Ver. Bonn, xvi. 154, 1859.

Amorphous. In grains and fragments aggregated into a tufa-like rock, or as a constituent of tufa or volcanic conglomerate.

H.=4—5. G=2·4—2·7; 1·82, melanhydrite. Lustre vitreous or greasy, or like pitchstone. Color amber-yellow, yellowish-brown, colophonite-brown, garnet-red, blackish, black. Streak yellowish, brownish-yellow.

Comp.—O. ratio for $\dot{\mathrm{R}}$, $\bar{\mathrm{R}}$, $\ddot{\mathrm{Si}}$, $\dot{\mathrm{H}}=1:2:4:n$; and for bases and silica 3 : 4, as in pinite, kaolinite, and serpentine, to which species the mineral is therefore related. Formula $(\frac{3}{4}(\dot{\mathrm{R}}^3,\bar{\mathrm{Fe}},\bar{\mathrm{Al}})+\frac{1}{4}\dot{\mathrm{H}}^3)^2\ddot{\mathrm{Si}}^3+n$ aq. Has been regarded by Bunsen a combination of unisilicates $\bar{\mathrm{R}}^2\ddot{\mathrm{Si}}^3+n$ aq, and bisilicates $(\dot{\mathrm{R}}^3)\ddot{\mathrm{Si}}^3+n$ aq, who writes for the palagonite of Iceland the formula $\dot{\mathrm{R}}^3\ddot{\mathrm{Si}}^3+\bar{\mathrm{R}}^2\ddot{\mathrm{Si}}^3+n$ aq; and for that of the Galapagos, $2\dot{\mathrm{R}}^3\ddot{\mathrm{Si}}^3+\bar{\mathrm{R}}^2\ddot{\mathrm{Si}}^3+n$ aq.

Analyses by v. Waltershausen (l. c.); means of results after gangue excluded:

		$\ddot{\mathrm{Si}}$	$\dddot{\mathrm{Al}}$	$\dddot{\mathrm{Fe}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Na}}$	$\dot{\mathrm{K}}$	$\dot{\mathrm{H}}$
I.	1. Krisuvik	40·68	14·59	14·24	7·65	6·95	1·84	0·45	13·60
II.	2. Hecla	40·75	8·42	17·99	4·54	8·64	0·62	0·44	18·60
	3. Laxá	42·28	11·14	16·71	6·39	5·68	—	1·80	16·00
	4. Val di Noto	38·69	13·61	14·51	6·13	8·38	1·07	1·35	16·26
III.	5. Galapagos	38·07	13·03	9·99	6·58	7·54	0·70	0·94	23·15
	6. "	36·94	11·56	10·71	6·28	7·95	0·55	0·78	25·23
IV.	7. Südafell	41·46	10·91	18·12	4·80	8·54	0·64	0·40	14·49
	8. Val di Noto	41·26	8·60	25·32	4·84	5·59	1·06	0·54	12·79
V.	9. "	40·86	10·07	20·54	3·28	4·46	3·99	1·10	15·70
VI.	10. "	34·99	6·02	20·50	11·02	6·08	0·92	0·93	19·54

Waltershausen calculates for chrysolite, and sometimes carbonate of lime, present as impurity and gives the following for the correct composition under the above types, I. to VI., to which h assigns the names and formulas annexed. The compounds are mainly hypothetical:

	$\overline{\ddot{\mathrm{Si}}}$	$\dddot{\mathrm{Al}}$	$\dddot{\mathrm{Fe}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Na}}$	$\dot{\mathrm{K}}$	$\dot{\mathrm{H}}$
I. *Palagonite*	41·90	12·72	16·74	6·86	6·71	1·92	0·99	12·16 $=\dot{R}^3\overline{\ddot{Si}}^2+2\,\dddot{R}\,\overline{\ddot{Si}}+6\,\dot{H}$.
II. "	40·62	11·03	15·86	5·44	7·28	0·62	1·53	17·67 = " " $+9\,\dot{H}$.
III. "	38·96	12·75	10·71	6·53	5·96	0·65	0·90	23·26 $=\dot{R}^3\overline{\ddot{Si}}+2\,\dddot{R}\,\overline{\ddot{Si}}+12\,\dot{H}$.
IV. *Korite*	44·07	12·00	19·47	4·95	5·53	0·70	0·44	12·84 $=\dot{R}\,\overline{\ddot{Si}}+\dddot{R}\,\overline{\ddot{Si}}+3\,\dot{H}$.
V. *Hyblite*	40·86	10·22	20·68	2·61	4·53	4·05	1·12	15·93 = " " $+4\,\dot{H}$.
VI. *Notite*	36·96	6·36	21·66	11·64	3·26	0·97	0·99	18·16 $=\dot{R}_2\overline{\ddot{Si}}+\dddot{R}\,\overline{\ddot{Si}}+5\,\dot{H}$.
VII. *Trinacrite*	31·82	5·25	33·95	4·57	2·57	4·19	3·42	14·22 $=\dot{R}^3\overline{\ddot{Si}}+3\,\dddot{R}\,\overline{\ddot{Si}}+9\,\dot{H}$.

The *Trinacrite* is dull brown, and cleavable or micaceous, and is mixed with his hypothetic *Siderosilicite*, a hydrous silicate of sesquioxyd of iron and alumina.

The following are Bunsen's results—gangue excluded (loc. cit., and Ramm. Min. Ch., 865):

	$\ddot{\mathrm{Si}}$	$\dddot{\mathrm{Al}}$	$\dddot{\mathrm{Fe}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Na}}$	$\dot{\mathrm{K}}$	$\dot{\mathrm{H}}$
1. Iceland	39·01	11·60	14·79	6·30	9·14	0·66	0·70	17·80
2. "	40·74	8·42	18·00	4·54	8·75	0·62	0·43	18·50
3. "	39·32	11·88	15·29	7·92	5·41	0·56	0·28	19·34
4. "	41·28	11·03	13·32	6·49	8·75	0·62	0·65	17·36
5. "	40·30	14·45	14·60	7·57	6·88	1·82	0·44	13·50, $\dddot{\mathrm{P}}$ 0·44
6. "	39·08	8·69	20·00	7·29	8·09	2·35	0·94	13·56
7. "	41·80	13·61	13·78	8·20	8·82	1·23	1·41	11·15
8. "	42·29	11·15	16·72	6·39	5·67	——	1·79	15·99
9. Galapagos	36·95	11·56	10·71	6·27	7·95	0·55	0·77	25·24
10. "	38·07	13·03	10·00	6·58	7·54	0·70	0·95	23·13
11. "	38·72	11·60	11·66	8·75	5·37	1·70	1·84	20·36
12. Cape Verdes	35·76	11·76	14·95	11·22	——	3·89	2·47	19·95
13. Limburg, *yw.*, *bnh.*	48·96	9·94	10·54	3·04	4·98	1·04	0·82	20·68
14. Honnef, *Melanhydr.*	41·63	18·72	2·36	5·23	1·07	$\dot{\mathrm{M}}$n 2·51	$\dot{\mathrm{F}}$e 7·83	20·71 Wack.

Pyr., etc.—Yields water. B.B. fuses easily to a black magnetic glass. Decomposed by mu atic acid with gelatinization.

Obs.—Tufas are formed through the action of waters, and often that of heated waters or ste accompanying an eruption of lavas, on the granulated volcanic rock, or volcanic sand; and in t process the protoxyd of iron of the pyroxene of the rock becomes more or less complete changed to sesquioxyd, and water is taken up, and so the palagonite is produced. As the volca rock is made up generally of pyroxene and a feldspar always in very variable proportio uniformity in such results of alteration is not possible.

Bunsen observes that palagonite is the basis of the basaltic tufas of Germany, France, Azor Canaries, Cape Verdes, Tortugas, and probably also of those of the Pacific Islands. *Melanhyd* (anal. 14, by Wackernagel, l. c., and Ramm. Min. Ch.) is velvet-black to brownish-black, and occ in irregular nodules in a decomposed wacke at Schmelzerthal near Honnef, on the Rhine.

Named *palagonite* from Palagonia, one of its localities in Sicily.

426. FAHLUNITE. Fahlunit (fr. Fahlun) *Hisinger*, Min.-Geogr. Sverige, 22, 1808. T clasit (fr. ib.) *J. F. L. Hausmann*, Moll's Efem., iv. 396, 1808. Hydrous iolite (fr. Abo) *v. Bo* *dorff*, Ak. H. Stockh., 156, 1827. Auralit (ib.) *v. Bonsd.* Hydrous Iolite, Bonsdorffite, *Thoms.*, Min., i. 278, 323, 1836. Raumit (from Raumo, Finl.) *v. Bonsdorff*. Weissit (fr. Fahlun) *Wachtmeister*, Ak. H. Stockh., 1827. Esmarkit *A. Erdmann*, Ak. H. Stockh., 188, 1840. Praseolite (fr. Bräkke) *Erdmann*, ib. Chlorophyllite (fr. Unity, Me.) *C. T. Jackson*, Rep. G. N. Hamp., 152, 1841, Am. J. Sci., xli. 357, 1841. Peplolit (fr. Ramsberg, Swed.) *Carlsson*, Œfv. Ak. Stockh., 241, 1857. Pyrargillit (fr. Helsingfors) *N. Nord.*, Jahresb., xii. 1832, 174. Polychroilith *Weibye*, Jahrb. Min., 1846, 289. Aspasiolit *Scheerer*, Pogg., lxviii. 323, 1846.

In six- to twelve-sided prisms, but derived from pseudomorphism after iolite. Cleavage: basal sometimes perfect.

H.=3·5–5. G.=2·6–2·8. Lustre of surface of basal cleavage pearly to waxy, glimmering. Color grayish-green, to greenish-brown, olive- or oil-green; sometimes blackish-green to black; streak colorless.

Var.—This species is a result of alteration; and considerable variation in the results of analyses should be expected. The crystalline form is that of the original iolite, while the basal cleavage when distinct is that of the new species fahlunite.

1. *Triclasite* and *fahlunite* were from the same locality, Fahlun, Sweden. The mineral has the above characters. *Bonsdorffite* and *auralite* are Bonsdorff's *Hydrous iolite*, from Abo, Finland, and identical with fahlunite. The name triclasite alludes to *three cleavages*, and is therefore bad, as they are not cleavages of the species, but in part of the original iolite. *Fahlunite* dates from the same year.

Esmarkite is fahlunite. Color grayish-green to whitish, with a greasy lustre. G.=2·709; H.=3·5. (*b*) *Praseolite* is similar from Bräkke, near Brevig, in granite. H.=3·5; G.=2·754. (*c*) *Raumite*, from Raumo in Finland, is of like nature and origin, according to A. E. Nordenskiöld (Beskrifn. Finl. Min.), although analysis gives a somewhat different constitution. (*d*) *Chlorophyllite* from Unity, Maine, is like fahlunite in composition, etc.; H. on base of prisms=1·5–3; G.=2·705. Named from χλωρός, *green*, and φύλλον, *leaf*. (*e*) *Peplolite* from Ramsberg, Sweden, has the composition essentially and form of esmarkite; G.=2·68–2·75.

2. *Pyrargillite* is near fahlunite, and probably essentially the same, though containing more water and less of protoxyd bases. Form the same, but cleavage not distinct; color blackish, bluish, liver-brown, or in part dull-red; H.=3·5; G.=2·5; lustre weak resinous. It is from granite near Helsingfors, Finland. Bischof has shown that it is only altered iolite.

3. *Polychroilite* has been referred here. It occurs in six-sided prisms of 120°, without distinct cleavage. H.=3–3·5; lustre greasy; color blue and green of different shades, and also brown and brick-red. Occurs in gneiss at Kragerøe, Norway.

4. *Aspasiolite* occurs in prisms like those of fahlunite, but with the cleavage less distinct; H.=3–3·5; G.=2·764; color green to greenish-gray, clouded with brown or red. It is from Kragerøe, Norway, with iolite in quartz.

Huronite Thomson (Min., i. 384, 1836). Considered an altered mineral near fahlunite, by T. S. Hunt. Occurs in spherical masses in hornblendic boulders in the vicinity of Lake Huron. Structure partly in imperfect folia, and partly granular. H.=3–3·5; G.=2·86; lustre waxy to pearly; color light yellowish-green; subtranslucent. *Weissite* Wachtmeister, is like fahlunite in most of its characters, but differs in composition, and may belong elsewhere. Occurs of bluish and green colors at Fahlun, in masses as large as hazel-nuts, in chlorite.

Comp.—O. ratio for $\mathrm{R}, \bar{\mathrm{R}}, \ddot{\mathrm{Si}}, \dot{\mathrm{H}} = 1 : 3 : 5 : 1$; whence the formula $(\frac{2}{3}(\dot{\mathrm{H}}, \dot{\mathrm{R}})^3 + \frac{1}{3}(\ddot{\bar{\mathrm{A}}}\mathrm{l}, \bar{\mathrm{F}}\mathrm{e}))^2 \ddot{\mathrm{Si}}^3$, the water being basic, and entering, as already suggested, to make up the deficiency of bases in the unisilicate. In some kinds, the same with the addition of $\dot{\mathrm{H}}$. The O. ratio of iolite, the original of the species, is 1 : 3 : 5.

Analyses: 1, Hisinger (Afh., iv. 210); 2, 3, Trolle Wachtmeister (Ak. H. Stockh., 1827, 213); 4, Bonsdorff (Ak. H. Stockh., 1827); 5, Malmgren (Arppe's Finsk. Min., 1861, 586, Verh. Min. St. Pet., 1862, 152); 6, Erdmann (Jahresb. 1841, 174); 7, C. T. Jackson (Rep. G. N. H., 1844, 184); 8, Rammelsberg (Min. Ch., 833); 9, Erdmann (l. c.); 10, J. Staudinger (Bonsdorff, l. c.); 11, Carlsson, Amark and Sieurin (l. c.); 12, Nordenskiöld (l. c.); 13, Scheerer (Pogg., lxviii. 323); 14, Wachtmeister (Ak. H. Stockh., 1827):

		$\ddot{\mathrm{Si}}$	$\ddot{\bar{\mathrm{A}}}\mathrm{l}$	$\bar{\mathrm{F}}\mathrm{e}$	$\dot{\mathrm{M}}\mathrm{n}$	$\dot{\mathrm{M}}\mathrm{g}$	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\mathrm{K}}$	$\dot{\mathrm{H}}$
1. Fahlun, *Tricl.*		46·79	26·73	5·01	$\bar{\mathrm{M}}\mathrm{n}$ 0·43	2·97	——	——	13·50=95·43 Hisinger.
2. " "	*bk.*	44·60	30·10	3·86	2·24	6·75	1·35	1·98	9·35, F *tr.*=100·23 W.
3. " "	*cryst.*	44·95	30·70	7·22	1·90	6·04	0·95	1·38	8·65=101·79 W.
4. Abo, *Bonsd.*		45	30	5	——	9	——	——	11=100 B.
5 " *Aur.*		41·76	31·25	8·35	0·30	4·73	1·78	1·50	10·44=100·11 Malm.

	$\dddot{Si}$	$\dddot{\bar{A}l}$		$\dot{Fe}$	$\dot{Mn}$	$\dot{Mg}$	$\dot{Ca}$	$\dot{K}$	$\dot{H}$
6. Brevig, *Esmark.*	45·97	32·08		3·83	0·41	10·32	——	——	5·49, $\dot{Ca}$, $\dot{Pb}$, $\dot{Cu}$, $\dot{Co}$, $\ddot{Ti}$ 0·45=98·55 Erdmann
7. Unity, *Chloroph.*	45·20	27·60		8·24	4·08	9·60	——	——	3·60, $\dddot{\bar{P}}$ *tr.*=98·32 J.
8. " "	46·31	25·17	$\dddot{\bar{F}e}$	10·99	*tr.*	10·91	0·58	——	6·70=100·66 Ramm.
9. Bräkke, *Pras.*	40·94	28·79	"	7·40	0·32	13·73	——	——	7·38, $\dot{Ca}$, $\ddot{Ti}$, $\dot{Cu}$, $\dot{Pb}$, $\dot{C}$ 0·50=99·06 A. Erdmann
10. Raumo, *Raumite*	43·00	19·00	"	19·20	——	12·55	——	——	6·00=99.75 Staudinger.
11. Ramsberg, *Pepl.* (⅓)	45·95	30·51		6·77	——	7·99	0·50	——	8·30=100·02 Carlsson.
12. Helsingfors, *Pyrarg.*	43·93	28·93		5·30	——	2·90*	——	1·05	15·47, $\dot{Na}$ 1·85=99·43 N.
13. Krageröe, *Aspas.*	50·40	32·38		2·34	——	8·01	——	——	6·73=99·86 Scheerer.
14. Fahlun, *Weissite*	59·69	21·70		1·43	0·63	8·99	——	4·10	3 20, $\dot{Na}$ 0·68, $\dot{Zn}$ 0·3 =100·72 Wachtmeister.

* With some Mn O.

In *polychroilite* Dahl found (l. c.) $\dddot{Si}$ 52, $\dddot{\bar{A}l}$ 37, $\dddot{\bar{F}e}$ 3, $\dot{Mg}$ 7, $\dot{Ca}$ 1, $\dot{H}$ 1; and Scheerer obtained about 6 p. c. of water. The *huronite* afforded Thomson (l. c.) $\dddot{Si}$ 45·80, $\dddot{\bar{A}l}$ 33·92, $\dot{Fe}$ 4·32, $\dot{Ca}$ 8·04, $\dot{Mg}$ 1·72, $\dot{H}$ 4·16=97·96; it is stated to be infusible and not attacked by acids.

An ash-gray mineral from Potton, Canada East, as analyzed by Tennant, is near weissite in composition. Tennant obtained (Rec. Gen. Sci., iii. 339) $\dddot{Si}$ 55·05, $\dddot{\bar{A}l}$ 22·60, $\dot{Fe}$ 12·60, $\dot{Mn}$ *tr.*, $\dot{Mg}$ 5·70, $\dot{Ca}$ 1·40, $\dot{H}$ 2·25=99·60; and gives H.=1·75, G.=2·8263. T. S. Hunt says it is probably only a rock, and not a mineral species, as he judges from a specimen he has seen so labelled (private communication).

Gigantolite and *Iberite* much resemble fahlunite, and like it are results of the alteration of iolite, occurring in large six to twelve-sided crystals. But they contain potash, and are therefore related in composition to pinite, of which they seem to be impure varieties. See under PINITE.

Pyr., etc.—Yields water. B.B. fuses to a white blebby glass. Not acted upon by acids. Pyrargillite is difficultly fusible, but is completely decomposed by muriatic acid.

427. GROPPITE. *Svanberg*, Œfv. Ak. Stockh., iii. 14, 1846.

Crystalline, with one distinct cleavage affording a broad cleavage surface, and two others less distinct.

H.=2·5. G.=2·73. Thin splinters translucent. Color rose-red to brownish-red. Streak paler. Fracture splintery.

O. ratio for $\dot{R}$, $\dddot{\bar{R}}$, $\dddot{Si}$, $\dot{H}$=2 : 3 : 6 : 2, whence, if half the water be basic, $(\frac{1}{3}(\dot{H}^3, \dot{R}^3)+\frac{1}{2}(\dddot{\bar{A}l}, \dddot{\bar{F}e}))^2 \dddot{Si}^3+\dot{H}$. Analysis by Svanberg:

$\dddot{Si}$	$\dddot{\bar{A}l}$	$\dddot{\bar{F}e}$	$\dot{Mg}$	$\dot{Ca}$	$\dot{Na}$	$\dot{K}$	$\dot{H}$
45·01	22·55	3·06	12·28	4·55	0·22	5·23	7·11, undissolved 0·18=100·13.

PYR.—In a matrass yields water. B.B. whitens, and on thin edges shows only incipient fusion. Svanberg's formula is the same as for ottrelite.

From a limestone at Gropptorp in Sweden.

428. VOIGTITE. *E. E. Schmid*, Pogg., xcvii. 108, 1856. Rastolyte *Shep.*, Min., 1857, Append., p. vi., and Am. J. Sci., II. xxiv. 128.

In small crystals and scales, mica-like in structure and aspect.

H.=2—3. G.=2·91. Lustre pearly. Color leek-green, often yellowish or brownish from alteration. Thin scales translucent.

Comp.—O. ratio for $\dot{R}$, $\dddot{\bar{R}}$, $\dddot{Si}$, $\dot{H}$=1 : 1 : 2 : 1; $(\frac{1}{3}\dot{R}^3+\frac{1}{3}\dddot{\bar{R}})^3 \dddot{Si}^3+3\dot{H}$, or the same as that of biotite with the addition of water.

Analyses: 1, Schmid (l. c.); 2, Pisani (C. R., liv. 686, Am. J. Sci., xxxiv. 208):

	$\dddot{Si}$	$\dddot{\bar{A}l}$	$\dddot{\bar{F}e}$	$\dot{Fe}$	$\dot{Mg}$	$\dot{Ca}$	$\dot{Na}$	$\dot{H}$
1. Ehrenberg	33·83	13·40	8·42	23·01	7·54	2·04	0·96	9·87=99·07 Schmid.
2. *Rastolyte*	34·98	21·88	——	28·44	6·24	——	——	9·22=100·76 Pisani.

Pyr., etc.—In a glass tube yields water, sometimes exfoliates, and becomes brown and metalli in lustre. B.B. fuses easily to a black glass, with the reaction of iron. Attacked by muriatic acid, giving a yellow solution, and the insoluble part becomes after some days colorless.

Obs.—Voigtite constitutes the mica in a kind of graphic granite at Ehrenberg near Ilmenau. Rastolyte is in ash-gray, reddish, and bluish laminæ, looking like an altered mica, at Monroe, N. Y., mixed with pyrite, and probably formed through the action of the decomposing pyrite on mica.

Named after Mr. Voigt, director of the mines of Saxe-Weimar.

Eukamptite of Kenngott (p. 307) is a similar hydrous biotite with less water.

Another from Rio Janeiro, closely related to the above, has been described by Kenngott in his Uebersicht for 1856-57, p. 80. It is in dull green short prismatic crystals, in granite. Composition, according to v. Hauer (l. c.), $\ddot{\text{Si}}$ 32·33, $\ddot{\bar{\text{Al}}}$ 20·47, $\dot{\text{Fe}}$ 26·25, $\dot{\text{Mg}}$, by loss, 7·75, $\dot{\text{Ca}}$ 0·85, $\dot{\text{K}}$ 2·02, ign. 10·33.

429. MARGARODITE. Margarodit *Schafhäutl*, Ann. Ch. Pharm., xlvi. 325, 1843.

Like muscovite or common mica in crystallization, and in optical and other physical characters, except usually a more pearly lustre, and the color more commonly whitish or silvery.

Comp.—O. ratio mostly 1 : 6 : 9 : 2; whence the formula $(\frac{1}{3}(\dot{\text{R}}^3, \dot{\text{H}}^3)+\frac{2}{3}\ddot{\bar{\text{Al}}})^2\,\ddot{\text{Si}}^3$, the water being basic. Sometimes O. ratio 1 : 9 : 12 : 2, whence, $(\frac{1}{4}(\dot{\text{K}}^3, \dot{\text{H}}^3)+\frac{3}{4}\ddot{\bar{\text{Al}}})^2\,\ddot{\text{Si}}^3$; but this division belongs with damourite, if the two are distinguishable. This species appears to be often, if not always, a result of the hydration of muscovite, there being all shades of gradation between it and that species. Muscovite has the O. ratio for bases and silica of 4 : 5, or nearly; and the deficiency of base for a unisilicate here indicated appears to be the source of its tendency to take up water, the water passing in to supply it.

For analyses and localities see under MUSCOVITE (p 309).

A hydrous mica, accompanying cyanite, at Litchfield, Ct., afforded Smith & Brush (Am J. Sci., II. xv. 210) $\ddot{\text{Si}}$ 44·60, $\ddot{\bar{\text{Al}}}$ 36·23, $\ddot{\bar{\text{Fe}}}$ 1·34, $\dot{\text{Mg}}$ 0·37, $\dot{\text{Ca}}$ 0·50, $\dot{\text{Na}}$ 4·10, $\dot{\text{K}}$ 6·20, $\dot{\text{H}}$ 5·26, $\dot{\text{Mn}}$, F *tr.*=98·60. It is a *soda-potash* mica intermediate between margarodite and paragonite; O. ratio 1 : 7½ : 10 : 2; G.=2·76.

430. DAMOURITE. *Delesse*, Ann. Ch. Phys., III. xv. 248, 1845.

An aggregate of fine scales, mica-like in structure.

H.=2–3. G.=2·792. Lustre pearly. Color yellow or yellowish-white. Optic-axial divergence 10 to 12 degrees, Descl.

Comp.—A hydrous potash-mica, like margarodite, to which it is closely related. O. ratio for $\dot{\text{R}}$, $\ddot{\bar{\text{R}}}$, $\ddot{\text{Si}}$, $\dot{\text{H}}$, 1 : 9 : 12 : 2.

Analyses: 1, Delesse (l. c.); 2, Igelström (B. H. Ztg., xxv. 308):

	$\ddot{\text{Si}}$	$\ddot{\bar{\text{Al}}}$	$\ddot{\bar{\text{Fe}}}$	$\dot{\text{K}}$	$\dot{\text{H}}$
1. Pontivy	45·22	37·85	*tr.*	11·20	5·25=99·52 Delesse.
2. Horrsjöberg	43·41	35·17	4·62	10·90	4·50, $\dot{\text{Mg}}$ 1·40=100 Igelström.

It is the gangue of cyanite at Pontivy in Brittany; and the same at Horrsjöberg, Wermland. Named after the French chemist Damour.

430A. SERICITE *List* (Ann. Ch. Pharm., lxxxi. 257). A scaly mineral from a silky schist, occurring at Nerothal near Wiesbaden. H.=1; G.=2·897; greenish or yellowish-white. It afforded List $\ddot{\text{Si}}$ 49·00, $\ddot{\bar{\text{Al}}}$ 23·65, $\dot{\text{Fe}}$ 8·07, $\dot{\text{Mg}}$ 0·94, $\dot{\text{Ca}}$ 0·63, $\dot{\text{Na}}$ 1·75, $\dot{\text{K}}$ 9·11, $\dot{\text{H}}$ 3·41, $\ddot{\text{Ti}}$ 1·89, Si F^2 1·60=100·14. Supposed to be near damourite. Named from its silky lustre.

431. PARAGONITE. Paragonit *Schafhäutl*, Ann. Ch. Pharm., xlvi. 334, 1843. Pregrattit *L. Liebener*, Kenng. Ueb. 1861, 53, 1862.

Massive, sometimes consisting distinctly of fine scales; the rock slaty or schistose. Cleavage of scales in one direction eminent, mica-like.

H.=2·5–3. G.=2·779, paragonite, Schafhäutl; 2·895, pregrattite, Œllacher. Lustre strong pearly. Color yellowish, grayish, grayish-white, greenish, light apple-green. Translucent; single scales transparent.

Comp.—A hydrous *soda* mica. O. ratio for $\dot{R}$, $\bar{R}$, $\ddot{Si}$, $\dot{H}=1:9:12:2$, or $1:1$ for bases and silica, if the water be made basic. Formula $(\frac{1}{4}(\dot{H}^3, \dot{Na}^3)+\frac{3}{4}\ddot{\bar{Al}})^2\ddot{Si}^3$; the pregrattite has a little more of protoxyd bases, the O. ratio being $1:7·3:9:1·7=3:22:27:5$, or nearly.

Analyses: 1, Schafhäutl (l. c.); 2, Rammelsberg (ZS. G., xiv. 761); 3, Œllacher (Kenng. Ueb., l. c.):

	$\ddot{Si}$	$\ddot{\bar{Al}}$	$\bar{Fe}$	$\dot{Mg}$	$\dot{Ca}$	$\dot{Na}$	$\dot{K}$	$\dot{H}$
1. *Paragonite*	50·20	35·90	2·36	—	—	8·45	—	2·45=99·36 Schafhäutl.
2. " (½)	46·81	40·06	*tr.*	0·65	1·26	6·40	*tr.*	4·82=100 Ramm.
3. *Pregrattite*	44·65	40·41	$\dot{Fe}$ 0·84	0·37	0·52	7·06	1·71	5·04, $\ddot{\bar{Cr}}$ 0·10=100·70 Œllacher.

Pyr.—B.B. the paragonite is stated to be infusible. The pregrattite exfoliates somewhat like vermiculite (a property of some clinochlore and other species), and becomes milk-white on the edges.

Obs.—Paragonite constitutes the mass of the rock at Monte Campione, in the region of St. Gothard, containing cyanite and staurotide, called paragonitic or talcose schist. The rock also contains garnet and black tourmaline. Named from παράγω, *I mislead.* The pregrattite is from Pregratten in the Pusterthal, Tyrol.

A Brevig mica afforded Defrance 5 p. c. of soda, but with much less silica than above. See under LEPIDOMELANE, p. 307, where relations to other Brevig mica are stated, that tend to show that it is an altered mica.

432. EUPHYLLITE. *Silliman, Jr.*, Am. J. Sci., II. viii. 381, 1849.

Structure as in mica, but laminæ not as easily separable.

H.=3·5–4·5. G.=2·963–3·008, Silliman; 2·83, Smith & Brush. Lustre of cleavage surface bright pearly, inclining to adamantine. Color white to colorless; sides faint grayish sea-green or whitish. Transparent to translucent; at times opaque or nearly so. Laminæ rather brittle. Biaxial; angle between the optical axes 71½°, Silliman.

Comp.—O. ratio for $\dot{R}$, $\bar{R}$, $\ddot{Si}$, $\dot{H}=1:8:9:2$; whence $(\frac{1}{3}\dot{R}^3+\frac{2}{3}\bar{R})^2\ddot{Si}^3+\frac{2}{3}\dot{H}=$, if $\dot{Ca}:\dot{K}:\dot{Na}=3:4:11$, Silica 41·6, alumina 42·3, lime 1·5, potash 3·2, soda 5·9, water 5·5=100. Analyses: Smith & Brush (Am. J. Sci., II. xv. 209):

	$\ddot{Si}$	$\ddot{\bar{Al}}$	$\dot{Fe}$	$\dot{Mg}$	$\dot{Ca}$	$\dot{Na}$	$\dot{K}$	$\dot{H}$
1. Unionville	40·29	43·00	1·30	0·62	1·01	5·16	3·94	5·00=100·32 Smith & Brush.
2. "	39·64	42·40	1·60	0·70	1·00	5·16	3·94	5·08=99·52 Smith & Brush.
3. "	40·21	41·50	1·50	0·78	1·88	4·26	3·25	5·91=99·29 Smith & Brush.
4. "	40·96	41·40	1·30	0·70	1·11	4·26	3·25	6·23=99·21 Smith & Brush.

The specimen for analysis 2 by Smith & Brush was from the original one described by Silliman. Their results show that the earlier analysis of Crooke (Am. J. Sci., II. viii. 381) and those of Erni & Garrett (this Min., 3d edit., 362, 1850) are erroneous. Erni's and Crooke's specimens were from the same that afforded the material for analysis 2 of Smith & Brush.

Pyr., etc.—In a matrass yields water. B.B. exfoliates, emits a strong light, and in the forceps fuses on the edges. Gives traces of fluorine.

Obs.—Occurs associated with tourmaline and corundum at Unionville, Delaware Co., Pa. The impression of the crystals of tourmaline on the lateral surface of the euphyllite leaves a very smooth, hard-looking surface. Also in the same vicinity in aggregated laminæ, or scales, or compact masses.

Dr. Smith refers here, with a query, a mica found by him with the emery of Asia Minor, which afforded him the following results (Am. J. Sci., II. xi. 62, xv. 210):

	$\ddot{Si}$	$\ddot{\bar{Al}}$	$\bar{Fe}$	$\dot{Mg}$	$\dot{Ca}$	$\dot{K}$, little $\dot{Na}$	$\dot{H}$
1. Gumuchdagh	42·80	40·61	1·30	*tr.*	3·01	*undet.*	5·62
2. Kulah	43·62	38·10	3·50	0·25	0·52	7·83	5·31
3. "	42·71	37·52	2·32	*tr.*	1·41	*undet.*	5·95
4. Nicaria	42·60	37·45	1·70	*tr.*	0·68	9·76	5·20

They afford the mean oxygen ratio, excluding the water, 1 : 10 : 12. May be *damourite*. A similar whitish mica, from Nowlin, Pa., afforded S. B. Sharples $\ddot{\mathrm{Si}}$ 43, $\bar{\mathrm{Al}}$ 40, alk. 7 to 8 p. c.

433. ŒLLACHERITE. Margarite from Pfitschthal *Œllacher*, Kenng. Uebers. 1860, 49, 1862. Œllacherite *Dana*, Am. J. Sci., II. xliv. 256, 1867.

In crystalline scales or laminæ; structure micaceous.

G.=2·884—2·994. Lustre strong pearly. Color grayish-white to white. In thin plates transparent. Elastic. Double refraction strong; optic-axial angle in the air 79° 21′ for the red ray, 78° 45′ for the blue, or the same as in muscovite; Descl.

Comp.—O. ratio for $\dot{\mathrm{R}}$, $\bar{\mathrm{R}}$, $\ddot{\mathrm{Si}}$, $\dot{\mathrm{H}}$, 1 : 4 : 6 : 1; whence the formula, if $\dot{\mathrm{H}}$ be basic, $(\frac{1}{3}(\dot{\mathrm{R}}^3, \dot{\mathrm{H}}^3)+\frac{2}{3}\bar{\mathrm{Al}})^2\ddot{\mathrm{Si}}^3$. Remarkable for the presence of baryta. Analyses: 1, Œllacher (l. c.); 2, Rammelsberg (ZS. G., xiv. 763):

	$\ddot{\mathrm{Si}}$	$\bar{\mathrm{Al}}$	$\bar{\mathrm{Fe}}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Mn}}$	$\dot{\mathrm{Cu}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Ba}}$	$\dot{\mathrm{Sr}}$	$\dot{\mathrm{Na}}$	$\dot{\mathrm{K}}$	$\dot{\mathrm{H}}$
1.	42·59	30·18	0·91	1·74	0·12	0·31	4·85	1·03	4·65	0·09	1·42	7·61	4·43=99·93 Œ.
2.	43·07	32·79	——	1·85	0·31	——	2·90	0·23	5·91	——	*undet.*		4·26 Ramm.

Obs.—Occurs near Kemmat in Pfitschthal, along with the chlorite analyzed by Hetzer (p. 502). The locality is about 12 miles in a direct line from that of margarite (p. 506).

434. COOKEITE. *G. J. Brush*, Am. J. Sci., II. xli. 246, 1866.

In minute scales, and in slender six-sided prisms, sometimes vermicularly bent. Often as a coating.

H.=2·5. G.=2·70. Lustre pearly on plane of cleavage. Color white to yellowish-green. In thin scales transparent. Flexible, inelastic.

Comp. O. ratio for $\dot{\mathrm{R}}$, $\bar{\mathrm{R}}$, $\ddot{\mathrm{Si}}$, $\dot{\mathrm{H}}$, 1·93 : 21 : 18·74 : 11·91, Brush=1 : 10 : 9 : 5½. Approaches a hydrous lithia mica in composition. Analysis: P. Collier (l. c.):

	$\ddot{\mathrm{Si}}$	$\bar{\mathrm{Al}}$	$\dot{\mathrm{Li}}$	$\dot{\mathrm{K}}$	$\dot{\mathrm{H}}$	$\mathrm{Si F^2}$ ·
(⅓)	34·93	44 91	2·82	2·57	13·41	0·47, $\dot{\mathrm{H}}$ exp. at 100°C. 0·38=99·49.

Three determinations of the silica obtained 35·04, 34·05, 35·71 p. c. The alumina contained a little oxyd of iron.

Pyr., etc.—B.B. exfoliates like vermiculite, and colors the flame intense carmine-red. In the closed tube yields water, which is at first neutral, then becomes acid by decomposing the fluorid of silicon evolved, while a ring of silica is deposited. Tube slightly etched. Fusible on thin edges, and gives blue color with cobalt solution. With phosphorus salt gives skeleton of silica. Partially decomposed by sulphuric acid.

Obs.—Occurs with tourmaline and lepidolite at Hebron and Paris, Me., often as a pearly coating on crystals of rubellite, of which it appears to be a product of alteration.

435. HISINGERITE. Hisingerit (fr. Riddarhyttan) *Berz.*, Pogg., xiii. 505, 1828. Degeröit *Holmberg*, Bidr. Finl. Nat., i. 4, Min. Ges. St. Pet., 1850, 1851, N. Nordenskiöld, Verz. Finl. Min., 1852. Skotiolit *Arppe*, Finsk. Min., 13, 1857.

Amorphous, compact, without cleavage.

H.=3. G.=3·045. Lustre greasy, inclining to vitreous. Color black to brownish-black. Streak yellowish-brown. Fracture conchoidal.

Var.—(1) *Hisingerite.* (2) *Degeröite*, G.=2·54, Holmberg; H.=2·5; color blackish-green to black. (3) *Scotiolite*; G.=3·09; H.=3; color dark green to black (and named from σκοτιος, *dark*); contains much magnesia, and less water than hisingerite.

Comp.—O. ratio for $\dot{\mathrm{R}}+\bar{\mathrm{R}}$, $\ddot{\mathrm{Si}}$, $\dot{\mathrm{H}}$=2 : 3 : 3; formula, making one-third of the water basic, $(\dot{\mathrm{R}}^3$, $\bar{\mathrm{F}}\mathrm{e})^2\ddot{\mathrm{Si}}^3+4\mathrm{aq}$, or specially, $(\frac{1}{3}\dot{\mathrm{H}}^3+\frac{2}{3}(\dot{\mathrm{R}}^3.\bar{\mathrm{Fe}}))^2\ddot{\mathrm{Si}}^3+4\mathrm{aq}$. In the latter formula $\dot{\mathrm{R}}^3$ includes some

$\ddot{\bar{\mathrm{Fe}}}$, $\dot{\mathrm{Mg}}$, $\dot{\mathrm{Ca}}$, and occasionally $\dot{\mathrm{Mn}}$. Excluding $\dot{\mathrm{R}}$, the percentage composition is Silica 35·9, sesquioxyd of iron 42·6, water 21·5=100. Cleve's analysis makes the *scotiolite* of Longban essentially hisingerite; and that of Orijärvi may be an impure variety (anal. 15).

Analyses: 1, Hisinger (Pogg., xiii. 505); 2–11, Cleve, Oeberg. Lindström, Nordenskiöld, Thoreld (Œfv. Ak. Stockh., 1866, 169); 12, Rammelsberg (Pogg., lxxv. 398); 13, 14, Thoreld (Min. Ges. St. Pet., 1850, 51, Œfv. Ak. Stockh., 1866, 169); 15, Arppe (l. c.):

		$\ddot{\mathrm{Si}}$	$\ddot{\bar{\mathrm{Al}}}$	$\ddot{\bar{\mathrm{Fe}}}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Mn}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{H}}$
1.	Riddarhyttan	36·30	—	44·39		—	—	—	20·70=101·39 Haidinger.
2.	"	35·02	1·20	39·46	2·20	—	0·80	*tr.*	21·70, undec. 0·95=101·33 Cleve.
3.	"	35·08	1·38	40·28	2·23	—	0·35	0·36	20·78=100·46 Oeberg.
4.	Solberg, Norway	35·33	—	32·14	7·08	—	3·60	—	22·04=100·19 Cleve.
5.	" "	37·55	1·17	30·57	7·00	—	2·91	1·41	20·32=100·93 Lindström.
6.	Jordosen	34·90	—	36·00	9·20	—	2·67	—	18·46=101·23 Cleve.
7.	Longban	35·71	—	27·70	7·52	3·02	1·68	1·48	22·83=99·94 Nordenskiöld.
8.	Waldemarsvik	33·66	—	39·90	2·30	—	2·95	—	21·09=99·90 Nordenskiöld.
9.	Orijärvi	36·92	—	31·87	8·92	—	2·06	—	21·09=100·86 Lindström.
10.	Tunaberg	37·14	1·39	30·24	3·02	0·17	6·06	—	21·56=99·58 Cleve.
11.	Longban, *Scotiolite*	36·73	—	34·97	3·09	*tr.*	8·75	—	15·80=99·34 Cleve.
12.	Riddarhyttan, *His.*	33·07	—	34·78	17·59	—	0·46	2·56	11·54=100 Rammelsberg.
13.	Degerö, *Degeröite*	36·60	0·80	41·56	1·16	—	2·50	2·90	13·70, $\ddot{\bar{\mathrm{Fe}}}\,\dddot{\mathrm{P}}$ 0·26, und. 1·50 Thor.
14.	" "	34·45	0·75	38·63	1·08	—	2·33	2·70	19·54, undec. 1·40 Thoreld.
15.	Orijärvi, *Scotiolite*	40·97	0·60	26·04	—	—	15·63	0·38	15·12=98·74 Arppe.

The part of the water driven off at 100° C. was in anal 2, 11·20; 4, 11·66; 5, 13·11; 6, 9·33; 7, 12·19; 8, 9·37; 9, 13·56; 10, 10·61; 11, 6·30; 14, 11·60; 15, 7·49.

Pyr., etc.—Yields much water. B.B. fuses with difficulty to a black magnetic slag. With the fluxes gives reactions for iron. In muriatic acid easily decomposed without gelatinizing.

Obs.—Found at the various localities mentioned above. At Riddarhyttan it occurs in reniform masses associated with pyrite in a copper mine, and is a result of alteration; at Degerö, near Helsingfors, Finland, in a silver mine.

Named after the Swedish chemist, Hisinger.

MELANOLITE *Wurtz* (this Min., 679, 1850). Approaches hisingerite. It is black, opaque, with streak dark olive-green; H.=2; G.=2·69. Surface of the mineral often striated, or with an imperfectly columnar aspect. H. Wurtz obtained, excluding 12·77 p. c. of carbonate of lime:

$\ddot{\mathrm{Si}}$ 35·36 $\ddot{\bar{\mathrm{Al}}}$ 4·49 $\ddot{\bar{\mathrm{Fe}}}$ 23·20 $\dot{\mathrm{Fe}}$ 25·18 $\dot{\mathrm{Na}}$ 1·86 $\dot{\mathrm{H}}$ 10·24=100·33.

From Milk-Row quarry, near Charlestown, Mass., incrusting the sides of a fissure.

436. EKMANNITE.

Ekmannit *L. J. Igelström*, Œfv. Ak. Stockh., 1865, B. H. Ztg., xxvi. 21, 1867.

Foliated, chlorite-like. Also foliated columnar and asbestiform, radiated; also granular massive; consisting of minute scales.

Hardness and lustre as in chlorite. Color grass-green, leek-green, grayish-white; also black.

Comp.—O. ratio for $\dot{\mathrm{R}}+\ddot{\bar{\mathrm{R}}}$, $\ddot{\mathrm{Si}}$, $\dot{\mathrm{H}}$=4 : 6 : 3, with the bases mainly *protoxyds* ($\dot{\mathrm{Fe}}$, $\dot{\mathrm{Mn}}$); only one-third to one-sixth being sesquioxyds ($\ddot{\bar{\mathrm{Fe}}}$, $\ddot{\bar{\mathrm{Al}}}$), and regarded as impurity by Igelström. Formula $(\frac{2}{3}(\dot{\mathrm{Fe}}, \dot{\mathrm{Mn}})+\frac{1}{3}\dot{\mathrm{H}})^3\,\ddot{\mathrm{Si}}+\frac{1}{3}\,\dot{\mathrm{H}}$, in which two-thirds of the water is made basic. Analyses: 1–6, Igelström (l. c.):

		$\ddot{\mathrm{Si}}$	$\ddot{\bar{\mathrm{Al}}}$	$\ddot{\bar{\mathrm{Fe}}}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Mn}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{H}}$
1.	*Fol. mass., grass-gn.*	34·30	*tr.*	4·97	35·78	11·45	2·99	—	10·51=100.
2.	*Fol.-col., gyh.-w.*	36·42	1·07	4·79	24·27	21·56	*tr.*	*tr.*	9·91=98·02.
3.	*Fol.-mass., leek-gn.*	40·30	5·08	3·60	25·51	7·13	7·64	—	10·74=100.
4.	*Gran.-mass., grass-gn.*	37·07	5·85	—	38·20		6·32	2·73	9·71=99·88.
5.	*Asbestif., green*	37·69	—	—	36·07[a]	14·74		—	11·50=100.
6.	*Fol.-mass., green*	36·82	3·63	—	31·09	9·29	7·53	*tr.*	10·71=99·07.

[a] With perhaps some alumina.

Pyr., **etc.**—On heating yields water, becomes black, submetallic, and after ignition strongly magnetic. B.B. fuses to a black slag. Soluble in muriatic acid, with a deposition of silica.

Obs.—From a mine of magnetite at Grythyttan, in Sweden, filling cavities in the ore, penetrating it extensively, and constituting nodular masses and beds. Anal. 4 is of the green interior of a nodule which was black externally. Some of it contains carbonate of lime, and some affords when heated a bituminous odor.

Named after G. Ekmann, proprietor of the mine.

Alt.—Becomes black on exposure, through oxydation.

437. NEOTOCITE. Néotokit *N. Nordenskiöld*, Verz. Finl. Min., 1852. Wittingit *id.*, ib. Vattenhaltigt Manganoxid-silikat *J. F. Bahr*, Œfv. Ak., 1850, 240. Stratopeit *L. J. Igelström*, ib., 1851, 143 (with mention of "Neotokit" and "Wittingit").

Amorphous.

H.=3–4. G.=2·64–2·8. Lustre dull, sometimes feebly submetallic. Color black to dark brown and liver-brown. Streak dark brown to black. Opaque.

Comp., **Var.**—The amorphous mineral substances here included are results of the alteration of rhodonite, in which the manganese passes from the state of protoxyd to that of sesquioxyd, and other changes take place through the presence of any ingredients in the altering infiltrating waters. A uniformity of composition is not therefore to be expected, and much doubt must exist as to the reality of the species which any chemical analyses may seem to indicate. The most recent analyses (anal. 2 to 5 below) have a correspondence in oxygen ratio which appears to show that there is among them at least one true hydrous silicate of manganese, and that it is related in composition to hisingerite. The O. ratio for $\dot{R}+\bar{R}$, $\ddot{Si}$, $\dot{H}$, in analysis 2 is 12·69 : 19·11 : 14·32; 3, 11·56 : 18·69 : 14·86; 4, 12·11 : 19·09 : 14·02; 5, 13·04 : 18·34 : 15·44; each of which correspond quite nearly to 2 : 3 : 2½, and to the general hisingerite formula, $(\dot{R}^3, \bar{R})^2\,\ddot{Si}^3+3$ aq, in which two-fifths of the water is made basic.

Neotocite (anal. 4, 5) is here included by A. E. Nordenskiöld along with stratopeite, and good authority appears thus to be given for setting aside the older analysis of it by Igelström (anal. 6). In *stratopeite*, G.=2·64, according to Igelström; in *neotocite* and *wittingite*, G.=2·7–2·8, according to N. Nordenskiöld.

Bahr's and Svanberg's analyses, 9–12, give a different composition, as the manganese is made sesquioxyd; but new determinations are required before these, or the analyses of wittingite, can be taken as representing distinct chemical compounds. Bahr writes for analyses 9, 10, 11, $\bar{Mn}^5\,\ddot{Si}^3+3\,\dot{H}$; and for anal. 12, obtains the O. ratio for $\dot{R}+\bar{R}$, $\ddot{Si}$, $\dot{H}$, 13·9 : 17·6 : 8·5. The *wittingite* analyzed by Arppe (anal. 7) contained 7·21 p. c. of carbonic acid, corresponding to 18·82 p. c. of carbonate of manganese.

Analyses: 1, Igelström (l. c.); 2–5, Cleve and A. E. Nordenskiöld (Œfv. Ak. Stockh., 1866, 169, J. pr. Ch., c. 121); 6, Igelström (Nord. Verz. Finl. Min., 1852, Beskrifn. Finl. Min., 138, 1863); 7, Arppe (Finsk. Min., 21); 8, Nordenskiöld (J. pr. Ch., c. 122); 9–12, Bahr (l. c.):

	$\ddot{Si}$	$\bar{Al}$	$\bar{Fe}$	$\dot{Fe}$	$\bar{Mn}$	$\dot{Mn}$	$\dot{Mg}$	$\dot{Ca}$	$\dot{H}$
1. Paisberg, *Stratopeite*	35·43	—	10·27	—	32·41	—	8·04	—	13·75=99·90 Igelström
2. " "	35·83	—	8·20	—	—	29·37	8·66	—	16·11, $\dot{Pb}$ 2·18 C.
3. " "	35·05	—	1·36	—	—	38·49	5·27	0·47	16·72, $\dot{Pb}$ 3·31 N.
4. Gestrikland, *Neotocite*	35·79	—	10·90	13·93	—	20·51	2·44	0·52	15·77=99·86 Nord.
5. " "	34·38	1·57	18·58	2·88	—	22·67	2·50	—	17·37=99·95 Cleve.
6. Ingoa "	35·69	0·40	25·08	—	24·12	—	2·90	0·55	10·37=99·11 Igelstr.
7. Wittingi, *Wittingite*	35·01	—	3·50	—	43·20		—	—	11·03, $\ddot{C}$ 7·21=99·95 A
8. Bredvik, "	39·72	—	2·06	—	34·76		1·21	0·69	21·98=100·42 Nord.
9. Klapperud	36·20	1·11	0·70	—	47·91	—	4·43	0·61	9·43=100·39 Bahr.
10. "	36·11	0·90	11·31	—	42·00	—	0·57	0·70	[9·43]=101·39 Svanb.
11. "	34·72	1·09	10·45	—	42·64	—	0·36	0·56	9·76=99·98 Bahr.
12. "	33·81	1·03	7·53	—	—	46·18	1·42	0·72	9·57=100·26 Bahr.

Pyr., **etc.**—Yields much water. Reactions with borax for manganese and iron. Difficultly fusible to infusible.

Obs.—Occurs with rhodonite at Paisberg in Filipstad, Sweden (*stratopeite*); Gestrikland (*neotocite*) in Sweden; at Ingoa (*ib.*), Finland; at Wittingi (*wittingite*) in Storkyro, Finland; at Bredvik (*ib.*) in West Gothland; at Klapperud in Dalecarlia, Finland.

Named from *νεοτοκος*, *of recent origin*. This name antedates ***stratopeite***.

438. STÜBELITE. Stübelit *Breith.*, B. H. Ztg., xxiv. 322, 1865.

Reniform and botryoidal massive.

H.=4–5. G.=2·223–2·263. Lustre vitreous, brilliant. Color velvet to pitchy bl dark brown. Fracture conchoidal, distinct. Brittle. Analysis by Stübel (l. c.):

$\ddot{\mathrm{Si}}$	$\bar{\mathrm{Al}}$	$\bar{\mathrm{Fe}}$	$\bar{\mathrm{Mn}}$	$\dot{\mathrm{Cu}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{H}}$	Cl
26·99	5·37	10·18	21·89	15·25	1·03	16·85	0·77=98·

Obs.—Occurs at the island of Lipari. Named from Dr. Alphonse Stübel.

439. GILLINGITE. Svart Stenart (fr. Gillinge) *Hisinger*, Afh., iii. 304, 181

Hisinger, Min. Geogr. Schwed. (Wöhler's), 102, 1826. Thraulit (fr. Bodenmais) v. xiv. 67, 1828. Traulit.

Amorphous—compact.

H.=3. G.=3·045, Hisinger, fr. Gillinge. Lustre shining to face of fracture earthy. Color black or blackish.

Comp., Var.—O. ratio for $\dot{\mathrm{R}}+\bar{\mathrm{R}}$, $\ddot{\mathrm{Si}}$, $\dot{\mathrm{H}}$=, nearly, 1 : 1 : 1; whence $(\dot{\mathrm{R}}^3, \bar{\mathrm{R}})^2\ddot{\mathrm{Si}}^3+$ anal. 3, of *gillingite*, $\dot{\mathrm{R}}^3$: $\bar{\mathrm{R}}$=2 : 5; in 4, 7 : 9·5, or nearly 3 : 4. (2) For anal 7, of Kobell adopts the same O. ratio, 1 : 1 : 1, observing that the mineral analyzed con mixed pyrrhotite. Analyses: 1, Hisinger (Afh., iii. 304); 2, Rammelsberg (398); 3, 4, Hoglund and Tamm (Œfv. Ak. Stockh., 1866, 169, J. pr. Ch., c. 123); (J. pr. Ch., xlvi. 238); 6, Hisinger (Pogg., xiii. 505); 7, v. Kobell (l. c.):

	$\ddot{\mathrm{Si}}$	$\bar{\mathrm{Al}}$	$\bar{\mathrm{Fe}}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Mn}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{H}}$
1. Gillingo	27·50	5·50	51·50	——	$\bar{\mathrm{Mn}}$ 0·77	——	——	11·75=97
2. "	32·18	——	30·10	8·63	——	4·22	5·50	19·37=10
3. "	27·88	——	31·62	18·29	1·17	6·95	——	13·92=99
4. "	29·85	2·96	34·23	11·66	2·69	3·12	0·50	15·52=10
5. Orijärvi, *Hising.*	29·51	——	10·74	37·49	——	7·78	——	13·00=9
6. Bodenmais, *Thraulite*	31·77	——	49·87		——	——	——	20·00=1
7. " "	31·28	——	43·42	5·70	——	——	——	19·12=9

Pyr., etc.—Yields much water. B.B. fuses at 5 to a black, slaggy, opaque, mag Decomposed by muriatic acid.

Obs.—From Gillinge-Grube, in Södermanland, Sweden, whence the name. *Thr* from θραυλός, *fragile*) occurs at Bodenmais, three leagues from Zwiesel, in Bavaria, w etc.

440. JOLLYTE. Jollyt *v. Kobell*, Ber. Ak. München, 1865, 168.

Compact, amorphous.

H.=3. G.=2·61. Lustre weak greasy. Color dark brown splinters transparent, with green to brownish-red color; the coar is light leek-green, the fine, light grayish-green; in some pos powder appears ochre-yellow. Fracture subconchoidal and spli thin splinters shows double refraction.

Comp.—O. ratio for $\dot{\mathrm{R}}$, $\bar{\mathrm{R}}$, $\ddot{\mathrm{Si}}$, $\dot{\mathrm{H}}$=1 : 2 : 3 : 2; $(\frac{1}{3}\dot{\mathrm{R}}^3+\frac{2}{3}\bar{\mathrm{Al}})^2\ddot{\mathrm{Si}}^3+4\dot{\mathrm{H}}$, if $\dot{\mathrm{Fe}}$: $\ddot{\mathrm{Si}}$ 35·5, $\bar{\mathrm{Al}}$ 27·0, $\dot{\mathrm{Fe}}$ 17·0, Mg 6·3, $\dot{\mathrm{H}}$ 14·2=100. Analysis: v. Kobell (l. c.):

$\ddot{\mathrm{Si}}$ 35·55 $\bar{\mathrm{Al}}$ 27·77 $\dot{\mathrm{Fe}}$ 16·67 $\dot{\mathrm{Mg}}$ 6·66 $\dot{\mathrm{H}}$ 13·18=99·83.

Pyr., etc.—In the closed tube yields water. B.B. swells up and fuses with diffi edges to a black mass, which is not magnetic, or only slightly so; with the fluxes gi tions for iron. Decomposed readily by muriatic acid, leaving gelatinous silica.

Obs.—Occurs at Bodenmais in Bavaria, with pyrite, vivianite, iolite, etc. Resembles a hisingerite in which the iron is replaced by alumina. It is distinguished from this mineral, as well as from gillingite, by the green color of its powder, and by yielding a residue before the blowpipe which is but slightly magnetic. Named after the physicist, G. Jolly.

L. Sæmann observes, in a letter to the author, that this species is very similar to fahlunite.

441. Epichlorite *Ramm.* (Pogg., lxxiii. 437, 1849). Fibrous or columnar, between schiller spar and chlorite in its characters. H.=2—2·5; G.=2·76; color dull leek-green; streak white to greenish; lustre greasy; in thin columns translucent and of a bottle-green color.

Comp.—O. ratio for Ṙ, R̶⃛, S̈i, Ḣ=4 : 3 : 9 : 4, whence, for bases, silica, and water, if half of the water be basic, 9 : 9 : 2. Analysis (l. c.):

S̈i 40·88 A̶⃛l 10·96 F̶⃛e 8·72 Ḟe 8·96 Ṁg 20·00 Ċa 0·68 Ḣ 10·18=100·38.

B.B. fuses only in thin fibres with difficulty. With the fluxes reaction of silica and iron.

Forms veins in a rock resembling serpentine at Harzburg. Named in allusion to its being near chlorite in characters.

442. Polyhydrite *Breith.* (Handb., ii. 334, 1841). From St. Cristoph, at Breitenbrunn, in Saxony. Amorphous; H.=2—3; G.= 2·095—2·142; lustre dull; color liver-brown; streak lighter, grayish. According to Plattner, contains S̈i, F̶⃛e, Ḟe, with some A̶⃛l, Ṁn, and 29·20 p. c. of water. In muriatic acid decomposed.

443. Lillite *Reuss* (Ber. Ak. Wien, xxv. 550, 1857). From Przibram in Bohemia, with pyrite, and arising, apparently, through the agency of decomposing pyrite. H.=2; G.=3·043. Earthy, like glauconite; blackish-green. Analysis afforded S̈i 32·48, F̶⃛e, Ḟe 54·95, Ḣ 10·20, Ċa C̈ 1·96, Fe S 0·63=100·22.

444. Chlorite-like Mineral, from the *keuper* of Altenburg, *Haushofer* (J. pr. Ch., xcix. 239). Color dark leek-green. Stated to be B.B. infusible. Analysis gave S̈i 29·51, A̶⃛l 11·54, F̶⃛e 18·26, Ḟe 25·26, Ċa 0·52, Ḣ 14·81=99·90. O. ratio of bases and silica=1 : 1, and of Ṙ, R̶⃛=1 : 2.

---

445. PYROSCLERITE. Pyrosklerit *v. Kobell*, J. pr. Ch., ii. 53, 1834.

Orthorhombic, or monoclinic; Descl. Cleavage: basal eminent or micaceous; in a transverse direction at right angles to the former, in traces. H.=3. G.=2·74, v. Kobell. Lustre of cleavage surface weak pearly. Color apple- to emerald-green. Translucent.

Comp.—O. ratio for Ṙ, R̶⃛, S̈i, Ḣ=4 : 2 : 6 : 3; whence $(\frac{1}{3}\dot{R}^3+\frac{1}{3}\bar{\dddot{Al}})^2\ddot{Si}^3+3\dot{H}$=Silica 38·9, alumina 14·8, magnesia 34·6, water 11·7=100. By making part of the water basic in this species and the three following, the O. ratio for bases and silica may be 3 : 2, and the formulas as written on p. 451.

Analysis: v. Kobell (l. c.):

	S̈i	A̶⃛l	C̶⃛r	Ḟe	Ṁg	Ḣ
1. Elba, *Pyrosclerite*	37·03	18·50	1·43	3·52	31·62	11·00=98·10.

The O. ratio from the analysis is 13·43 : 6·75 : 19·74 : 9·78, whence 20·18 : 19·74 for the bases and silica.

Pyr., etc.—Yields water. B.B. fuses at 3·8—4 to a grayish glass. With the fluxes reacts for chromium and iron. Decomposed by muriatic acid with gelatinization.

Obs.—Pyrosclerite appears to differ from kämmererite in crystallization as well as composition. It may include *tabergite* (p. 496, 7, 8) and the *Talc-chlorite* of Traversella (p. 500).

Occurs with chonicrite, constituting seams in serpentine, near Porto Ferrajo, Elba.

Named from πῦρ, *fire*, and σκληρός, *hard* (refractory).

445A. Vermiculite *T. H. Webb* (Am. J. Sci., vii. 55, 1824). Hexagonal, being optically uniaxial, Descl. Occurs in small foliated scales, distributed through a steatitic base, and hence scaly-massive. H.=1—2; G.=2·756, Crossley; lustre somewhat talc-like; color grayish, somewhat brownish.

Analysis: Crossley (this Min., 3d ed., 291, 1850):

$\ddot{\mathrm{Si}}$ 35·74 $\ddot{\bar{\mathrm{Al}}}$ 16·42 $\dot{\mathrm{Fe}}$ 10·02 $\dot{\mathrm{Mg}}$ 27·44 $\dot{\mathrm{H}}$ 10·30=99·92.

O. ratio for $\dot{\mathrm{R}}$, $\ddot{\bar{\mathrm{R}}}$, $\ddot{\mathrm{Si}}$, $\dot{\mathrm{H}}$=13·20 : 7·66 : 19·16 : 9·14=7 : 4 : 11 : 5, or approximately 4 : 2 : 6 : 3, which is that of pyrosclerite. General formula $(\dot{\mathrm{R}}^3, \ddot{\bar{\mathrm{R}}})^2 \ddot{\mathrm{Si}}^3 + 2$ aq, as above. Thomson obtained $\ddot{\mathrm{Si}}$ 49·08, $\ddot{\bar{\mathrm{Al}}}$ 7·28, $\ddot{\bar{\mathrm{Fe}}}$ 16·12, $\dot{\mathrm{Mg}}$ 16·96, $\dot{\mathrm{H}}$ 10·28; but he evidently took the specimen in mass, while Crossley separated with great care from the base the scaly mineral which is the true vermiculite. When heated exfoliates prodigiously, the scales opening out into long. worm-like threads, made up of the separate folia. Exfoliation commences at 500° to 600° F., and takes place with so much force as often to break the test tube in which the mineral may be confined. B.B. fuses at 3·5 to a grayish-black glass.

Occurs at Milbury, near Worcester, Mass. Named by Webb, as he says, from the Latin *vermiculor, I breed worms.*

446. CHONICRITE. Chonikrit *v. Kob.*, J. pr. Ch., ii. 51, 1834. Metaxoit *Arppe*, Finsk. Min., Act. Sci. Fenn., vi. 580, 1861, Holmberg, Verh. Min. St. Pet., 1862, 145.

Massive, crystalline granular, or compact; sometimes globular, radiated.

H.=2·5–3. G.=2·91, v. Kob.; 2·58–2·61, Arppe. Lustre weak silky, to glimmering or dull. Color white, sometimes with yellowish or grayish spots; pale greenish-blue.

Comp., Var.—O. ratio for $\dot{\mathrm{R}}$, $\ddot{\bar{\mathrm{R}}}$, $\ddot{\mathrm{Si}}$, $\dot{\mathrm{H}}$=3 : 2 : 5 : 2. It is a *lime* pyrosclerite. *Chonicrite* occurs only massive, white, with G.=2·91, and has the lime to the magnesia as 1 : 2. *Metaxoite* is greenish-blue to nearly white, amorphous or crystalline granular, with G.=2·58–2·61, and lime to magnesia about 1 : 1. It contains more silica, the oxygen ratio for bases, silica, and water being 5 : 6 : 3. Analyses: 1, v. Kobell (l. c.); 2–4, Asp and Hällsten (Finsk. Min., l. c.):

	$\ddot{\mathrm{Si}}$	$\ddot{\bar{\mathrm{Al}}}$	$\ddot{\bar{\mathrm{Fe}}}$	$\ddot{\bar{\mathrm{Mn}}}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{H}}$
1. *Chonicrite*	35·69	17·12	—	—	1·46	22·50	12·60	9·00=98·37 Kobell.
2. *Metaxoite, cryst.*	38·69	9·68	4·7	*undet.*	—	15·28	*undet.*	12·97 Asp.
3 " "	37·90	9·78	6·73	2·05	—	12·23	18·79	12·76=100·24 Asp.
4. " *amorph.*	40·63	10·17	6·78	*undet.*	—	11·24	16·03	12·88 Hällsten.

Chonicrite gives the O. ratio for $\dot{\mathrm{R}}$, $\ddot{\bar{\mathrm{R}}}$, $\ddot{\mathrm{Si}}$, $\dot{\mathrm{H}}$=12·8 : 8 : 19·0 : 8; or for bases, silica, and water, 20·8 : 19 : 8.

Metaxoite, anal 3, gives 10·3 : 7·17 : 20·21 : 11·34=for bases, silica, and water, 17·5 : 20·2 : 11·3.

Pyr., etc.—Yield much water Chonicrite fuses with intumescence at 3·5–4 to a grayish-white glass, and is decomposed by muriatic acid, the silica separating in powder. Metaxoite acts much the same.

Obs.—Chonicrite forms, with pyrosclerite, seams in serpentine, on Elba; and metaxoite is found near Lupikko in Finland, some versts south of Pitkaranta, with serpentine.

Chonicrite is from χωνεια, *fusion*, and κριτός, *test*, its fusibility distinguishing it from some allied species. *Metaxoite*, from its nearness to *metaxite.*

447. JEFFERISITE. Vermiculite? *G. J. Brush*, Am. J. Sci., II. xxxi. 369, 1861; Jefferisite *id.*, ib., xli. 248, 1866.

Orthorhombic? In broad crystals or crystalline plates. Cleavage: basal eminent, affording easily very thin folia, like mica. Surface of plates often triangularly marked, by the crossing of lines at angles of 60° and 120°.

H.=1·5. G.=2·30. Lustre pearly on cleavage surface. Color dark yellowish-brown and brownish-yellow; light yellow by transmitted light. Transparent only in very thin folia. Flexible, almost brittle. Optically biaxial, Descl.

Comp.—O. ratio for $\dot{\mathrm{R}}$, $\ddot{\bar{\mathrm{R}}}$, $\ddot{\mathrm{Si}}$, $\dot{\mathrm{H}}$=2 : 3 : 5 : 2½ (in the analysis, 3); whence $(\frac{2}{3}\dot{\mathrm{R}}^3 + \frac{1}{3}\ddot{\bar{\mathrm{R}}})^2 \ddot{\mathrm{Si}}^3 + 3\dot{\mathrm{H}}$. Differs from pyrosclerite in the larger proportion of sesquioxyds. Analysis: Brush (l. c.)

	$\ddot{\mathrm{Si}}$	$\ddot{\bar{\mathrm{Al}}}$	$\ddot{\bar{\mathrm{Fe}}}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Na}}$	$\dot{\mathrm{K}}$	$\dot{\mathrm{H}}$
Westchester	37·10	17·57	10 54	1 26	19·65	0·56	*tr.*	0·43	13·76=100 87 Brush.

The exact O. ratio is 8·20 : 11·36 : 19·79 : 12·23, giving for bases and silica 19·56 : 19·79.

Pyr., etc.—When heated to 300° C. exfoliates very remarkably (like vermiculite); B.B. in forceps after exfoliation becomes pearly-white and opaque, and ultimately fuses to a dark gray mass. With the fluxes reactions for silica and iron. Decomposed by muriatic acid.

Obs.—Occurs in veins in serpentine at Westchester, Pa. Plates often several inches across Named after W. W. Jefferis of Westchester, Pa.

A foliated mineral similarly exfoliating occurs coarse-granular massive, according to R. Pumpelly, in Japan, in the mountains of the peninsula of Kadzusa, S.E. of Yedo.

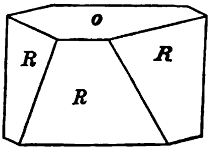
A mineral from the Vosges, referred to pyrosclerite by Delesse (Ann. d. Min., IV. xx. 155, 1851), approaches more nearly the jefferisite in its oxygen ratio, although containing less oxyd of iron as a substitute for alumina. It has the following characters: cleavage as in pyrosclerite, perfect in one direction, and less so in a transverse; structure a little lamellar; soft; G.=2·622; lustre greasy or waxy; color grayish, bluish, and emerald-green. Composition, according to Delesse, $\dddot{\mathrm{S}}\mathrm{i}$ 38·39, $\ddot{\bar{\mathrm{A}}}\mathrm{l}$ 26·54, $\ddot{\bar{\mathrm{C}}}\mathrm{r}$ *tr.*, $\dot{\mathrm{F}}\mathrm{e}$ 0·59, $\dot{\mathrm{M}}\mathrm{n}$ *tr.*, $\dot{\mathrm{M}}\mathrm{g}$ [22·16], $\dot{\mathrm{C}}\mathrm{a}$ 0·67, $\dot{\mathrm{H}}$ 11·67. O. ratio for $\dot{\mathrm{R}}$, $\ddot{\bar{\mathrm{R}}}$, $\dddot{\mathrm{S}}\mathrm{i}$, $\dot{\mathrm{H}}$=2 : 3 : 5 : 2½. As the magnesia was not directly determined, the results are doubtful. It occurs in nodules in serpentine at St. Philippe, near Sainte Marie-aux-Mines.

448. PENNINITE. Chlorite pt. Hydrotalc (=Wasserglimmer of Morin) *Necker*, Min., 1835 Pennine *J. Fröbel & E. Schweizer*, Pogg., l. 523, 1840. Kämmererite *Nordensk.*, Act. Soc. Sci. Fen., i. 483, 1841, and Arsberät. 1843, 193. Rhodochrom *Fiedler*, Rose, Reise n. d. Ural, ii. 1842, and Pogg., lix. 1843. Tabergit pt. *Scheerer*, Pogg., lxxi. 448, 1847. Chromchlorit *Herm.*, J. pr. Ch., liii. 21, 1851. Rhodophyllite *Genth.*, Proc. Ac. Sci. Philad., 1852, 118, 121. Penninite *Dana.*

Rhombohedral. $R \wedge R$=65° 36′, $O \wedge R$=103° 55′; a=3·4951. Observed planes: O, i; rhombohedral, $\frac{4}{13}$, $\frac{2}{5}$, $\frac{7}{10}$, R, $\frac{5}{2}$ (r), $\frac{7}{2}$ (m), occurring often as pyramids, f. 416. $O \wedge \frac{4}{13}$=128° 51′; $O \wedge \frac{2}{5}$=121° 47′; $R \wedge \frac{2}{5}$=162° 8′; $O \wedge \frac{5}{2}$ (r)=95° 40′ (95° 16′ obs.); $O \wedge \frac{7}{2}$ (m)=94° 3′ (obs. 94° 0′); $R \wedge y$, in twin,=152° 10′. Cleavage: basal, highly perfect. Crystals often tabular, and in crested groups. Also massive, consisting of an aggregation of scales; also compact cryptocrystalline.

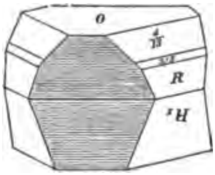
H.=2–2·5; 3, at times, on edges. G.=2·6–2·85; 2·673, Ala. Lustre of cleavage surface pearly; of lateral plates vitreous, and sometimes brilliant. Color green, apple-green, grass-green, grayish-green, olive-green; also reddish, violet, rose-red, pink, grayish-red; occasionally yellowish and silver-white; violet crystals, and sometimes the green, hyacinth-red by transmitted light along the vertical axis. Transparent to subtranslucent. Laminæ flexible, not elastic. Double refraction feeble; axis either negative or positive, and sometimes positive and negative in different laminæ of the same plate or crystal.

414



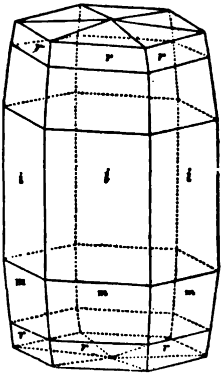
Texas, Pa.

415



Texas, Pa.

41



Kämmererite, Urals.

Var.—1. *Penninite.* As first named, it included a green crystallized chlorite from the Pennine Alps.

Hydrotalc of Necker is penninite from the Binnen valley, in the Valais. Axis of double refraction positive, Descl. Most of the penninite from Zermatt, and that of Binnen and the Tyrol, have

a negative optical axis; some crystals of Zermatt, and those of Ala, a positive; and
from Zermatt consist of positive and negative laminæ united; Descl.

2. *Tabergite*, from Taberg, Wermland (*Blue talc* of Werner, and called also *mica-c*
bluish-green or green chlorite. According to Descloizeaux's optical observations, it is
axial, with the axis positive like true *penninite*. But in other cases uniaxial and b
are combined, and negative and positive also; and the axial divergence of the biaxial
from 1° to 33°, indicating a mixture of penninite and another chlorite, either py
ripidolite.

Crystals of Texas have the double refraction positive though feeble (Descl., Cook
often mixed with ripidolite, and sometimes a crystal is traversed by a band of ripi
optic-axial angle is 60° to 70° (Descl.).

3. *Kämmererite*. The original specimen was a reddish-violet micaceous mineral fro
Bissersk, in Perm, Russia, partly in 6-sided prisms. It was named after Kämmer
Rhodophyllite of Genth, and *chrom-chlorite* of Herm. (anal. 12), are the same, from Texa
2·617—2·62. *Rhodochrome* is a compact or scaly-granular variety, originally from L. I
having a splintery fracture, with G.=2·66—2·67. Color deep green; but violet, ro
blossom-red in thin splinters, whence the name.

4. *Loganite* of Hunt (=*Pseudophite* of Kenngott) is near penninite in compositio
of loganite, from Calumet Falls, Canada, is given under *Altered Hornblende* (p. 242),
form, angles, and cleavage of that species; and also of an allied material under *Alt*
(p. 221). It has G.=2·60—2·64; color clove-brown to chocolate-brown; lustre dull.

Pseudophite of Kenngott (Ber. Ak. Wien, xvi. 1855) has the composition of lo
compact massive, without cleavage, and resembles serpentine (whence the name,
false, and *ophite* or serpentine); H.=2·5; G.=2·75—2·77; lustre weak; color g
olive-green, pistachio-green; feel unctuous. It forms the gangue of enstatite (Mg
Aloysthal, Moravia. In the occurrence of a massive form, penninite is thus like t
lite, and other related species.

Descloizeaux found (Min., 436) *R* ∧ *R*=65° 28′ in penninite, and *O* ∧ *R*=103°
latter in the Texas kämmererite. The above angles, and figs. 414, 415, are from Coo
the latter (Am. J. Sci., II. xliv. 201), and f. 416 is from Kokscharof (Verh. Min. Ges. S

Comp.—O. ratio for bases and silica 4 : 3, corresponding to 8 ($\dot{\mathrm{M}}\mathrm{g}^3$, $\ddot{\mathrm{A}}\mathrm{l}$), 9 $\ddot{\mathrm{S}}\mathrm{i}$, 12
ing from 4 : 3 to 5 : 4. Exact deductions from the analyses cannot be made until
oxydation of the iron in all cases is ascertained; and, further, until it is also prov
may not be a crystalline mixture such as is mentioned above under tabergite. The
contains microscopic grains of magnetite, and these are supposed by Kenngott to o
of the discrepancies in the analyses.

Analyses: (1) *Penninite*. 1, Schweizer (Pogg., l. 526); 2, 3, Marignac (Ann. Ch.
428); 4, Merz (Kenngott's Uebers., 1858, 62); 5, MacDonnell (Proc. R. Acad. Dubl
Marignac (l. c.); 7, Rammelsberg (4th Suppl., 87). (2) *Kämmererite, etc.* 8, Hartw
xxiii. 266); 9, Hermann (J. pr. Ch., liii. 1); 10, T. H. Garrett (Am. J. Sci., II.
Genth (Proc. Ac. Sci. Philad., 1852, 121); 12, Hermann (l. c.); 13, 14, Smith & B
Sci., II. xvi. 47); 15, 16, Pearse (Am. J. Sci., II. xxxvii. 222); 17, Hermann (l. c.).
18, v. Hauer (Ber. Ak. Wien, xvi. 1855); 19, T. S. Hunt (Rep. G. Can., 1863, 491):

		$\ddot{\mathrm{S}}\mathrm{i}$	$\dddot{\mathrm{A}}\mathrm{l}$	$\dddot{\mathrm{C}}\mathrm{r}$	$\bar{\mathrm{F}}\mathrm{e}$	$\dot{\mathrm{M}}\mathrm{g}$	$\dot{\mathrm{H}}$
1.	Zermatt, *Penninite*	33·07	9·69	—	$\dot{\mathrm{F}}\mathrm{e}$ 11·36	32·34	12·58=99·08 Schweize
2.	" "	33·36	13·24	0·20	5·93	34·21	12·80=99·74 Marignac
3.	" "	33·40	13·41	0·15	5·73	34·57	12·74=100 Marignac.
4.	" "	33·26	11·69	—	$\dot{\mathrm{F}}\mathrm{e}$ 7·20	35·18	12·18=99·51 Merz.
5.	" "	33·64	10·64	—	8·83	34·95	12·40=100·46 MacDon
6.	Binnen, "	33·95	13·46	0·24	6·12	33·71	12·52=100 Marignac.
7.	Snarum	34·88	12·48	—	5·81	34·02	13·68=100·87 Ramme
8.	Ural, *Käm.*	37·00	14·20	1·00	$\dot{\mathrm{F}}\mathrm{e}$ 1·50	31·50	13·00, $\dot{\mathrm{C}}\mathrm{a}$ 1·5=99·70 H
9.	L. Itkul, "	30·58	15·94	4·99	$\dot{\mathrm{F}}\mathrm{e}$ 3·32	33·45	12·05=100·33 Herman
10.	Texas, Pa., "	37·66	11·82	3·60	$\dot{\mathrm{F}}\mathrm{e}$ 2·50	24·97	13·58, $\dot{\mathrm{C}}\mathrm{a}$ 4·11, $\dot{\mathrm{N}}\mathrm{i}$ 0·6
11.	" " $(\frac{3}{2})$	33·20	11·11	6·85	1·43	35·54	12·95, $\dot{\mathrm{L}}\mathrm{i}$, $\dot{\mathrm{N}}\mathrm{a}$ 0·28, K
12.	" "	31·82	15·10	0·90	4·06	35·24	12·75, $\dot{\mathrm{N}}\mathrm{i}$ 0·25=100·1
13.	" "	33·26	10·69	4·78	1·96	35·93	12·64, $\dot{\mathrm{K}}$, $\dot{\mathrm{N}}\mathrm{a}$ 0·35=9
14.	" "	33·30	10·50	4·67	1·60	36·08	13·25, $\dot{\mathrm{K}}$, $\dot{\mathrm{N}}\mathrm{a}$ 0·35=9
15.	" "*r'h-g'n*	31·86	13·75	2·15	$\dot{\mathrm{F}}\mathrm{e}$ 2·31	34·90	13·98, $\dot{\mathrm{C}}\mathrm{a}$ 1·27, $\dot{\mathrm{N}}\mathrm{i}$ 0·2
16.	" "*red*	31·31	12·84	2·98	$\dot{\mathrm{F}}\mathrm{e}$ 2·46	35·02	13·20, $\dot{\mathrm{C}}\mathrm{a}$ 0·82, $\dot{\mathrm{N}}\mathrm{i}$ 0·4
17.	*Rhodochrome*	34·64	10·50	5·50	1·80	35·47	12·03=99·94 Herman
18.	*Pseudophite*	33·42	15·42	—	$\dot{\mathrm{F}}\mathrm{e}$ 2·58	34·04	12·68=98·14 Hauer.
19.	*Loganite*	33·28	13·30	—	1·92	35·50	16·00=100 Hunt.

In anal. 15, G.=2·63; 18, G.=2·383; 20, G.=2·355.

Tabergite afforded Svanberg (Ak. H. Stockholm, 155, 1839): $\ddot{\text{Si}}$ 35·76, $\dddot{\text{Al}}$ 13·03, $\dot{\text{Fe}}$ 6·34, $\dot{\text{Mn}}$ 1·64, $\dot{\text{Mg}}$ 29·27, $\dot{\text{K}}$ 2·07, Mg F 1·1, $\dot{\text{H}}$ 11·76=100·98. C. W. C. Fuchs obtained for its composition (Jahrb. Min. 1867, 822) $\ddot{\text{Si}}$ 32·95, $\dddot{\text{Al}}$ 13·08, $\dot{\text{Fe}}$ 13·72, $\dot{\text{Mn}}$ 0·07, $\dot{\text{Mg}}$ 26·83, $\dot{\text{Ca}}$ 0·95, $\dot{\text{H}}$ 11·34, K 0·33, Na 1·25, F 0·97=100·49; giving the O. ratio for $\dot{\text{R}}$, $\dddot{\text{R}}$, $\ddot{\text{Si}}$, $\dot{\text{H}}$=7 : 3 : 9 : 5, while the analysis of Svanberg gives 6 : 3 : 9 : 5; both of which are near that of *pyrosclerite*. G.=2·813. Des cloizeaux refers a part of tabergite to ripidolite (see below).

Pyr., etc.—In the closed tube yields water. B.B. exfoliates somewhat and is difficultly fusible. With the fluxes all varieties give reactions for iron, and many varieties react for chromium. Partially decomposed by muriatic and completely by sulphuric acid.

Obs.—Occurs with serpentine in the region of Zermatt, Valais, near Mt. Rosa, especially in the moraines of the Findelen glacier; crystals from Zermatt are sometimes 2 in. long and 1½ in. thick; also at the foot of the Simplon; at Ala, Piedmont, with clinochlore; at Schwarzenstein in the Tyrol; at Taberg in Wermland; at Snarum, greenish and foliated, called *steatite of Snarum*.

Kämmererite is found at the localities already mentioned; also near Miask in the Urals; at Haroldswick in Unst, Shetland Isles. Abundant at Texas, Lancaster Co., Pa., along with clinochlore, some crystals being imbedded in clinochlore, or the reverse.

The union of kämmererite and penninite is made by Descloizeaux, and is sustained by his optical examinations, as well as by chemical composition.

449. DELESSITE. Chlorite ferrugineuse *Delesse*, Ann. d. M., IV. xii. 195, 1847, and xvi. 520, 1849. Delessite *Naum.*, Min., 1850. Eisenchlorit.

Massive, with a short fibrous or scaly feathery texture, often radiated.

H.=2·5. G.=2·89. Color olive-green to blackish-green. Powder gray or green.

Analyses: Delesse (l. c):

	$\ddot{\text{Si}}$	$\dddot{\text{Al}}$	$\dddot{\text{Fe}}$	$\dot{\text{Fe}}$	$\dot{\text{Mg}}$	$\dot{\text{Ca}}$	$\dot{\text{H}}$
1. Mielen	31·07	15·47	17·54	4·07	19·14	0·46	11·55=99·30.
2. Oberstein	29·08	42·00		——	12·23	3·70	12·99=100.
3. Zwickau	29·45	18·25	8·17	15·12	15·32	0·45	12·57=99·33.

Anal. 1 affords the O. ratio for $\dot{\text{R}}$, $\dddot{\text{R}}$, $\ddot{\text{Si}}$, $\dot{\text{H}}$=8·7 : 12·5 : 16·5 : 10·27; and anal. 3, 11·87 : 10·96 15·70 : 11·18. The former gives for the O. ratio of bases and silica 1 : 1·29, and the latter 1 : 1·45; he mean of which is about 3 : 4.

In a matrass yields water and becomes brown. B.B. fuses with difficulty on the edges. Easily oluble in acids, affording a deposit of silica.

Occurs coating or filling the cavities of amygdaloid, or amygdaloidal porphyry, at Oberstein, wickau, La Grève near Mielen.

Named after Delesse, of Paris.

50. **RIPIDOLITE.** Chlorite pt. *early authors* (for Syn., see p. 501). Hexagonal Chlorite pt. Ripidolith (fr. Achmatovsk, Schwarzenstein) *v. Kob.*, J. pr. Ch., xvi. 1839. ? Tabergit pt. Clinochlore (fr. Westchester) *W. P. Blake*, Am. J. Sci., II. xii. 339, 1851. Klinochlor *Germ.* Kotschubeit (fr. S. Ural) *Kokscharof*, Bull. Ac. St. Pet., v. 369, 1861.

Monoclinic. $C=62°\ 51'=O \wedge i\text{-}i$, $I \wedge I=125°\ 37'$, $O \wedge 4\text{-}\breve{i}=108°\ 14'$; $: b : c=1{\cdot}47756 : 1 : 1{\cdot}73195$. Observed planes: O; vertical, I, $i\text{-}i$, $i\text{-}\breve{i}$, $i\text{-}\breve{3}$; inodomes, $3\text{-}\breve{i}$, $4\text{-}\breve{i}$; hemidomes, $\frac{2}{3}\text{-}i$, $1\text{-}i$, $\frac{4}{3}\text{-}i$, $4\text{-}i$, $-4\text{-}i$; hemioctahedral, $\frac{2}{3}$, , 1, −2, −6; $\frac{2}{3}\text{-}\breve{3}$, $2\text{-}\breve{3}$, $-6\text{-}\breve{3}$, Kokscharof.

$\wedge I=113°\ 57'$
$\wedge 1$, adj.,$=102\ \ 7$
$\wedge -4\text{-}i=125\ \ 7$
$\wedge 1\text{-}i$, back,$=103\ \ 55$
$\wedge \frac{4}{3}\text{-}i=93\ \ 18$

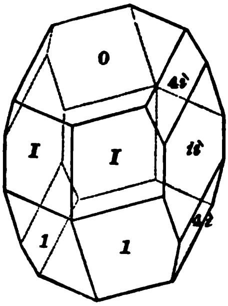
$O \wedge \frac{2}{3}$, adj.,$=118°\ 32'$
$O \wedge \frac{2}{3}\text{-}\breve{3}=116\ \ 45$
$O \wedge i\text{-}\breve{i}=90$
$1 \wedge 1=121\ \ 28$
$I \wedge 1=143\ \ 57$

$I \wedge i\text{-}\breve{3}=150°\ 10'$
$4\text{-}\breve{i} \wedge 4\text{-}\breve{i}$, ov. $i\text{-}\breve{i}$,$=143\ \ 33$
$i\text{-}\breve{i} \wedge i\text{-}\breve{3}=147\ \ 1\frac{1}{2}$
$i\text{-}\breve{3} \wedge i\text{-}\breve{3}=114\ \ 3$
$O \wedge i\text{-}\breve{3}=104\ \ 23$

leavage: O eminent; crystals often tabular, also oblong; frequently ombohedral in aspect, as in f. 424, the plane angles of the base 60° or

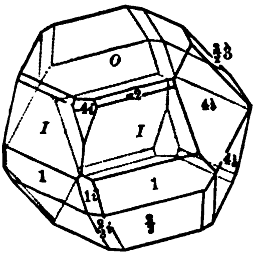
120°. Twins: composition-face $\frac{3}{2}$, making stellate groups, as in f. 420, 421, very common; $O \wedge \frac{3}{2} = 89° 43'$ to 90°, and these twins therefore having small or no reëntering angles on the face of cleavage. Crystals often grouped in rosettes. Massive coarse scaly granular to fine granular and earthy.

417



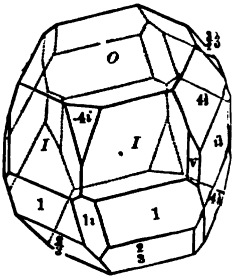
Achmatovsk.

418



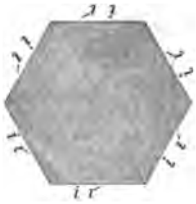
Achmatovsk.

419



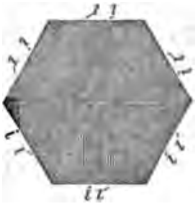
Achmatovsk.

420



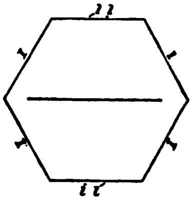
Texas.

421



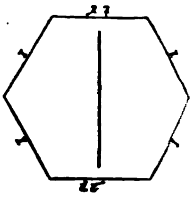
Westchester.

422



Texas.

423



Texas.

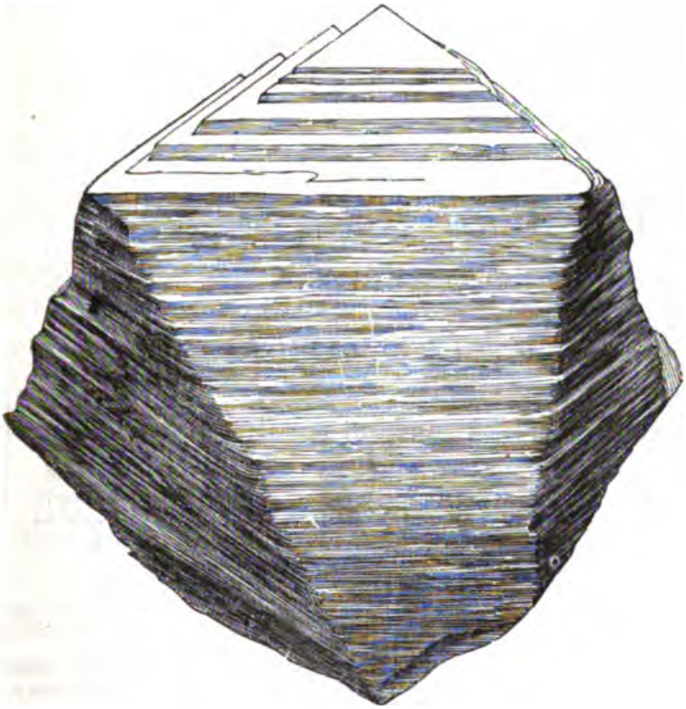
H.=2—2·5. G.=2·65—2·78; 2·774, fr. Achmatovsk, G. Rose; 2·672, ib., Marignac; 2·603, ib., Hermann; 2·673, fr. Ala, Marignac; 2·714, fr Texas, Blake; 2·71, fr. Willimantic, Burton. Lustre of cleavage-fac somewhat pearly. Color deep grass-green to olive-green; also rose-red Often strongly dichroic, being sometimes brownish or hyacinth-red trans verse to the vertical axis, by transmitted light, when green in the directio of the axis; at other times green in both directions. Streak greenish-whit to uncolored. Transparent to translucent. Flexible and somewhat elastic Optic-axial divergence 10° to 86°; bisectrix acute positive, inclined 12° t 16° to the normal to O; plane in a direction either parallel (f. 422), o at right angles (f. 423) to two sides of the hexagonal base, the lines in 422, 423, and the lining in f. 420, 421 (of the twins), showing the tw directions.

Var.—1. *Ordinary;* green ripidolite, passing into bluish-green and bluish (tabergite); (*a*) fo ated; (*b*) massive. 2. *Kotschubeite;* rose-red. 3. *Exfoliating,* much like vermiculite. Descloizeau found the optic-axial angle in the mineral from Texas 15°—60° (a crystal having a hexagonal n cleus of kämmererite); others from Pennsylvania 70°—86°; from Achmatovsk and Arendal, N way, 40°—42°; fr. Zermatt, 46°; fr. Zillerthal, 48°—50°; fr. Pfunders, 46°—54°; fr. St. Gothar 25°; fr. Cavalaire, Dept. of Var, 26°, 44°, 72°; fr. Pfitsch, Tyrol, 15°—38°; fr. Ala, 15°—42°; Traversella, 15°—24°; fr. Taberg (tabergite), bluish to green, 10°—33°. In a Pennsylvania p he found 68° at 20° to 100° C.; 69° at 150° C.; 72° at 180° C.; 73½° at 190° C.; 75° at 205°

Cooke found the angle for plates fr. Texas 67°—84°, with the inclination of the bisectrix 13½° to 15½°.

Comp.—O. ratio for $\dot{\text{R}}$, $\overline{\text{R}}$, $\ddot{\text{Si}}$, $\dot{\text{H}}$=5 : 3 : 6 : 4; corresponding to 5 $\dot{\text{Mg}}$, $\overline{\text{Al}}$, 3 $\ddot{\text{Si}}$, 4 $\dot{\text{H}}$=Silica 32·5, alumina 18·6, magnesia 36·0, water 12·9=100. Analyses: 1, 2, W. J. Craw (Am. J. Sci., II. xiii. 222); 3, v. Kobell (Gel. Anz. München, Ap. 10, 1854); 4, Varrentrapp (Pogg., xlviii. 185); 5–7, v. Kobell (J. pr. Ch., xvi. 470); 8, Brüel (Pogg., xlviii.); 9, Delesse (Ann. Ch. Phys., III. ix. 396); 10, 11, Marignac (Ann. Ch. Phys., III. x. 430); 12, Hermann (J. pr. Ch., xl. 13); 13, B S Burton (priv. contrib.):

424—Natural size.



Westchester, Pa.

		$\ddot{\text{Si}}$	$\overline{\text{Al}}$	$\overline{\text{Cr}}$	$\overline{\text{Fe}}$	$\dot{\text{Fe}}$	$\dot{\text{Mg}}$	$\dot{\text{H}}$
1.	Chester Co., Pa.	31·34	17·47	1·69	3·85	—	33·44	12·60=100·39 Craw.
2.	" " "	31·78		22·71		—	33·64	12·60=100·73 Craw.
3.	Bavaria	33·49	15·37	0·55	2·30	4·25	32·94	11·50=100·40 Kobell.
4.	Achmatovsk	30·38	16·97	—	—	4·37	33·97	12·63=98·31 Varrentrapp.
5.	"	31·25	18·72	—	—	5·10	32·08	12·63=99·78 Kobell.
6.	"	31·14	17·14	—	—	3·85	34·40	12·20, insol. 0·85=100·11 Kob.
7.	Schwarzenstein	32·68	14·57	—	—	5·97	33·11	12·10, insol. 1·02=99·73 Kobell.
8.	Zillerthal	31·47	16·67	—	—	5·97	32·56	12·42=99·11 Brüel.
9.	Pyrenees	32·1	18·5	—	—	0·6	36·7	12·1=100 Delesse.
0.	Ala	30·01	19·11	—	4·81	—	33·15	12·52=99·60 Marignac.
	Slatoust	30·27	19·89	—	4·42	—	33·13	12·54=100·25 Marignac.
	" *white*	30·80	17·27	—	1·37	—	37·07	12·30=98·82 Hermann.
	Willimantic, Ct.	31·86	15·80	—	4·77	—	34·30	12·72, $\dot{\text{Ca}}$ 1·30=99·75 Burton.

Rammelsberg found 4·55 $\dot{\text{Fe}}$ in the mineral from Achmatovsk. In anal 9, G.=2·615; 10, G.=573; 11, G.=2·672; 12, G.=2·603. Pearse found the green chlorite of Texas to contain (Am

J. Sci., II. xxxvii. 222) $\ddot{\mathrm{S}}\mathrm{i}$ 28·62, $\bar{\bar{\mathrm{A}}}\mathrm{l}$ 18·37, $\bar{\bar{\mathrm{C}}}\mathrm{r}$ 1·97, $\dot{\mathrm{N}}\mathrm{i}$ 0·37, $\dot{\mathrm{F}}\mathrm{e}$ 3·73, $\dot{\mathrm{M}}\mathrm{g}$ 32·13, $\dot{\mathrm{C}}\mathrm{a}$
=100·66; and on the ground of the low silica makes it a new species, and names it
γρασττις, grass. The mineral was probably the true ripidolite of Texas, perhaps impu

Pyr., etc.—Yields water. B.B. in the platinum forceps whitens and fuses with
the edges to a grayish-black glass. With borax, a clear glass colored by iron, an
chromium. In sulphuric acid wholly decomposed. The variety from Willimantic, Ct.,
worm-like forms, like vermiculite.

Obs.—Occurs in connection with chloritic and talcose rocks or schist, and serpen
at Achmatovsk and other foreign localities mentioned above; red (*kotschubeite*) in t
Ufalcisk, Southern Ural; at Ala, Piedmont, with prochlorite; at Zermatt, with brov
Markt Leugast in Bavaria; Marienberg, Saxony.

In the U. States, in large crystals and plates at Westchester, in serpentine, an
Pa. (f. 424); at Texas, with chromite, and intimately associated, and sometimes
with red and green penninite.

On cryst. see Kokscharof, Min. Russl., ii. 7 (abstract in Am. J. Sci., II. xix.
zeaux, Min., i. 412; Hessenberg, Min. Not., No. vii. 28; J. P. Cooke, Am. J. Sci.,
from whom figs. 420–423 are taken.

Named *ripidolite* from *ριπις, a fan*, in allusion to a common mode of grouping of
and *clinochlore*, from the inclined monoclinic form of crystallization ascertained by
investigation. It has since been found, and first through examinations by Koksch
chlorite of Achmatovsk, and also that of Schwarzenstein and Ala, the three up
Kobell based his description of ripidolite, are also *monoclinic*, and identical wi
Ripidolite has nevertheless been, to some extent, set aside for *clinochlore*, because of
in the science connected with that name (see p. 502); but the latter name is very
since there is now a second monoclinic chlorite known (p. 504). The former name i
von Kobell's important chemical discovery that the old chlorite included two d
(p. 502), and ought to be retained.

TALC-CHLORITE OF TRAVERSELLA occurs in large hexagonal plates regularly
presents, according to Descloizeaux, the optical characters of clinochlore. The pla
consisting of six triangular sections; at centre they are translucent and blackish-g
a *negative* bisectrix, and exteriorly clear green and transparent, with a *positive* bis
nac regards it as between talc and chlorite. He obtained (Ann. Ch. Phys., III. xi

	$\ddot{\mathrm{S}}\mathrm{i}$	$\bar{\bar{\mathrm{A}}}\mathrm{l}$	$\dot{\mathrm{F}}\mathrm{e}$	$\dot{\mathrm{M}}\mathrm{g}$	$\dot{\mathrm{H}}$
1.	38·45	11·75	12·82	28·19	8·49=99·7
2.	39·81	12·56	11·10	28·41	7·79=99·67
3.	41·34	11·42	10·09	29·67	7·66=100·

Corresponds nearly with the O. ratio 3 : 1 : 4 : 3, and therefore the general f
$\ddot{\mathrm{S}}\mathrm{i}^3$+aq, or that of *pyrosclerite.* But it is possibly ripidolite impure from mix
which view would account for the high percentage of silica. Occurs at Travers
with magnetite and ripidolite.

At Traversella there is still another *talc-chlorite*, soft and of a silvery-white l
single optical axis, or two very slightly divergent; the hexagonal plates are opaqu
transparent toward the borders. It affords much water in a matrass, and fuses
on the edges to a white enamel.

451. LEUCHTENBERGITE.

Leuchtenbergit *Komonen*, Verh. Min. St.
Chlorite blanche de Mauléon *Delesse*, Ann. Ch. Phys., III. ix. 396, 18

Hexagonal. In hexagonal plates or crystals. Cleavage: ba
H.=2·5. G.=2·61–2·71; 2·61–2·64, v. Leuchtenberg;
Kokscharof. Lustre of cleavage surface pearly. Colorless, w
ish-white, greenish-white; often opaque externally (from alt
colorless within. Translucent in thin laminæ when unalt
laminæ flexible, very slightly elastic. Optically unaxial; Ha

Comp.—O. ratio for $\dot{\mathrm{R}}$, $\bar{\bar{\mathrm{R}}}$, $\ddot{\mathrm{S}}\mathrm{i}$, $\dot{\mathrm{H}}$=4½ : 3 : 5 : 3⅓; (⅗ $\dot{\mathrm{M}}\mathrm{g}^3$+⅖ $\bar{\bar{\mathrm{A}}}\mathrm{l}$) $\ddot{\mathrm{S}}\mathrm{i}$+1⅓ $\dot{\mathrm{H}}$=Sil
20·9, magnesia 36·5, water 12·2=100. It is a prochlorite with the protoxyd ba
magnesia. Analyses: 1, Hermann (J. pr. Ch., xl. 13); 2, v. Leuchtenberg (Bull
188); 3, Delesse (l. c.):

	$\ddot{\text{Si}}$	$\bar{\text{Al}}$	$\bar{\text{Fe}}$	$\dot{\text{Mg}}$	$\dot{\text{Ca}}$	$\dot{\text{H}}$
1. Slatoust	32·35	18·00	4·37	32·29	—	12·50=99·51 Hermann.
2 "	(⅔) 30·46	19·74	$\dot{\text{Fe}}$ 1·99	34·52	0·11	12·74=99·56 Leuchtenberg.
3. Mauléon	32·1	18·5	0·6	36·7	—	12·1=100 Delesse.

Von Leuchtenberg's analysis was made on unaltered material, separated with great care, even microscopic, from impurities. It gives the O ratio for $\dot{\text{R}}$, $\bar{\text{R}}$, $\ddot{\text{Si}}$, $\dot{\text{H}}$=13·83 : 9·85 : 16·24 : 11·32; and Hermann's, 12·92 : 10·69 : 17·26 : 11·11. The "white chlorite" of Mauléon appears to be identical with leuchtenbergite.

Pyr., etc.—In the closed tube yields water. B.B. exfoliates and fuses with difficulty on the thin edges, becoming white and opaque.

Obs.—Found in the Schischimsk Mts., near Slatoust, partly in large crystals, and partly quite small, imbedded in steatite. The crystals are mostly opaque and altered externally, and contain in this outer part from 9·30 to 10·75 p. c of water. The mineral contains minute garnets and some other crystals as impurities.

Named after Duke N. v. Leuchtenberg.

452. **PROCHLORITE.** Mica pt., Telgsten pt.?, Lapis colubrinus lamellosus (fr. Salberg), *Wall.*, Min., 130, 1747. Talgsten pt., Specksten pt., *Cronst.*, Min., 89, 1758. Chlorit pt. (fr. St. Gothard, Tolfa, Altenberg) *Wern.*, Bergm. J., i. 376 and 391, 1789. Blättriger Chlorit (fr. St. Gothard) *Wern.*, 1800, Ludwig Min, i. 118, 1803. Chlorite *v. Kobell*, J. pr. Ch., xvi. 1839. Hexagonal Chlorite. Ripidolite *G. Rose*, and *this Min.*, *last edit.* Lophoit, Ogkoit, *Breith.*, Handb., i. 381, 383, 1841. Helminthe *G. O. Volger*, Entw. Min., 142, 1854. Grengesite (fr. Dalarne) *Hisinger*, Suckow's Erz. u. Gesteinlager schwed. Geb., 50, 1831=Strahlige Grüneisenerde v. Dalarne. Prochlorite *Dana*, Am. J. Sci., II. xliv. 258, 1867.

Hexagonal? Cleavage: basal, eminent. Crystals often implanted by their sides, and in divergent groups, fan-shaped, or spheroidal. Also in large folia. Massive granular. H.=1—2. G.=2·78—2·96. Translucent to opaque; transparent only in very thin folia. Lustre of cleavage surface feebly pearly. Color green, grass-green, olive-green, blackish-green; across the axis by transmitted light sometimes red. Streak uncolored or greenish. Laminæ flexible, not elastic. Double refraction very weak; one optical negative axis (Dauphiny); or two very slightly diverging, apparently normal to plane of cleavage.

425

Comp.—O. ratio for $\dot{\text{R}}$, $\bar{\text{R}}$, $\ddot{\text{Si}}$, $\dot{\text{H}}$=12 : 9 : 14 : 9⅓; for bases and silica 3 : 2; $(\frac{4}{7}(\dot{\text{Mg}}, \dot{\text{Fe}})^3+\frac{3}{7}\bar{\text{Al}})\ddot{\text{Si}}+\frac{4}{3}\dot{\text{H}}$=, if $\dot{\text{Mg}}$: $\dot{\text{Fe}}$=1 : 1, Silica 26·8, alumina 19·7, protoxyd of iron 27·5, magnesia 15·3, water 10·7=100. Analyses: 1, Varrentrapp; 2, Rammelsberg (Min. Ch., 538); 3, 4, v. Kobell (J. pr. Ch., xvi.); 5, Tschermak (Ber. Ak. Wien, liii. 26); 6, v. Kobell (l. c.); 7, 8, Marignac Ann. Ch. Phys., III. xiv. 59); 9, Hermann; 10, J. L. Smith (Am. J. Sci., II. xi. 65); 11, Genth Am. J. Sci., II. xxviii. 250); 12, Hisinger (Suckow, Erz. u. Gesteinlager schwed. Geb., 1831, 50); 3, Erdmann (Erdmann's Lärobok, 1853, 373):

	$\ddot{\text{Si}}$	$\bar{\text{Al}}$	$\dot{\text{Fe}}$	$\dot{\text{Mn}}$	$\dot{\text{Mg}}$	$\dot{\text{H}}$
1. St. Gothard	25·36	18·56	28·79	—	17·09	8·96=98·70 Varrentrapp.
2. "	25·12	22·26	23·11	$\bar{\text{Fe}}$ 1·09	17·41	10·70=99·69 Rammelsberg.
3. Zillerthal	26·51	21·81	15·00	—	22·83	12·00=98·15 Kobell.
4. "	27·32	20·69	15·23	0·47	24·89	12·00=100·60 Kobell.
5. "	26·3	19·8	15·1	—	24·4	12·4, $\dot{\text{Ca}}$ 1·0=99·0 Tschermak.
6. Rauris	26·08	18·47	26·87	0·62	14·69	10·45, gangue 2·24=99·40 Kobell.
7. Dauphiny	26·88	17·52	29·76	—	13·84	11·33=99·33 Marignac.
8. " St. Christophe	27·14	19·19	24·76	—	16·78	11·50=99·37 Marignac.
9. Miask	25·60	22·21	$\bar{\text{Fe}}$ 5·00	—	30·96	13·43, undec. 2·25=99·45 Herm.
0. Gumuch-dagh	27·20	18·62	23·21	—	17·64	10·61=97·28 Smith.

	$\ddot{\mathrm{Si}}$	$\dddot{\mathrm{Al}}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Mn}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{H}}$
11. Steele's M., N. C.	24·90	21·77	24·21	1·15	12·78	10·59, $\dddot{\mathrm{Fe}}$ 4·60=100 Genth.
12. *Grengesite*	27·81	14·31	25·63	2·18	14·31	12·55=96·79 Hisinger.
13. Dannemora	27·89	14·30	21·21	5·43	14·42	10·30, $\dddot{\mathrm{Fe}}$ 5·96, $\dot{\mathrm{Ca}}$ 0·43, $\dot{\mathrm{Na}}$ 0·23, $\dot{\mathrm{K}}$ 0·17=100·34 Erdmann.

Analyses 3, 4, are of the *lophoite* of Breithaupt; $R \wedge O$=105° 14′—105° 25′; G.=2·78—2·89. Analyses 1 and 6 are of his *ogcoite*.

The *helminthe* of Volger occurs in slender vermiform crystallizations like fig. 425 (whence the name), transversely foliated, penetrating quartz and feldspar. The figure is from a New Hampshire specimen described by O. P. Hubbard, and may be one of the other species of chlorite.

A dark green mineral from the Pfitschthal, accompanying Œllacher's margarite, afforded Hetzer (Ramm. Min. Ch., 845, ZS. Nat. Ver. Halle, v. 301) $\ddot{\mathrm{Si}}$ 28·04, $\dddot{\mathrm{Al}}$ 23·19, $\dddot{\mathrm{Fe}}$ 25·7, $\dot{\mathrm{Mg}}$ 15·68, $\dot{\mathrm{Ca}}$ 1·43, $\dot{\mathrm{H}}$ 2·30, F 0·98=97·32. It is stated to be infusible.

Pyr., etc.—Same as for ripidolite.

Obs.—Like other chlorites in modes of occurrence. Sometimes in implanted crystals, as at St. Gothard, enveloping often adularia, etc.; at Greiner in the Zillerthal, Tyrol; Rauris in Salzburg; Traversella in Piedmont; at Mtn. Sept Lacs in Dauphiny (anal. 7); in Styria; Bohemia. Also massive in Cornwall, in tin veins (where it is called *peach*); at Arendal in Norway; Salberg and Dannemora, Sweden; Dognacska, Hungary; also as pseudomorphs, at Bergmannsgrün, Saxony, after garnet, and at Greiner, Tyrol, after hornblende.

Grengesite from Grängesberg in Dalecarlia, Sweden (anal. 12), occurs partly in hexagonal crystallizations, more or less radiately grouped, and probably results, Erdmann observes (Lärobok Min., 1853, 374), from the alteration of pyroxene. Erdmann spells the name *Grängesite*. Specific gravity 3·1; color dark green. Reported also from Fischbachthal, as altered augite, in melaphyre.

Named from χλωρός, *green*.

Werner's species chlorite was shown to include more than one species by von Kobell in 1838, and the name *chlorite* was thereupon given by him to the St. Gothard and other chlorites having 25 to 27 p. c. silica, and *ripidolite* to that of Schwarzenstein and Achmatovsk having 30 to 33 p. c. of silica.

In 1839, G. Rose reversed the names of v. Kobell (see paper on chlorite by Varrentrapp, Pogg., xlviii. 193, 1839) on the ground that v. Kobell's *ripidolite* was not so characteristically fan-shaped in aggregation as the other species. But the change was unfortunate, as both species are now known to differ but little in this respect, and it has resulted in much confusion in the science. Moreover, it violated an older claim of priority; for Werner's *blättriger Chlorit* (or *Chlorites lamellosus*), the first crystallized chlorite recognized by him (in 1800 or earlier, Ludwig's Min., i. 118, 1803), was the hexagonal chlorite of St. Gothard, and this should therefore, in the division, have retained the name *chlorite*.

As the term *chlorite* has become the designation of a family of minerals, it seems necessary that it should have some modified form for this species, and hence the application of *prochlorite*, from πρό, *before*, and *chlorite*, in allusion to its being the earliest crystallized kind recognized.

The following are chlorite-like minerals of doubtful nature:

453. A CHLORITE-LIKE mineral from Webster, N. C., in crystals, micaceous in structure, of a dark bluish to brownish-green color, afforded Genth (Am. J. Sci., II. xxxiii. 200):

$\ddot{\mathrm{Si}}$	$\dddot{\mathrm{Al}}$	$\dddot{\mathrm{Cr}}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Ni}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{K}}$	$\dot{\mathrm{H}}$
31·45	13·08	4·16	4·88	0·16	43·10	0·17	0·06	3·29=100·35.

The ratio between the oxygen of the bases and silica is about 3 : 2. It is remarkable for the small amount of water and iron, and the large proportion of magnesia: a constitution which may have an explanation in its being a mixture of talc and chlorite. It is associated with a talc which Genth found to be nearly anhydrous (p. 453).

454. APHROSIDERITE *Sandberger* (Ueb. Geol. Nassau, 97, 1847). A soft ferruginous chlorite, of a dark olive-green color, scaly massive in structure; the scales minute, transparent, and hexagonal, and having G.=2·8 and H.=1; from Weilburg, Duchy of Nassau, at the Gelegenheit mine. A similar mineral, but more magnesian, has been found in gneiss at Guistberg in Wermland; in hematite at Bonscheuer near Muttershausen, Duchy of Nassau, having G.=2·991; at Balduinstein on the Lahr; and in mica schist with hematite at several places in Upper Styria, consisting of microscopic scales of a clear green color. Analyses: 1, Sandberger (loc. cit.); 2, J. Igelström (J. pr. Ch., lxxxiv. 480); 3, Erlenmeyer (Jahresb., 1860, 773); 4, v. Hauer:

	$\ddot{\text{Si}}$	$\ddot{\bar{\text{Al}}}$	$\ddot{\bar{\text{Fe}}}$	$\dot{\text{Fe}}$	$\dot{\text{Mg}}$	$\dot{\text{H}}$
1. Weilburg	26·45	21·25	——	44·24	1·06	7·74=100·74 Sandberger.
2. Guistberg	25·0	20·6	——	32·0	14·3	7·6=99·5 Igelström.
3. Bonscheuer	25·72	20·69	4·01	27·79	11·70	10·05=99·96 Erlenmeyer.
4. Styria	26·08	20·27	——	32·91	10·00	10·06=99·32 Hauer.

Anal. 1 corresponds nearly to $\dot{\text{Fe}}^3\ddot{\text{Si}}+\ddot{\bar{\text{Al}}}\ddot{\text{Si}}+2\dot{\text{H}}$. The others have part of the iron replaced by magnesia, and approach ordinary prochlorite.

455. **Metachlorite** *List* (ZS. G., iv. 634, 1852). Foliated columnar, like chlorite, vitreous to pearly in lustre, dull leek-green color. H.=2·5. Composition according to K. List (l. c.):

$\ddot{\text{Si}}$	$\ddot{\bar{\text{Al}}}$	$\dot{\text{Fe}}$	$\dot{\text{Mg}}$	$\dot{\text{Ca}}$	$\dot{\text{K}}$	$\dot{\text{Na}}$	$\dot{\text{H}}$
23·77	16·43	40·36	3·10	0·74	1·37	0·08	13·75=99·60.

Whence the oxygen ratio for $\dot{\text{R}}$, $\ddot{\bar{\text{R}}}$, $\ddot{\text{Si}}$, $\dot{\text{H}}$, is very nearly 4½ : 3 : 5 : 5, which gives for the oxygen of the bases and silica the ratio 7½ : 5=3 : 2, as in aphrosiderite.

B.B. fuses on the edges to a dark enamel. Gelatinizes in the cold with muriatic acid. Forms small veins in a green rock at Büchenberg near Elbingerode, in the Harz.

Baltimorite. "Baltimorite," so called from Baltimore, afforded v. Hauer (Jahrb. G. Reichs., 1853) $\ddot{\text{Si}}$ 27·15, $\ddot{\bar{\text{Al}}}$ 18·54, $\dot{\text{Ca}}$ 15·08, $\dot{\text{Mg}}$ 26·00, $\dot{\text{H}}$ 13·23=100. Hermann found in "Baltimorite" of a bluish color, $\ddot{\text{Si}}$ 33·26, $\ddot{\bar{\text{Al}}}$ 7·23, $\ddot{\bar{\text{Cr}}}$ 4·34, $\dot{\text{Fe}}$ 2·89, $\dot{\text{Mg}}$ 38·56, $\dot{\text{H}}$ 12·44, $\ddot{\text{C}}$ 1·30. Thomson, who instituted the species, found for it the composition essentially of serpentine (see p. 467). It is a good example of the indefinite mixtures that exist among the serpentine and allied minerals, and of the uncertainty as to the value of a species that is based on only one or two analyses of the specimens of a region, and especially on specimens received from ordinary collectors.

Prasilite *T. Thomson* (Phil. Mag., III. xvii. 416, 1840). A leek-green fibrous mineral, soft as Venetian talc, from Kilpatrick Hills, the fibres loosely cohering, with G.=2·311. Stated to consist of silica, magnesia, sesquioxyd of iron and alumina, with probably soda, and 18 p. c. of water. Analysis not given. Probably a chlorite of some kind.

455A. **Dumasite** *Delesse* (Dufr. Min., iii. 790, 1847, iii. 286, 1859). A chlorite lining cavities or fissures in certain melaphyres in the Vosges; color green; soft, and somewhat resembling ripidolite.

456. CRONSTEDTITE. Cronstedtit *Steinmann*, Schw. J., xxxii. 69, 1821. Chloromelan *Breith.*, Char., 33, 184, 1823.

Rhombohedral. Occurs in hexagonal prisms, tapering toward the summit, or adhering laterally, and vertically striated; also in fibrous diverging groups, cylindroidal and reniform; also amorphous. Cleavage: basal, highly perfect.

H.=3·5. G.=3·348. Lustre brilliantly vitreous. Color coal-black to brownish-black. Streak dark olive-green. Opaque. Not brittle. Thin laminæ elastic.

Comp.—O. ratio for $\dot{\text{R}}$, $\ddot{\bar{\text{R}}}$, $\ddot{\text{Si}}$, $\dot{\text{H}}$=3 : 3 : 4 : 3; whence $(\frac{1}{2}(\dot{\text{Fe}},\dot{\text{Mn}})^3+\frac{1}{2}\ddot{\bar{\text{Fe}}})\ddot{\text{Si}}+\frac{3}{4}\dot{\text{H}}$, from Damour's analysis. Analyses: 1, Steinmann (l. c.); 1A, same, as corrected by v. Kobell, after a determination of the degree of oxydation of the iron (Schw. J., lxii. 196); 2, second anal. of Steinmann, altered to correspond with the $\ddot{\bar{\text{Fe}}}$ in Damour's anal. (Am. J. Sci., II. xxxi. 359); 3, Damour (Ann. Ch. Phys., III. lviii. 99):

	$\ddot{\text{Si}}$	$\ddot{\bar{\text{Fe}}}$	$\dot{\text{Fe}}$	$\dot{\text{Mn}}$	$\dot{\text{Mg}}$	$\dot{\text{H}}$
1. Przibram	22·452	——	58·852	5·078	2·885	10·700=99·968 Steinmann.
1A. "	22·452	35·350	27·112	5·078	2·885	10·700=103·577 Steinmann, altered.
2. "	22·83	29·08	31·44	3·43	3·25	10·70=100·73 Steinmann. altered.
3. "	21·39	29·08	33·52	1·01	4·02	9·76=98·78 Damour. G.=2·35.

Pyr., etc.—B.B. froths and fuses on the edges, yielding in R.F. a magnetic gray or black globule. With borax gives reactions for iron and manganese. Gelatinizes in concentrated muriatic acid.

Obs.—Accompanies limonite and calcite in veins containing silver ores at Przibram in Bohemia. Occurs also at Wheal Maudlin in Cornwall, in diverging groups.

Named after the Swedish mineralogist and chemist, A. Fr. Cronstedt.

456A. SIDEROSCHISOLITE *Wernekink* (Pogg., i. 387, 1824). Probably cronstedtite. Rhombohedral, affording the planes *O*, *I*, 1; crystals minute and often hemispherically grouped; cleavage, basal, perfect; also massive. H.=2·5; G.=3—3·4. Lustre splendent; color pure velvet-black when crystallized, dark greenish-gray; streak leek-green, greenish-gray; opaque.

Formula: $\dot{\mathrm{Fe}}^4\ddot{\mathrm{Si}}+1\frac{1}{2}\dot{\mathrm{H}}$, Wernekink, from an analysis of only three grains of the mineral (l. c.)

$\ddot{\mathrm{Si}}$ 16·3 $\quad \bar{\mathrm{Al}}$ 4·1 $\quad \dot{\mathrm{Fe}}\ \bar{\mathrm{Fe}}$ 75·5 $\quad \dot{\mathrm{H}}$ 7·3=103·2.

B.B. easily fusible, according to Wernekink (infusible, Berzelius); gelatinizes in muriatic acid. It occurs in cavities in pyrrhotite and siderite, at Conghonas do Campo, Brazil.

457. CORUNDOPHILITE. *Shepard* (fr. N. Car.), Am. J. Sci., II. xii. 211, 1851; (fr. Chester, Mass.) *id.*, ib., xl. 112, 1865. Clinochlore (fr. Chester) *J. P. Cooke*, Am. J. Sci., II. xliv. 206, 1867.

Monoclinic, Descl. Form double hexagonal pyramids. Cleavage eminent, as in clinochlore. Twins common, like those of clinochlore (p. 498, f. 421).

H.=2·5. G.=2·90, fr. Chester, Brush. Lustre of cleavage surface somewhat pearly. Color olive-green, leek-green, grayish-green. Transparent to nearly opaque. Laminæ flexible, somewhat elastic. Optically biaxial; angle between the axes varies from a very small angle to 73½°, mostly 30° to 73½°; bisectrix positive, oblique to plane of cleavage; double refraction strong.

Var.—Descloizeaux found the optic-axial angle in a plate from Chester, Mass. (letter to the author of Jan. 1866), 65°, with an increase of 3° in the angle on heating to 200° C., a character which, he observes, distinguishes this mineral and ripidolite from penninite. Cooke found (l. c.) for the same, from different plates, the angles 32°, 45°, 71½°, 73½°. The plane of the axes perpendicular to two sides of the hexagon.

Comp.—O. ratio for $\dot{\mathrm{R}}$, $\bar{\mathrm{R}}$, $\ddot{\mathrm{Si}}$, $\dot{\mathrm{H}}$, fr. Pisani, 1 : 1 : 1 : $\frac{5}{6}$, and between bases and silica 2 : 1; whence $(\frac{1}{2}\dot{\mathrm{R}}^3+\frac{1}{2}\dddot{\bar{\mathrm{Al}}})^4\ddot{\mathrm{Si}}^3+5\dot{\mathrm{H}}$. Analyses: 1, Pisani (Am. J. Sci., II. xli. 394); 2, J. L. Smith, "on material not absolutely pure" (ib., xlii. 92):

	$\ddot{\mathrm{Si}}$	$\dddot{\bar{\mathrm{Al}}}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{H}}$
1. Chester, Mass.	24·0	25·9	14·8	22·7	11·9, $\dot{\mathrm{Mn}}$, $\dot{\mathrm{Ca}}$, Li *tr.*=99·3 Pisani.
2. " "	25·06	30·70	16·50	16·41	10·62=99·29 Smith.

Dr. C. T. Jackson found in the Chester chlorite (Proc. N. H. Soc., Boston, x. 321) $\ddot{\mathrm{Si}}$ 22·50, $\dddot{\bar{\mathrm{Al}}}$ 23·50, $\bar{\mathrm{Fe}}$ 41·50, $\dot{\mathrm{Mg}}$ 1·80, $\dot{\mathrm{H}}$ 11·00=100·30. It contained, he observes, some mixed magnetite. But it is further evident that nearly all the magnesia was left unseparated from the iron.

Obs.—Occurs with corundum or emery; its low percentage of silica accords with this association. The species was instituted on a chlorite found with the corundum of Asheville, N. C., whence the name, from corundum, and φιλος, *friend*. The above description is from specimens occurring abundantly, and sometimes in large and small crystals, at the emery mine of Chester, Mass., which Shepard has referred to corundophilite; its identity with the Asheville mineral is not yet ascertained. Shepard describes the latter (l. c.) as occurring in monoclinic crystals, with $I \wedge I=120°$, $O \wedge I=97°\ 30'$, $O \wedge i\text{-}i=88°$ to 89°; sometimes in stellate groups; thin laminæ flexible; and he obtained in a very unsatisfactory chemical examination of 0·146 grain, $\ddot{\mathrm{Si}}$ 34·75, $\dddot{\bar{\mathrm{Al}}}$ 8·55, $\dot{\mathrm{Fe}}$ 31·25, $\dot{\mathrm{H}}$ 5·47, with a loss of 20 p. c.

458. CHLORITOID. Chloritspath *Fiedler*, Pogg., xxv. 329, 1832. Chloritoid *G. Rose*, Reis. Ural, i. 252, 1837. Barytophyllit *Glock.*, Grundr., 570, 1839. Masonite *C. T. Jackson*, Rep. G. of R. Island, 88, 1840. Sismondine *Delesse*, Ann. Ch. Phys., III. ix. 385, 1843.

Monoclinic, or triclinic. $I \wedge I'$ about 100°; *O* (or cleavage surface) on lateral planes 93°—95°, Descl. Cleavage: basal perfect; parallel to a lateral plane imperfect. Usually coarsely foliated massive; folia often curved or bent, and brittle; also in thin scales or small plates disseminated through the containing rock.

H.=5·5—6. G.=3·5—3·6 Color dark gray, greenish-gray, greenish-black, grayish-black, often grass-green in very thin plates; strongly dichroic. Streak uncolored, or grayish, or very slightly greenish. Lustre of surface of cleavage somewhat pearly. Brittle. Double refraction feeble; bisectrix oblique to the base; axial divergence small.

Var.—1. The original *chloritoid* (or chloritspath) from Kossoïbrod, near Katharinenburg in the Ural, is in large curving laminæ or plates, grayish to blackish-green in color, often spotted with yellow from mixture with limonite; G.=3·55, Fiedler, 3·557, Breith.

2. The *Sismondine* or St. Marcel mineral is black; but, according to Descloizeaux, grass-green when in very thin laminæ parallel to O, pale green and black in two different directions at right angles to this; it has $I \wedge I$=about 100°, $O \wedge I$=93°; bisectrix negative; G.=3·565, Delesse.

3. *Masonite*, from Natic, R. I., is in very broad plates of a dark grayish-green color, but bluish-green in very thin laminæ parallel to O, and grayish-green at right angles to this; G.=3·529, Kenngott; $O \wedge I$, plane of cleavage, =95°, Descl. It is evidently impure, and this must have been especially true of the material analyzed by Jackson (anal. 12).

The Canada mineral is in small plates, one-fourth in. wide and half this thick, disseminated through a schist (like phyllite), and also in nodules of radiated structure, half an inch through; G.=3·513, Hunt. That of Gumuch-Dagh resembles sismondine, is dark green in thick folia and grass-green in very thin; G.=3·52, Smith.

Comp.—O. ratio for $\dot{\text{R}}$, $\bar{\text{R}}$, $\ddot{\text{Si}}$, $\dot{\text{H}}$=1 : 3 : 2 : 1, for most analyses; whence the formula $(\frac{1}{2}(\dot{\text{Fe}}, \dot{\text{Mg}})^3+\frac{1}{2}\ddot{\bar{\text{Al}}})^4\ddot{\text{Si}}^3+3\dot{\text{H}}$=Silica 24·0, alumina 40·5, protoxyd of iron 28·4, water 7·1. The Bregratten mineral contains one-third less water ($2\dot{\text{H}}$).

Analyses: 1, Bonsdorff (G. Rose, Reis. Ural, i. 252); 2, v. Kobell (J. pr. Ch., lviii. 40); 3, Hermann (ib., liii. 13); 4, 5, O. L. Erdmann (ib., iv. 127, vi. 89); 6, Gerathewohl (ib., xxxiv. 454); 7, v. Kobell (Gel. Anz. München, Apr., 1854); 8, Delesse (Ann. Ch. Phys., III. ix. 385); 9, Kobell (J. pr. Ch., lviii. 39); 10, J. L. Smith (Am. J. Sci., II. xi. 64); 11, J. D. Whitney (Proc. N. H. Soc., Boston, 1849, 100); 12, C. T. Jackson (Rep. G. R. I., 88, 1840); 13, T. S. Hunt (Am. J. Sci., II. xxxi. 442):

	$\ddot{\text{Si}}$	$\ddot{\bar{\text{Al}}}$	$\ddot{\bar{\text{Fe}}}$	$\dot{\text{Fe}}$	$\dot{\text{Mg}}$	$\dot{\text{H}}$
1. Kossoïbrod, *Chlor.*	27·48	35·57	——	27·05	4·29	6·95, $\dot{\text{Mn}}$ 0·30=101·64 Bonsd.
2. " "	23·01	40·26	——	27·40	3·97	6·34=100·98 Kobell.
3. " "	24 54	30·72	17·28	17·30	3·75	6·38=99·97 Hermann.
4. " "	24·90	46·20	——	28·89	——	——=99·99 Erdmann.
5. " "	24·96	43·83	——	31·21	——	——=100 Erdmann.
6. " "	24·40	45·17	——	30·29	——	——=99·86 Gerathewohl.
7. Bregratten	26·19	38·30	6·00	21 11	3·30	5·50=100·40 Kobell.
8. *Sismondine*	24·1	43·2	——	23 8	——	7·6, $\ddot{\text{Ti}}$ *tr.*=98·7 Delesse.
9. "	25·75	37·50	——	21·00	6·20	7·80, undec. 0 5=98·75 K.
10. Asia Minor	23·91	39·52	——	28·05	——	7·08=98·56 Smith.
11. R. Island, *Masonite*	28·27	32·16	——	33·72	0·13	5·00=99·28 Whitney.
12. " "	33·20	29·00	——	25·93	0·24	4·00, $\dot{\text{Mn}}$ 6·00=99·37 Jackson.
13. Leeds, Canada	26·30	37·10	——	25·92	3·66	6·10, Mn 0·93=101·01 Hunt.

Erdmann, who made the earliest analysis, and also Gerathewohl (who made his examination on he same specimen, and under Erdmann's direction), obtained no water, and Hermann observes hat the specimen had probably been calcined, as it is the custom to burn the emery rock at the xality in the Urals.

A green chlorite-like mineral, in fine scales, occurring in a quartz geode in the Spirifer sandtone in the vicinity of Ems, in Nassau, afforded Herget (Jahresb., 1863, 820):

$\ddot{\text{Si}}$ 22·26 $\ddot{\bar{\text{Al}}}$ 31·76 $\dot{\text{Fe}}$ 36·97 $\dot{\text{H}}$ 8·63=99·62.

iving the O. ratio for $\dot{\text{R}}$, $\bar{\text{R}}$, $\ddot{\text{Si}}$, $\dot{\text{H}}$=8 : 11 : 11 : 7⅓, and corresponding to $(\frac{4}{11}\dot{\text{Fe}}^3+\frac{7}{11}\ddot{\bar{\text{Al}}})^4\ddot{\text{Si}}^3+\dot{\text{H}}$. If a little of the iron is sesquioxyd, the composition may be the same as for chloritoid.

Pyr., etc.—In a matrass yields water. B.B. nearly infusible; becomes darker and magnetic. ompletely decomposed by sulphuric acid. The masonite fuses with difficulty to a dark green namel.

Obs.—The Kossoïbrod chloritoid is associated with mica and cyanite; the St. Marcel occurs in dark green chlorite schist, with garnets, magnetite, and pyrites; the Rhode Island, in an argilxeous schist; the Chester, Mass., in talcose schist, with emery, diaspore, etc.; the Canada, at ome, in micaceous schist, and at Leeds in argillaceous schist. Chloritoid occurs also at Breatten, in Tyrol; at Gumuch-Dagh, Asia Minor, with emery; in Saasthal, Valais.

Named *Chloritoid* from the resemblance to chlorite. The name *Chloritspath*, or in English *Chlorite Spar*, has the precedence in time. But it is objectionable in form and signification, and has rightly been superseded by chloritoid.

458A. **Phyllite** *Thomson* (Ann. Lyc. N. Y., iii. 47, 1828. Ottrelite *Descl. & Damour*, Ann. d. M., IV. ii. 357, 1842. Newportite *Totten*, Shepard's Min., i. 161, 1857). Phyllite (and ottrelite) closely resembles chloritoid, as observed by Hunt (Am. J. Sci., II. xxxi.), and also by Descloizeaux (Min., i. 466). The analyses hitherto made, however, show a wide discrepancy. Yet it should be noted on this point that we have only one of each variety, and the mineral is so involved in the containing slate rock that it is very difficult to obtain it pure.

Occurs in small, oblong, shining scales or plates, more or less hexagonal, in argillaceous schist. According to Descloizeaux, ottrelite is probably monoclinic, and the optical axes are very divergent. H=5–5·5; G. of ottrelite 4·4. Color blackish-gray, greenish-gray, black; streak grayish, greenish.

Analyses: 1, Thomson (l. c.); 2, Damour (l. c., 357):

	$\ddot{\mathrm{Si}}$	$\bar{\dddot{\mathrm{Al}}}$	$\bar{\dddot{\mathrm{Fe}}}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Mn}}$	$\dot{\mathrm{K}}$	$\dot{\bar{\mathrm{H}}}$
1. Sterling, *Phyllite*	38·40	23·68	17·52	——	8·96	6·80	4·80=100·16 Thomson.
2. Ottrez, *Ottrelite*	43·34	24·63	——	16·72	8·18	——	5·66=98·53 Damour.

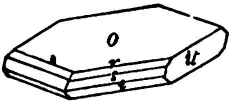
Yields water in the closed tube. Difficultly fusible to a magnetic globule. Reactions for iron with the fluxes.

Phyllite occurs in the schist of Sterling, Goshen, Chesterfield, Plainfield, etc., in Massachusetts, and Newport, R. I., and the rock in consequence of it is called by Hitchcock (Rep. G. Mass., 4to, 594, 1841) "Spangled Mica Slate," the phyllite being the mica of the schist. The scales are from $\frac{1}{8}$–$\frac{1}{4}$ in. long, and half to one-third this broad. Ottrelite is from a similar rock near Ottrez on the borders of Luxembourg, and from Ardennes. Phyllite has also been reported from Tuscany. Descloizeaux remarks on the close resemblance of the ottrelite of Ardennes to the Newport phyllite, and Hunt on the same to the Canada chloritoid.

459. MARGARITE. Perlglimmer (fr. Sterzing) *Mohs*, Char., 1820, Grundr., 232, 1824. Margarite *Tyrolese min. dealers*. Corundellite (fr. Pa.), Clingmanite (fr. N. C.), *Silliman, Jr.*, Am. J. Sci., II. viii. 380, 383, 1849. Emerylite (fr. Asia Minor) *Smith*, ib., viii. 378, 1849, xi. 59, 1851.

Orthorhombic; hemihedral, with a monoclinic aspect, like muscovite. *I* ∧ *I*=119°–120°, *O* ∧ *r*=152°–153°, *O* ∧ *t*=144°–145°, *O* ∧ *s*=129°–134°, *O* ∧ *i-ī*=90°. Lateral planes horizontally striated. Cleavage: basal, eminent. Twins: common, composition-face *I*, and forming, by the crossing of 3 crystals, groups of 6 sectors. Usually in intersecting or aggregated laminæ; sometimes massive, with a scaly structure.

426



H.=3·5–4·5. G.=2·99, Hermann. Lustre of base pearly, laterally vitreous. Color grayish, reddish-white, yellowish. Translucent, subtranslucent. Laminæ rather brittle. Optic-axial angle very obtuse, 109° 32′, 117° 30′, 126° 24′, 128° 48′, for the red ray in different plates; plane of axes parallel to the longer diagonal; dispersion feeble.

Comp.—O. ratio for $\dot{\mathrm{R}}$, $\bar{\dddot{\mathrm{R}}}$, $\ddot{\mathrm{Si}}$, $\dot{\mathrm{H}}$=1 : 6 : 4 : 1; whence, if the water be basic, for bases and silica=2 : 1; formula $(\frac{1}{3}(\dot{\mathrm{R}}^3, \dot{\mathrm{H}}^3)+\frac{2}{3}\bar{\dddot{\mathrm{Al}}})^4\ddot{\mathrm{Si}}^3$=Silica 30·1, alumina 51·2, lime 11·6, soda 2·6, water 4·5.

Analyses: 1–9, J. L. Smith (Am. J. Sci., II. xi. 59, and xv. 208); 10–13, W. J. Craw (ib., viii. 379); 14, B. Silliman, Jr. (this Min., 1850, 362); 15, W. J. Craw (ibid.); 16, C. Hartshorne (ibid.); 17, Hermann (J. pr. Ch., liii. 1); 18, 19, Smith & Brush (Am. J. Sci., II. xv. 209); 20, Faltin (ZS. Nat. Ver. Halle, v. 301); 21, J. L. Smith (Am. J. Sci., II. xlii. 90):

	$\ddot{\mathrm{Si}}$	$\bar{\dddot{\mathrm{Al}}}$	$\bar{\dddot{\mathrm{Fe}}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Na}}$, $\dot{\mathrm{K}}$	$\dot{\bar{\mathrm{H}}}$
1. Gumuch-Dagh	29·66	50·88	1·78	0·50	13·56	1·50	3·41 Smith.
2. "	30·90	48·21	2·81	*undet.*	9·53	*undet.*	4·61 Smith.
3. "	31·93	48·80	1·50	"	9·41	2·31	3·62, $\dot{\mathrm{Mn}}$ *tr.* Smith.
4. Island of Nicaria	30·22	49·67	1·33	*tr.*	11·57	2·31	5·12 Smith.
5. " "	29·87	48·88	1·68	*tr.*	10·84	2·86	4·32 Smith.

	S̈i	A̶l	F̶e	Ṁg	Ċa	Ṅa, K̇	Ḣ	
6. Island of Naxos	30·02	49·52	1·65	0·48	10·82	1·25	5·55	Smith.
7 " "	28·90	48·53	0·87	*undet.*	11·92	*undet.*	5·08	Smith.
8. " "	30·10	50·08	*undet.*	"	10·80	"	4·52	Smith.
9. Siberia	28·50	51·02	1·78	"	12·05	"	5·04	Smith.
10. Village Green, Pa.	32·31	49·24	——	0·30	10·66	2·21	5·27	Craw.
11. " "	31·06	51·20	——	0·28	9·24	2·97	5·27	Craw.
12. " "	31·26	51·60	——	0·50	10·15	1·22	4·27	Craw.
13. " "	30·18	51 40	——	0·72	10·87	2·77	4·52	Craw.
14. Buncombe Co., N. C.	29·17	48·40	——	1·24	9·87	6·15	3·99, H F 2·03,	Silliman, Jr.
15. Unionville, Pa.	29·99	50·57	——	0·62	11·31	2·47	5·14	Craw.
16. " "	32·15	54·28	*tr.*	0·05	11·36	*undet.*	0·50	Hartshorne.
17. Sterzing	32·46	49·18	1·34	3·21	7·42	1·76[a]	4·93=100·30	Hermann.
18. "	28·47	50·24	1·65	0·70	11·50	1·87[b]	5·00=99·26	Smith & Brush.
19. "	28 64	51·66		0·68	12·25	[2·01[b]]	4·76=100	Smith & Brush.
20. "	29·57	52·63	1·61	0·64	10·79	0·18	3·20=99·75	Faltin.
21. Chester, Mass.	32·21	48·87	2·50	0·32	10·02	1·91	4·61, L̇i 0·32, Ṁn 0·20=100·96	Smith

[a] 0·05 of this is K O.

[b] Trace of K O.

Pyr., etc.—Yields water in the closed tube. B.B. whitens and fuses on the edges.

Corundellite and *clingmanite* were based on an incorrect determination of the silica in the analyses.

Diphanite of Nordenskiöld (Bull. Ac St. Pet., v. 17) is only margarite. It occurs in hexagonal prisms with perfect basal cleavage. H.=5—5·5. G.=3·04—3·97. Color white to bluish. Analysis by Jevreinof: S̈i 34·02, A̶l 43·33, Ċa 13·11, Ḟe 3·02, Ṁn 1·05, Ḣ 5·34=99·87.

Obs.—Margarite occurs in chlorite from the Greiner mount, near Sterzing in the Tyrol, where first found (f. 426); at different localities of emery in Asia Minor and the Grecian Archipelago, as discovered by Dr Smith; with corundum at Village Green, Delaware Co., Pa.; at Unionville, Chester Co., Pa (corundellite); at the corundum locality in Buncombe Co., North Carolina (clingmanite); with the corundum of Katharinenburg, Urals. It occurs massive in Pennsylvania. *Diphanite* is from the emerald mines of the Ural, with chrysoberyl and phenacite.

Named *Margarite* from μαργαρίτης, *pearl*. The name is attributed to Fuchs, but he nowhere published it. Von Leonhard (Handb., 1826, 766) gives it as "the current name among the Tyrolese dealers in minerals"

This species, according to Dr. Krantz (Am. J. Sci., II. xliv. 256), is the *original* margarite. The specimen from Sterzing analyzed by Smith & Brush was one received so labelled from Dr. Krantz of Bonn.

EPHESITE *J. L. Smith*, Am. J. Sci., II xi. 59, 1851. Lamellar, and resembles white cyanite Cleavage difficult. Scratches glass easily. G.=3·15—3·20. Color pearly-white.

Analysis by Smith (l. c.):

	S̈i	A̶l	Ċa	Ḟe	Ṅa, little K̇	Ḣ
1.	31·54	57·89	1·89	1·34	4·41	8·12=100·19.
2.	30 04	56·45	2·11	1·00	4·41	8·09=97·07.

The oxygen ratio deduced for the protoxyds, sesquioxyds, silica, and water, is 1 : 15 : 9 : 2. From the emery locality of Gumuch-Dagh, near Ephesus, on specimens of magnetite. Probably related to margarite, near which it is placed by Dr. Smith.

460. THURINGITE.

Thuringit *Breith.*, Char., 95, 1832. Owenite *Genth*, Am. J. Sci., II. xvi. 1853.

Massive; an aggregation of minute scales; compact. Cleavage of scales distinct in one direction.

H.=2·5. G.=3·186, fr. Saalfeld, Smith; 3·151—3·157, id., Breith.; 3·197, owenite, Genth; 3·191, id., Smith. Lustre of scales pearly; of mass glistening or dull. Color olive-green to pistachio-green. Streak paler. Fracture subconchoidal. Very tough. Feel of powder greasy.

Comp.—O ratio for Ṙ, R̶, S̈i, Ḣ=2 : 3 : 3 : 2; whence, if half the water is basic, $(\frac{1}{2}(\dot{R}, \dot{H})^3 + \frac{1}{2}(\bar{Al}, \bar{Fe}))^4 \ddot{Si}^3 + 4\dot{H}$.

Analyses: 1, Rammelsberg (Min. Ch., 851); 2, J. L. Smith (Am. J. Sci., II. xviii. 376); 3, 4, P. Keyser (ib., 411); 5, 6, J. L. Smith (l. c.):

	$\ddot{\mathrm{Si}}$	$\dddot{\bar{\mathrm{Al}}}$	$\dddot{\bar{\mathrm{Fe}}}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Na}}$	$\dot{\mathrm{K}}$	$\dot{\mathrm{H}}$
1. *Thuringite*	22·35	18·39	14·86	34·34	1·25	—	—	9·81=101 Rammelsberg.
2. "	22·05	16·40	17·66	30·78	0·89	0·14		11·44=99·36 Smith.
3. " $(\frac{3}{3})$	23·55	15·63	13·79	34·20	1·47	—	—	10·57=99·21 Keyser.
4. *Owenite*	23·21	15·59	13·89	34·58	1·26	0·41	0·08	10·59, $\dot{\mathrm{C}}$a 0·36=99·97 Keyser.
5. "	23 58	16·85	14·33	33·20	1·52	0·46	*tr.*	10·45, $\dot{\mathrm{M}}$n 0·09=100·48 Smith.
6 Arkausas	23·70	16·54	12·18	33·14	1·85	0·32		10·90=99·74 Smith.

Pyr., **etc.**—In the closed tube yields water. B.B. fuses at 3 to an iron-black magnetic globule. With the fluxes reacts for iron. Gelatinizes with muriatic acid.

Obs.—Thuringite is from Reichmannsdorf (anal. 1, 2) and Schmiedeberg (anal 3), near Saalfeld in Thuringia; Hot Springs, Arkansas (anal. 6); owenite from the metamorphic rocks on the Potomac, near Harper's Ferry.

Owenite was named after the geologist, Dr. D. D. Owen.

461. SEYBERTITE. Bronzite (fr. Amity) *J. Finch*, Am. J. Sci., xvi. 185, 1829. Clintonite (fr. Amity) *Mather*, 1828, but unpublished; Mather's Rep. G. of N. Y., 467, 1843. Seybertite (fr. Amity) *Clemson*, Ann. d. M., III. ii. 493, 1832, Am. J. Sci., xxiv. 171, 1833. Clintonit *im Handel* [=of the trade], Chrysophan (fr. Amity) *Breith.*, Char., 92, 1832. Holmite (fr. Amity) *Thomson*, Rec. Gen. Sci., iii. 335, 1836. Xanthophyllit *G. Rose*, Pogg., l. 654, 1840, Reis. Ural, ii. 120, 514, 527. Brandisit *Liebener*, in Haid. Ber., i. 4, 1846. Disterrit *Breith.*, in v. Kobell, J. pr. Ch., xli. 154, 1847.

Orthorhombic. *I* ∧ *I*=120°. In tabular crystals, sometimes hexagonal; also foliated massive; sometimes lamellar radiate. Cleavage: basal perfect. Structure thin foliated, or micaceous parallel to the base.

H.=4—5. G.=3—3·1. Lustre pearly submetallic. Color reddish-brown, yellowish, copper-red. Streak uncolored, or slightly yellowish or grayish. Folia brittle. Double refraction strong; axial divergence 15° to 30° for white light; sometimes apparently uniaxial, or united at the ordinary temperature; bisectrix negative, normal to the base; axial plane parallel to *i-ī*; Descl.

Var.—1. The Amity *seybertite* (called also *clintonite*, *holmite*, and *chrysophan*) is in reddish-brown to copper-red brittle foliated masses; the surfaces of the folia often marked with equilateral triangles like some mica and chlorite; optic-axial divergence very small, or none at the ordinary temperature. G.=3·148, Brush.

2. *Xanthophyllite*, fr. the Schischimskian Mts., near Slatoust, is in crusts, or in implanted globular forms. 1½ in. through, which consist of tabular crystals about a centre of talcose schist, which is also the enclosing rock. Optically uniaxial; axis negative, or two axes very slightly divergent, and hardly separating with increase of temperature; Descl.

3. *Brandisite* (called also *disterrite*), from Fassa, Tyrol, is in hexagonal prisms of a yellowish-green or leek-green color to reddish-gray; H.=5 of base; of sides, 6—6·5: G.=3·042—3·051, v. Kobell; 3·013—3·062, v. Hauer; 3·01—3·06, Liebener; optic-axial divergence 15° to 30°. Some of it pseudomorphous, after fassaite.

Comp.—O. ratio for $\dot{\mathrm{R}}$, $\dddot{\bar{\mathrm{R}}}$, $\ddot{\mathrm{Si}}$, $\dot{\mathrm{H}}$, from Brush's analysis,=6 : 9 : 5 : ½; whence for $\dot{\mathrm{R}}+\dddot{\bar{\mathrm{R}}}$, $\ddot{\mathrm{Si}}$=3 : 1, and formula $(\frac{3}{4}\dot{\mathrm{R}}^3+\frac{2}{3}\dddot{\bar{\mathrm{Al}}})^2\ddot{\mathrm{Si}}+\frac{1}{2}\dot{\mathrm{H}}$. From v. Kobell's (anal. 9), O. ratio for $\dot{\mathrm{R}}+\dddot{\bar{\mathrm{R}}}$: $\ddot{\mathrm{Si}}$ the same, or 3 : 1, with $\dot{\mathrm{R}}^3$: $\dddot{\bar{\mathrm{R}}}$=1 : 1. From Meitzendorff's, O. ratio for $\dot{\mathrm{R}}$, $\dddot{\bar{\mathrm{R}}}$, $\ddot{\mathrm{Si}}$, $\dot{\mathrm{H}}$=12 : 20 : 9 : 2·, and for $\dot{\mathrm{R}}+\dddot{\bar{\mathrm{R}}}$, $\ddot{\mathrm{Si}}$=3½ : 1. The state of oxydation of the iron was not examined except in the analysis by Brush.

Analyses: 1, Clemson (l. c.); 2, Richardson (Rec. Gen. Sci., May, 1836); 3, 4, G. J. Brush (this Min., 1854, 505); 5, Plattner (Breith. Handb., ii. 385); 6–8, Meitzendorf (Pogg., lviii. 165); 9, v. Kobell (l. c.):

	$\ddot{\mathrm{Si}}$	$\dddot{\bar{\mathrm{Al}}}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{H}}$
1. Amity, *Seyb.*	17·0	37·6	5·0	24·3	10·7	3·6=98·2 Clemson.
2. " "	19·35	44·75	$\dddot{\bar{\mathrm{Fe}}}$ 4 80	9·05	11·45	4 55, $\dot{\mathrm{M}}$n 1·35, HF 0·9, $\dddot{\mathrm{Zr}}$ 2·05=98·25 R.
3. " "	20·24	39·13	" 3·27	20·84	13·69	1·04, $\dot{\mathrm{N}}$a, $\dot{\mathrm{K}}$ 1·43, $\dddot{\mathrm{Zr}}$ 0·75=100·39 Brush.

	$\ddot{\text{Si}}$	$\dddot{\text{Al}}$	$\dot{\text{Fe}}$	$\dot{\text{Mg}}$	$\dot{\text{Ca}}$	$\dot{\text{Na}}$	$\dot{\text{H}}$
4. Amity, *Seyb.*	20·13	38·68	$\dddot{\text{Fe}}$ 3·48	21·65	13·35	—	1·05, [$\dot{\text{Na}}$, $\dot{\text{K}}$ 1·43], $\ddot{\text{Zr}}$ 0·68=100·45 B.
5. " "	21·4	46·7	" 4·8	9·8	12·5	—	3·5=98·7 Plattner.
6. Slatoust, *Xanth.*	16·55	43·73	2·62	19·04	13·12	0·69	4·33=100·06 Meitzendorf.
7. " "	16·41	43·17	2·23	19·47	14·50	0·62	4·45=100·85 Meitzendorf.
8. " "	16·20	44·96	2·73	19·43	12·15	0·55	4·33=100·35 Meitzendorf.
9. Fassa, *Dister.*	20·00	43·22	$\dddot{\text{Fe}}$ 3·60	25·01	4·00	—	3·60, $\dot{\text{K}}$ 0·57=100 Kobell.

Pyr., etc.—Yields water. B.B. infusible alone, but whitens. In powder acted on by concentrated acids.

Obs.—*Seybertite* occurs in limestone with serpentine, associated with hornblende, spinel, pyroxene, graphite, etc.; *xanthophyllite* in talcose schist; *brandisite* in white limestone, either disseminated or in grouped crystals, in geodes, among crystals of fassaite and black spinel.

The seybertite was discovered in 1828 by Messrs. Fitch, Mather, and Horton, and named *clintonite* by them on the spot, after De Witt Clinton, as stated by Mather in his Rep. Geol. N. Y., 1843. But the name was not published at the time by either of the discoverers; and Finch, the next year, 1829 (l. c.), announced the mineral under the name of *bronzite*. Clemson's name *seybertite*, after H. Seybert (1832, l. c.), has therefore priority of publication, and must be accepted as the name of the species.

APPENDIX TO HYDROUS SILICATES.

462. WOLCHONSKOITE. *Kämmerer*, Jahrb. Min., ii. 420, 1831.

Amorphous. Dull—shining. Color bluish-green, passing into grass-green. Streak bluish-green and shining. Feel resinous. Polished by the nail. Fracture subconchoidal. Adheres slightly to the tongue. Very fragile. H.=2·25. G.=2·2–2·3.

Comp.—O. ratio for bases, silica, and water (anal. 2, 4) 2 : 3 : 3, as in deweylite and genthite. Analyses: 1, Berthier (Mem., ii. 263); 2, Kersten (Pogg., xlvii. 489); 3, Ilimoff (Ann. Jour. Mines de Russie, 1842, 366); 4, Ivanof (Koksch. Min. Russl., i. 145):

	$\ddot{\text{Si}}$	$\dddot{\text{Al}}$	$\dddot{\text{Cr}}$	$\dddot{\text{Fe}}$	$\dddot{\text{Mn}}$	$\dot{\text{Mg}}$	$\dot{\text{H}}$
1. Ochansk	27·2	—	34·0	7·2	—	7·2	23·2=98·8 Berthier.
2. "	37·01	6·47	17·93	10·43	1·66	1·91	21·84, $\dot{\text{Pb}}$ 1·01, $\dot{\text{K}}$ *tr.*=98·26 Kersten.
3. "	36·06	3·09	31·24	9·39	—	6·50	12·40, $\dot{\text{Ca}}$ 1·90, $\dot{\text{Pb}}$ 0·16=100·74 Ilimoff.
4. "	36·84	3·50	18·85	17·85	—	—	22·46, $\dot{\text{Ca}}$ 1·39=100·89 Ivanof.

Pyr., etc.—In the closed tube yields water. B.B. blackens, but is infusible. With the fluxes gives reactions for chromium and iron. Gelatinizes with hot concentrated muriatic acid, in which half the chromium is dissolved, the rest remaining in union with silica.

Obs.—From Okhansk in Siberia.

Named after M. Wolchonsky, of Russia.

463. **Selwynite**, *Ulrich* (Laboratory, i. 237, 1867). Massive. H.=3·5. G.=2·58. Emerald-green. Subtranslucent. Fracture uneven and splintery. Somewhat brittle.

Composition, according to an analysis by Mr. Cosmo Newbery:

$\ddot{\text{Si}}$ 47·15 $\dddot{\text{Al}}$ 33·23 $\dddot{\text{Cr}}$ 7·62 $\dot{\text{Mg}}$ 4·56 $\dot{\text{H}}$ 6·23=98·78.

Corresponds to the O. ratio for $\dot{\text{R}}$, $\dddot{\text{R}}$, $\ddot{\text{Si}}$, $\dot{\text{H}}$, 1 : 10 : 16⅓ : 3; or for bases and silica about 2 : 3; but probably a mixture. Perhaps containing some talc as impurity, with which it is traversed in thin seams. B.B. becomes white and fuses on the edges to a grayish-white blebby glass. Only partially soluble in strong acids.

Found near Heathcote, Victoria (Australia), in the Upper Silurian. Named after A. C Selwyn, director of the geological survey of Victoria.

464. *Chrome Ochre.* A clayey material, containing some oxyd of chrome. Occurs earthy of a bright green shade of color.

Analyses: 1, Drappiez; 2, Duflos (Schw. J., lxii. 251); 3, Zellner (Isis, 1834, 637):

	$\dddot{\text{Si}}$	$\dddot{\bar{\text{Al}}}$	$\dddot{\bar{\text{Cr}}}$	$\dddot{\bar{\text{Fe}}}$	$\dot{\text{H}}$
1. Creuzat, Fr.	64·0	23·0	10·5	—	—, $\dot{\text{Ca}}$ and $\dot{\text{Mg}}$ 2·5=100 Drappiez.
2. Halle	57·0	22·5	5·5	3·5	11·0=99·5 Duflos.
3. Silesia	58·50	30·00	2·00	3·00	6·25=99·75 Zellner.

The formula $(\dddot{\bar{\text{Al}}}, \dddot{\bar{\text{Cr}}}, \dddot{\bar{\text{Fe}}})^2 \dddot{\text{Si}}^3$ corresponds nearly to the composition, the water excepted.

Chrome ochre occurs at the localities above mentioned; also on Unst in Zetland, Mortenberg in Sweden, and elsewhere.

The *chrome ochre* of Halle, analyzed by Wolff (J. pr. Ch., xxxiv. 202), approaches selwynite in composition, but contains much more water. It afforded $\dddot{\text{Si}}$ 46·11, $\dddot{\bar{\text{Al}}}$ 30·53, $\dddot{\bar{\text{Cr}}}$ 4·28, $\dddot{\bar{\text{Fe}}}$ 3·15, $\dot{\text{H}}$ 12·53, $\dot{\text{Na}}$ 0·46, $\dot{\text{K}}$ 3·44=100·49; G.=2·7, giving rather closely the formula of kaolin, and may be an impure kaolinite.

465. **MILOSCHITE.** Miloschin *Herder*, Pogg., xlvii. 485, 1839. Serbian *Breith.*, J. pr. Ch., xv. 327, 1838.

Compact. H.=1·5—2. G.=2·131, Breith. Color indigo-blue to celandine-green.

Comp.—Approaches $(\dddot{\bar{\text{Al}}}, \dddot{\bar{\text{Cr}}}) \dddot{\text{Si}} + 3 \dot{\text{H}}$, it being a *chromiferous allophane* with half the water of allophane. Analyses: 1, Kersten (Pogg., xlvii. 485); 2, Bechi (Am. J. Sci, II. xiv. 62):

	$\dddot{\text{Si}}$	$\dddot{\bar{\text{Al}}}$	$\dddot{\bar{\text{Cr}}}$	$\dot{\text{Ca}}$	$\dot{\text{Mg}}$	$\dot{\text{H}}$
1. Rudniak	27·50	45·01	3·61	0·30	0·20	23·30=99·92 Kersten.
2. Tuscany	28·36	41·33	8·11	—	—	22·75=100·55 Bechi.

In a matrass yields water. B.B. infusible. Partly dissolved in muriatic acid.

From Rudniak in Servia, associated with quartz and brown iron ore; Volterra, Tuscany.

Named after Prince Miloschi.

466. **PIMELITE.** Grüner Chrysopraserde (fr. Kosemütz) *Klapr.*, Schrift., Ges. N. Berlin, viii. 17, 1788, Beitr., ii. 134, 1797. Pimelit *Karst.*, Tab., 28, 72, 1800.

Massive or earthy. H.=2·5. G.=2·23—2·3; 2·71—2·76, Baer. Lustre weak, greasy. Color apple-green Streak greenish-white. Translucent to subtranslucent. Feel greasy. Does not adhere to the tongue.

Comp.—Analyses: 1, Klaproth (Beitr., ii. 134); 2, W. Baer (J. pr. Ch., lv. 49):

	$\dddot{\text{Si}}$	$\dddot{\bar{\text{Al}}}$	$\dddot{\bar{\text{Fe}}}$	$\dot{\text{Ni}}$	$\dot{\text{Mg}}$	$\dot{\text{Ca}}$	$\dot{\text{H}}$
1. *Chrysoprase earth*	35·00	5·00	4·58	15·63	1·25	0·42	38·12 Klaproth.
2. *Hard Pimelite*	35·80	23·04	$\dot{\text{Fe}}$ 2·69	2·78	14·66	—	31·03=100 Baer.

Pimelite gives water in the closed tube, is infusible B.B., and with the fluxes reacts for nickel. Decomposed by acids.

From Silesia and elsewhere. Named from πιμελὴ, *fatness*. For Glocker's *alipite* see p. 404.

467. **CHLOROPHÆITE.** *Macculloch*, Western Isles, i. 504, 1825.

Granular massive, imbedded, or as a coating in geodes, fissures, or amygdaloidal cavities. Cleavage in two directions.

H.=1·5—2. G.=2·02, Macculloch; 1·809, Forchhammer. Lustre subresinous, rather dull. Color dark green, olive-green, changing to dark brown or black on exposure.

Formula perhaps $\dot{\text{Fe}} \dddot{\text{Si}} + 6 \dot{\text{H}}$?=Silica 38·3, protoxyd of iron 26·7, water 40·0=100.

Analysis by Forchhammer (J. pr. Chem., xxx. 399, 1843): From Faröe, $\dddot{\text{Si}}$ 32·85, $\dot{\text{Fe}}$ 21·56, $\dot{\text{Mg}}$ 3·44, $\dot{\text{H}}$ 42·15=100, the iron being corrected (Rammelsberg) for the true atomic weight. B.B. fuses to a black glass.

A chlorite-like mineral from the Western Isles of Scotland, at Scuir More in the island of Rum, and from Fifeshire, occurring in amygdaloid; also from Qualböe and Suderöe, Faröe Islands. Reported also as incrusting chalcedony in Antrim, and in small botryoidal groups in amygdaloid at Down Hill. But the chemical identity of the original chlorophæite of Macculloch from Scuir More with that of Faröe or the other localities has not yet been ascertained. Named from χλωρὸς, *green*, and φαιός, *brown.*

468. **KLIPSTEINITE.** Schwarz-Braunsteinerz von Klapperud *Klapr.*, Beitr., iv. 137=Opsimose *Beud.*, Tr., 187, 1832. Vattenhaltigt Manganoxidsilikat *Bahr*, Œfv. Ak. Stockh., 1850, 242. Klipsteinite *v. Kob.*, J. pr. Ch., xcvii. 180.

Amorphous. Compact.

H.=5—5·5. G.=3·5. Lustre dull to submetallic. Color dark liver-brown to black. Streak reddish-brown or yellowish-brown. Opaque.

Comp.—O. ratio for Ṙ+R̶, S̈i, Ḣ, doubtful; perhaps for klipsteinite 9 : 6 : 3, whence (Ṙ^3, R̶)^2 S̈i^3 + Ṙ^3 Ḣ^3. Perhaps only a mixture.

Analyses: 1, Klaproth (l. c.); 2, Bahr (l. c.); 3, v. Kobell (l. c.):

	S̈i	A̶l	F̶e	M̶n	Ṁn	Ṁg	Ċa	Ḣ	
1. Klapperud, *Opsim.*	25	——	——	60	——	——	——	13	=98 Klaproth.
2. "	23·69	0·61	9·14	56·21	——	0·39	0·50	9·51	=100·05 Bahr.
3. Dillenburg, *Klipst.*	25·00	1·70	4·00	32·17	25·00	2·00	——	9·00	=98·87 Kobell.

Pyr., etc.—Yields much water. Fuses to a slag which is black in the oxydation flame. Gives reactions for manganese and iron. Easily decomposed by muriatic acid, the klipsteinite and Bahr's mineral evolving chlorine.

Obs.—From Klapperud in Dalecarlia with rhodonite; also from the Bornberg mine at Herborn, near Dillenburg.

Beudant's name *opsimose* has the priority, but is intolerable. It is from the Greek ὀψιμος, *doing anything late.* Klipsteinite was given after Prof. v. Klipstein of Giessen.

469. **CHAMOISITE.** Mine de fer oxydé en grains agglutinés *Gueymard*, J. d. M., xxxv. 29, 1814; Chamoisite *Berthier*, Ann. d. M., v. 393, 1820. Minerai de fer en grains *Berthier*, Ann. Ch. Phys., xxxv. 258, 1827. Berthierine *Beud.*, Tr., 128, 1832. Bavalite *Huot*, Min., 290, 1841.

Chamoisite occurs compact or oolitic, with H. about 3; G.=3—3·4; color greenish-gray to black; streak lighter; opaque; feebly attracted by a magnet. *Berthierine* is similar in structure, has H.=2·5; color bluish-gray, blackish, or greenish-black; streak dark greenish-gray; and strongly attracted by the magnet.

Analyses: 1, Berthier (l. c.); 2, id. (Ann. Ch. Phys., xxxv. 258, 1827):

	S̈i	A̶l	Ḟe	Ḣ	
1. *Chamoisite*	14·3	7·8	60·5	17·4	=100 Berthier.
2. *Berthierine*	12·4	7·8	74·7	5·1	=100 Berthier.

Chamoisite fuses easily, and also gelatinizes. Berthierine fuses with difficulty to a black magnetic globule, and gelatinizes. The latter is mixed with 50 p. c. or more of siderite and calcite; Berthier found 40·3 of the former in the material he examined.

Chamoisite forms thick beds of rather limited extent in a limestone containing ammonites, at Chamoison, near St. Maurice, in the Valais; and a similar substance is reported from Mettenberg in the Bernese Oberland, and Banwald in the Vosges. *Berthierine* constitutes a valuable bed of iron ore at Hayanges, Dept. of Moselle, and also occurs in the ores of Champagne, Bourgogne, Lorraine.

470. **ALVITE.** *D. Forbes & T. Dahll*, Nyt. Mag., xiii.

Tetragonal. Crystals like those of zircon.

H.=5·5. G.=3·601—3·46. Lustre greasy. Color reddish-brown, becoming grayish-brown by alteration. Subtranslucent to opaque.

Comp.—A very small portion, somewhat altered, afforded (l. c):

S̈i 20·33 A̶l, B̶e 14·11 F̶e 9·66 Z̈r 3·92 T̈h (?) 15·13 C̈e 0·27 Ẏ 22·01 Ċa 0·40 Cu, Sn *tr.* Ḣ 9·32=97·24.

Pyr., etc.—Yields water. B.B. infusible; with the fluxes reacts for iron but not for titanium. Insoluble in acids.

Obs.—From Helle and Narestö in Norway, with feldspar and black mica.

470A. PICROFLUITE. *Arppe*, Act. Soc. Fenn., vi.; Verh. Min. St. Pet., 1852, 148.

Amorphous. Lustre greasy to dull. Color white, inclining to yellow and blue. H.=2·5 G.=2·74.

Comp.—Probably a mixture of fluorite with a magnesian silicate. Analyses: 1, Galindo (l. c.); 2, Arppe (l. c.):

	$\dddot{Si}$	$\dot{Fe}$	$\dot{Mn}$	$\dot{Mg}$	$\dot{Ca}$	$\dot{H}$	F
1. Lupikko	29·00	1·54	0·78	28·79	22·72	8·97	11·16=102·96.
2. "	32·16	3 50	——	25·19	19·86	9·08	*undet.*

Pyr., etc.—B.B. fuses easily with intumescence. Completely soluble in acids; evolves fluorid of silicon with sulphuric acid.

Obs.—Occurs at Lupikko in Finland, some versts south of Pitkaranta, with chalcopyrite and blende.

---

2. TANTALATES, COLUMBATES.

I. PYROCHLORE GROUP. Isometric.

471. Pyrochlore	? $\dot{R}^2\overset{\cdot\cdot\cdot\cdot\cdot}{Cb}$	$Cb_2\Theta_3|\Theta_4|(R_2, \bar{R})_2$
472. Microlite	? $(\dot{Ca}, \dot{Mn})^2\overset{\cdot\cdot\cdot\cdot\cdot}{Ta}$	

II. TANTALITE GROUP. Orthorhombic.

473. Tantalite	$(\dot{Fe}, \dot{Mn})\overset{\cdot\cdot\cdot\cdot\cdot}{Ta}$	$(Ta\,\Theta_2)_2|\Theta_2|(Fe, \bar{Mn})$
474. Columbite	$(\dot{Fe}, \dot{Mn})(\overset{\cdot\cdot\cdot\cdot\cdot}{Cb}, \overset{\cdot\cdot\cdot\cdot\cdot}{Ta})$	$((Ta, Cb)\,\Theta_2)_2|\Theta_2|(Fe, \bar{Mn})$
475. Tapiolite	$\dot{Fe}^5\overset{\cdot\cdot\cdot\cdot\cdot}{Ta}^4$	$Ta_8\Theta_{15}|\Theta_{10}|Fe_5$
476. Hielmite	$\overset{\cdot\cdot\cdot\cdot\cdot}{Ta}, \ddot{Sn}, \dot{Fe}, \dot{U}, \dot{Y}, \dot{Ca}, \dot{H}$	
477. Yttrotantalite	$(\dot{Y}, \dot{Fe}, \dot{Ca}, \dot{U})^{10}\overset{\cdot\cdot\cdot\cdot\cdot}{Ta}^3$	$Ta_6\Theta_5|\Theta_{20}|R_{10}$
478. Samarskite	$\overset{\cdot\cdot\cdot\cdot\cdot}{Cb}, \ddot{Zr}, \ddot{Th}, \ddot{\bar{U}}, \dot{Fe}, \dot{Y}, \dot{Ce}$	
479. Euxenite	$\overset{\cdot\cdot\cdot\cdot\cdot}{Cb}, \overset{\cdot\cdot\cdot\cdot\cdot}{Ta}, \ddot{Ti}, \dot{U}, \dot{Y}, \dot{Ce}, \dot{H}$	
480. Æschynite	$\overset{\cdot\cdot\cdot\cdot\cdot}{Ta}, \overset{\cdot\cdot\cdot\cdot\cdot}{Cb}, \ddot{Ti}, \ddot{Zr}, \ddot{Th}, \dot{Fe}, \dot{Ce}, \dot{La}, \dot{Y}, \dot{H}$	
481. Polycrase	$\overset{\cdot\cdot\cdot\cdot\cdot}{Cb}, \ddot{Ti}, \ddot{\bar{U}}, \ddot{Zr}, \dot{Fe}, \dot{Y}, \dot{Ce}$	
482. Polymignite		

III. FERGUSONITE GROUP. Tetragonal.

483. Fergusonite	? $(\dot{R}^3, \ddot{Zr})^5\overset{\cdot\cdot\cdot\cdot\cdot}{Cb}^2$	$Cb_2\Theta_5|\Theta_5|(R, \gamma\bar{Zr})_5$
484. Adelpholite		

Appendix.—485. Mengite 486. Rutherfordite.

471. PYROCHLORE. Pyrochlor (fr. Friedericksvärn) *Wöhler*, Pogg., vii. 417, 1826.
Hydrochlor, Fluochlor, *Herm.*, J. pr. Ch., l. 186, 187, 1850.

Isometric. Observed planes: 1, *I*, 2-2, 3-3, *O*. In octahedrons; f. 2, 8, 20+8, 8 with planes 2-2. Cleavage: octahedral, sometimes distinct, especially in the smaller crystals.

H.=5–5·5. G.=4·2–4·35; 4·32, from Miask, Rose; 4·203, ib., Hermann; 4·203—4·221, from Friederichsvärn, Hayes. Lustre vitreous or resinous. Color brown, dark reddish or blackish-brown. Streak light brown, yellowish-brown. Subtranslucent—opaque. Fracture conchoidal.

Var.—The name *hydrochlor* was given by Hermann to kinds containing water (anal. 5, 7), and *fluochlor* to those containing fluorine (anal. 1, 2, 3); both bad and unnecessary names.

Comp.—A columbate of lime, cerium, and other bases, but exact constitution not ascertained; $\dot{R}^3 \ddot{\mathrm{C}}\mathrm{b}$? Analyses: 1, Wöhler (Pogg., xlviii. 83); 2, 3, Hermann (J. pr. Ch., xxxi. 94, l. 188, 192); 4, id. (Bull. Soc. Nat. Moscou, xxxviii. 366); 5, Wöhler (l. c.); 6, Chydenius (Pogg., cxix. 43); 7, Wöhler (l. c.); 8, 9, A. A. Hayes (Am. J. Sci., xlvi. 164):

	$\ddot{\mathrm{C}}\mathrm{b}$	$\ddot{\mathrm{T}}\mathrm{i}$	$\dot{\mathrm{F}}\mathrm{e}$	$\dot{\mathrm{M}}\mathrm{n}$	$\dot{\mathrm{Y}}$	$\dot{\mathrm{C}}\mathrm{e}$	$\dot{\mathrm{L}}\mathrm{a}$	$\dot{\mathrm{M}}\mathrm{g}$	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\mathrm{N}}\mathrm{a}$	$\dot{\mathrm{K}}$	F	$\dot{\mathrm{H}}$
1. Miask	67·38	*tr.*	1·29	0·15	0·81	18·15	—	?	10·98	3·93[a]	—	3·23	1·16, $\ddot{\mathrm{S}}\mathrm{n}$?=102·08 W.
2. “	62·25	2·28	5·11	*tr.*	0·70	3·09	2·00	—	13·54	3·72[b]		3·00	0·50, $\ddot{\mathrm{Z}}\mathrm{r}$ 5·57=101·71 H.
3. “	60·83[c]	4·90	2·23	—	0·94	15·23		1·46	9·80	2·69[a]	0·54[a]	2·21	—=100·83 H.
4. “	61·80	3·23	1·54	—	—	6·20[d]		—	11·97	2·69[a]	0·54	2·21	—, $\ddot{\mathrm{T}}\mathrm{h}$ 8·88=99·06 H.
. Brevig	67·02	*tr.*	1·33	1·69	—	5·16[d]	—	*tr.*	9·88	*tr.*	—	—	7·06, $\overline{\mathrm{U}}$ 4·60=97·80 W.
. “	61·07		2·82[e]	—	—	5·00	—	—	16·02	4·60	—	*und.*	1·17, $\ddot{\mathrm{T}}\mathrm{h}$ 4·62, $\ddot{\mathrm{S}}\mathrm{n}$ 0·57=95·87 C.
. Fred'v'n	—	62·75	2·16[f]	2·75	—	6·80[g]	—	—	12·85	*tr.*	*tr.*	—	4·20, $\dot{\mathrm{U}}$ 5·18, $\ddot{\mathrm{S}}\mathrm{n}$ 0·61=97·25 W
“	53·10	20·20	2·35[f]	—	—	—	—	—	19·45	—	—	—	0·80, $\overline{\mathrm{U}}$, $\ddot{\mathrm{M}}\mathrm{n}$, Pb, $\ddot{\mathrm{S}}\mathrm{n}$ 1·20=97·10 H.
“	59·00	18·33	0·70[f]	—	—	—	—	—	16·73	5·63	—	—	0·80=101·19 H.

[a] Without the oxygen [b] Id., and with some Li. [c] Later made to consist of 14·68 columbic acid and 46·15 pocolumbic acid. [d] With thoria. [e] With protox. of uranium. [f] Fe^2O^3. [g] Ce^2O^3.

Pyr., etc.—Pyrochlore from the Miask gives but traces of water in the closed tube. B.B. fusible, but turns yellow and colors the flame reddish-yellow. When ignited it glows momenrily as if taking fire, the same phenomenon as observed with gadolinite. With borax and salt phosphorus in both flames gives a light green bead, becoming colorless on cooling. A saturated ad of borax gives a greenish-gray enamel in R.F., while that with salt of phosphorus is reddishay. Decomposed by concentrated sulphuric acid with evolution of fluorine (G. Rose). Pyrolore from Norway gives water in the closed tube, and B.B. fuses with difficulty to a dark brown ggy mass. With borax in R.F. gives a dark red bead, which by flaming turns to a grayishle to pure blue enamel. Dissolved with effervescence in salt of phosphorus, giving in O.F. a llow bead while hot, becoming grass-green on cooling (uranium). In R.F. the bead is made rk red to violet (titanic acid). Fused with soda gives a green color (manganese). All varieties decomposed by fusion with bisulphate of potash. Most specimens are sufficiently decomposed muriatic acid to give a blue color when the concentrated solution is boiled with metallic tin; s color disappears after a time, and almost immediately if diluted with water.

bs.—Occurs imbedded in syenite at Friederichsvärn and Laurvig, Norway, with zircon, polymite, and xenotime; at Brevig, with thorite; and near Miask in the Urals.

amed from πῦρ, *fire*, and χλωρός, *green*, because B.B. it becomes yellowish-green.

MICROLITE. Microlite *C. U. Shepard*, Am. J. Sci., xxvii. 361, 1835, xxxii. 338, xliii. 116. Pyrochlore *Hayes*, ib., xliii. 33, xlvi. 158, 338.

Isometric. Forms octahedral. Observed planes: 1, *I*, 2-2 (or 3-3). gs. 2, 8, 20+8. Known only in small crystals.

I.=5·5. G.=5·485–5·562, the last from a large crystal, Shepard; 5·405, yes. Lustre vitreous or resinous. Color pale clear yellow to brown. eak pale yellowish or brownish. Translucent to opaque.

Comp.—The yellow crystals were made by Hayes essentially columbate of lime. From blowpip investigation suggested by Brush to be probably (priv. contrib.) a pyrochlore, in which tantali acid replaces the columbic, this corresponding with the high specific gravity and larger percentag of the metallic acid.

Analyses: 1, Shepard (l. c., xxxii. 338); 2, Hayes (ib., xlvi. 158):

	$\dddot{\text{Cb}}(\dddot{\text{Ta}}?)$	$\ddot{\text{Sn}}$	$\dot{\bar{\text{U}}}, \bar{\text{Mn}}$	$\dot{\text{Pb}}$	$\dot{\text{Ca}}$	$\dot{\bar{\text{W}}}, \dot{\text{Y}}, \dot{\text{U}}$	$\dot{\text{H}}$
1. Chesterfield	75·70	——	——	——	14·84	7·42	2·04=100 Shepard.
2. "	79·60	0·70	2·21	1·60	10·87,	$\dot{\bar{\text{Fe}}}$ 0·99=95·97 Hayes.	

Pyr., etc.—B.B. infusible. In salt of phosphorus difficultly soluble, giving in O.F. a bea yellow while hot, and colorless on cooling. In R.F. after long blowing yields a pale bluish-gree bead. Not attacked by muriatic acid, but decomposed on fusion with bisulphate of potash, an the solution of the fused mass remains uncolored when boiled with metallic tin.

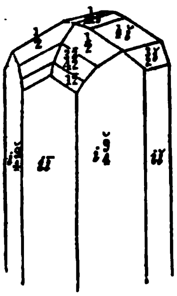
Obs.—Occurs at Chesterfield, Mass., in the albite vein, along with red and green tourmaline columbite, and a little cassiterite.

Named from μικρός, *small*, alluding to the size of the crystals.

473. TANTALITE. Tantalit *Ekeberg*, Ak. H. Stockh., xxiii. 80, 1802. Tantalite pt. *later author* Ferro-tantalite *Thom.*, Rec. Gen. Sc., iv. 416, 1836; =Columbate of Iron; =Siderotantal *Hausm* Handb., ii. 960, 1847; =Tammela-Tantalit *N. Nordenskiöld*, Act. Soc. Sc. Fenn., i. 119; =Skogb lit *A. E. Nordenskiöld*, Beskrifn. Finl. Min., 1855. Kimito-Tantalit *N. Nord.*; =Ixiolith *A. E. Nord* Pogg., ci. 632, 1857. Finbo-Tantalit; Broddbo-Tantalit; =Kassiterotantal *Hausm.*, l. c. Ildefon sit *Haid.*, Handb., 1845, 548; =Harttantalerz *Breith.*, Char., 230, 1832, Handb., 874, 1847.

Orthorhombic. Observed planes as in the figure. $I \wedge I = 101° \ 32'$ $O \wedge 1\text{-}\bar{i} = 122° \ 3\tfrac{1}{2}'$; $a : b : c = 1·5967 : 1 : 1·2247$.

427



$O \wedge \tfrac{1}{2}\text{-}\breve{i} = 146° \ 54'$

$O \wedge \tfrac{3}{2}\text{-}\breve{i} = 117 \ 2$

$O \wedge \tfrac{1}{12}\text{-}\breve{i} = 173 \ 49$

$i\text{-}\bar{i} \wedge 1\text{-}2 = 143 \ 6\tfrac{1}{2}$

$i\text{-}\bar{i} \wedge \tfrac{1}{2} = 123 \ 45$

$i\text{-}\bar{i} \wedge \tfrac{3}{4}\text{-}\tfrac{\bar{3}}{2} = 135 \ 4$

$\tfrac{1}{2} \wedge \tfrac{1}{2}$, adj., $= 126$

$\tfrac{1}{2} \wedge \tfrac{1}{2}$, ov. $\tfrac{1}{2}\text{-}\breve{i}$, $= 112° \ 31'$

$\tfrac{1}{2} \wedge \tfrac{1}{2}$, ov. I, $= 91 \ 44$

$1\text{-}2 \wedge 1\text{-}2$, adj., $= 141 \ 48$

$i\text{-}\bar{i} \wedge i\text{-}\tfrac{9}{4} = 118 \ 33$

$\tfrac{1}{2}\text{-}\breve{i} \wedge \tfrac{1}{2}\text{-}\breve{i}$, top, $= 113 \ 48$

$\tfrac{3}{2}\text{-}\breve{i} \wedge \tfrac{3}{2}\text{-}\breve{i}$, top, $= 54 \ 4$

$\tfrac{1}{12}\text{-}\breve{i} \wedge \tfrac{1}{12}\text{-}\breve{i}$, top, $= 167 \ 38$

Twins: composition-face $i\text{-}\breve{i}$, common. Also massive. H.=6—6·5. G.=7—8. Lustre nearly pure metal lic, somewhat adamantine. Color iron-black. Strea reddish brown to black. Opaque. Brittle.

Comp., Var.—$(\dot{\text{Fe}}, \dot{\text{Mn}})\dddot{\text{Ta}}$, with sometimes stannic acid ($\ddot{\text{Sn}}$) replacing part of the tantal A tantalate either (1) of iron (anal. 1–11, 13–15, 19, 20). or (2) of iron and manganese (anal. 12), o (3) a stanno-tantalate of these two bases, part of the tantalic acid being replaced by oxyd of t (anal. 16-18, 21–23). Number 1 is the *Ferrotantalite* of Thomson; 1 and 2, the *Siderotantalite* Hausmann; 3, the *Cassiterotantalite* and *Ixiolite*. The kinds shade into one another. The last ha the lowest specific gravity, G.=7—7·3. The mineral varies in the state of oxydation of th bases, owing, as Rose has shown, to alteration of the protoxyds to sesquioxyds; with the increa of the latter the streak loses its black color. It varies also in O. ratio for bases and ac between 1 : 4 and 1 : 5. The latter corresponds to Tantalic acid 86·05, protoxyd of iron 13·9 and the former to 83·1 and 16·9. Rose finds that prolonged washing of the powdered mine carries off the iron.

Analyses: 1, Nordenskiöld (Jahresb., xii. 190); 2, Jacobson (Pogg., lxiii. 317); 3, Brooks (ib 4, Weber (Pogg., civ. 85); 5, 6, Arppe (Act Soc. Sci. Fenn., vi.; Verh. Min. St. Pet., 1862, 155 7, Blomstrand (Mem. Univ. Lund., 1865, J. pr. Ch., xcix. 43); 8, Damour (Ann. d. M., IV. xiii. 337 9, 10, Jenzsch (Pogg., xcvii. 104—the 2d anal. of a specimen altered by exposure); 11, Chandl (Inaug. Dissert.); 12, 13, Berzelius (Schw. J., xvi. 259, 447, xxxi. 374); 14, Hermann (J. pr. Ch lxx. 205); 15, A. Nordenskiöld (Pogg., ci. 630); 16, Wornum (Pogg., lxiii. 317); 17, 18, Web (Pogg., civ. 85); 19, A. Nordenskiöld (Pogg., cvii. 374); 20, Blomstrand (l. c.); 21–23, Berzeli (Afh., iv. 172, 205, 207):

		$\mathrm{\dddot{T}a}$	$\mathrm{\ddot{S}n}$	$\mathrm{\dot{F}e}$	$\mathrm{\dot{M}n}$	$\mathrm{\dot{C}u}$	$\mathrm{\dot{C}a}$
1.	Tammela	83·44	*tr.*	13·75	1·12	*tr.*	——=98·31 Nordenskiöld; G.=7 264
2.	"	84·15	0·32	14·68	0·90	1·81	0·07=101·93 Jacobson; G.=7·197.
3.	"	84·70	0·50	14·29	1·78	0·04	——=100·81 Brooks.
4.	"	83·90	0·66	13·81	0·74	0·11	——=99·22 Weber; G.=7·414.
5.	"	83·66	0·80	15·54	——	——	——=100 Arppe; G.=7·36.
6.	"	82·71	0·83	15·99	——	——	——=99·53 Arppe.
7.	"	84·05	0·81	14·47	0·27	——	—— $\mathrm{\dot{M}g}$ 0·08=99·68 Blomstrand.
8.	Chanteloube	82·98	1·21	14·62	*tr.*	$\mathrm{\ddot{S}i}$ 0·42	——=99·23 Damour; G.=7·65.
9.	"	83·55	1·02	14·48	*tr.*	$\mathrm{\ddot{Z}r}$ 1·54	——=100·59 Jenzsch; G.=7·703.
10.	"	78·98	2·36	13·62	*tr.*	" 5·72	——=100·68 Jenzsch; G.=7·04.
11.	"	79·89	1 51	14·14	1·82	" 1·32	——=98·67 Chandler; G.=7·53.
12.	Kimito	83·2	0·6	7·2	7·4	——	——=98·4 Berz.
13.	"	85·85	0·80	12·94	1·60	$\mathrm{\ddot{S}i}$ 0·72	0·56=102·47 Berz; G.=7·936.
14.	"	84·09	0·70	3·38	1·32	$\mathrm{\bar{F}e}$10·08	——=99·70 Herm.
15.	"	84·44	1·26	13·41	0 96	$\mathrm{\dot{C}u}$ 0·14	0·15=100·36 Nord.; G.=7·85.
16.	"	77·83	6·81	8·47	4·88	" 0·24	0·50=98·73 Wornum; G.=7·155.
17.	"	75·71	9·67	9·80	4·82	——	——=99·50 Weber.
18.	"	76·81	9·14	9·49	4 27	0·07	0 41=100·19 Weber; G.=7·277.
19.	Björkboda	83·79	1·78	13·42	1·63	——	——=100·62 Nord.
20.	"	81·46	1·99	13·03	2·29	——	0·85, $\mathrm{\dddot{W}}$ 0·27, $\mathrm{\ddot{Z}r}$ 0·26, $\mathrm{\dot{M}g}$ 0·19=99·84 Blomstrand.
21.	Broddbo	68·22	8·26	$\mathrm{\bar{F}e}$ 9·58	$\mathrm{\bar{M}n}$ 7·15	$\mathrm{\dddot{W}}$ 6·19	1·19=100·59 Berz.
22.	"	66·35	8·40	" 11·07	" 6 60	" 6·12	1·50=100 04 Berz.
23.	Finbo	66·99	16·75	" 7·67	" 7·98	——	2·40=101·79 Berz.

Tantalic and *columbic* acids were formerly supposed to contain either 3 or 2 of oxygen. and a *hypotantalic* and a *hypocolumbic* were recognized. The recent results of Marignac, confirmed by those of Blomstrand, have led to the conclusion that there is but one acid, and that this one contains 5 of oxygen, as represented in the symbol above used.

Klaproth obtained from the Kimito tantalite (Beitr., v. 5) $\mathrm{\dddot{T}a}$ 88, $\mathrm{\dot{F}e}$ 10, $\mathrm{\dot{M}n}$ 2=100; Vauquelin (Haüy Tabl., 308) $\mathrm{\dddot{T}a}$ 83, $\mathrm{\bar{F}e}$ 12, $\mathrm{\dot{M}n}$ 8=103; and Wollaston (Phil. Trans., 1809) $\mathrm{\dddot{T}a}$ 85, $\mathrm{\dot{F}e}$ 10, $\mathrm{\dot{M}n}$ 4=99.

Pyr., etc.—B.B. unaltered. With borax slowly dissolved, yielding an iron glass, which, at a certain point of saturation, gives, when treated in R.F. and subsequently flamed, a grayish-white bead; if completely saturated becomes of itself cloudy on cooling. With salt of phosphorus dissolves slowly, giving an iron glass, which in R.F., if free from tungstic acid, is pale yellow on cooling; treated with tin on charcoal it becomes green. If tungstic acid is present the bead is dark red, and is unchanged in color when treated with tin on charcoal. With soda and nitre gives a greenish-blue manganese reaction. On charcoal, with soda and sufficient borax to dissolve the oxyd of iron, gives in R.F. metallic tin. Decomposed on fusion with bisulphate of potash in the platinum spoon, and gives on treatment with dilute muriatic acid a yellow solution and a heavy white powder, which, on addition of metallic zinc, assumes a smalt-blue color; on dilution with water the blue color soon disappears (v. Kobell).

Obs.—Tantalite is confined mostly to albite or oligoclase granite, and is usually associated with beryl. Near Härkäsaari, tantalite is associated with rose quartz and gigantolite, in albitic granite. At Katiala it is associated with lepidolite, black tourmaline, and colorless beryl.

Occurs in Finland, in Tammela, at Härkäsaari near Torro, associated with gigantolite and rose quartz; in Kimito at Skogböle, in Somero at Kaidasuo, and in Kuortane at Katiala, with lepidolite, tourmaline, and beryl; in Sweden, in Fahlun, at Broddbo and Finbo; in France, at Chanteloube near Limoges, in pegmatite. *Ixiolite*, from Kimito, was instituted on a supposed (not real) difference of crystalline form. *Ildefonsite* is from Ildefonso, Spain, and has G.=7·416, H.=6–7.

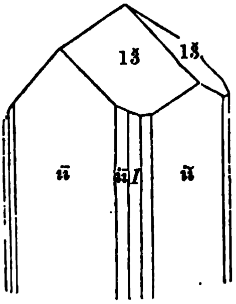
Named *Tantalite* by Ekeberg, from the mythic Tantalus, in playful allusion to the difficulties (tantalizing) he encountered in his attempts to make a solution of the Finland mineral in acids. The name was afterward extended to the American mineral *columbite*, and to the same from other localities; while the name columbite, the metal columbium having been discovered a little prior to tantalum, received a similar extension, so as to include all tantalite. The subsequent discovery that tantalum and columbium were distinct metals, and that the two compounds differed also in the atomic proportions of the constituents, finally established them as independent species.

474. **COLUMBITE.** Ore of Columbium (fr. Conn.) *Hatchett*, Phil. Tr., 1802. Columbite *Jameson*, Min., ii. 582, 1805. Columbate of Iron. Columbeisen *Germ.* Baierine (fr. Bavaria) *Beud.*, Tr., ii. 655, 1832. Torrelite *Thom.*, Rec. Gen. Sci., iv. 408, 1836. Niobite *Haid.*, Handb., 549,

1845. Greenlandite *Breith.*, B. H. Ztg., xvii. 61, 1858. Dianite *v. Kob.*, Ber Ak. München Mar. 10, 1860.

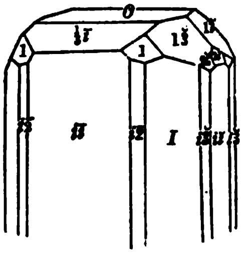
Orthorhombic. *I* ∧ *I*=101° 26′; *O* ∧ 1-ī=134° 53½′; *a* : *b* : *c*=1·0038 : 1 : 1·2225. Observed planes: *O*; vertical, *i*-ī, *i*-ĭ, *I*, *i*-$\breve{\frac{5}{3}}$, *i*-2̆, *i*-3̆; domes, $\frac{1}{6}$-ī, $\frac{1}{3}$-ī, $\frac{1}{2}$-ī, $\frac{2}{3}$-ī; 1-ĭ, 2-ĭ; octahedral, $\frac{1}{3}$, 1; $\frac{2}{3}$-2̆, 2-2̆; 1-$\breve{\frac{3}{2}}$, 2-$\breve{\frac{3}{2}}$; 2-2̆; 1-3̆, 2-3̆, 9-3̆; 2-6̆, 4-$\breve{12}$. Of these planes, zone 1-ĭ : *i*-ī contains 1-ĭ, 1-3̆, 1-$\breve{\frac{3}{2}}$, 1, 2-2̆: zone 2-ĭ : *i*-ī contains 2-ī, 2-6̆, 2-3̆, 2-2̆, 2-$\breve{\frac{3}{2}}$; zone $\frac{1}{3}$-ī : *i*-ĭ contains $\frac{1}{3}$, 1-3̆, 2-6̆, 4-$\breve{12}$; zone $\frac{2}{3}$-ī : *i*-ĭ contains $\frac{2}{3}$-ī, $\frac{2}{3}$-2̆, 1-$\breve{\frac{3}{2}}$, 2-3̆.

428



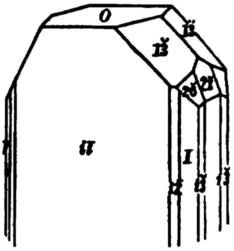
Haddam.

429



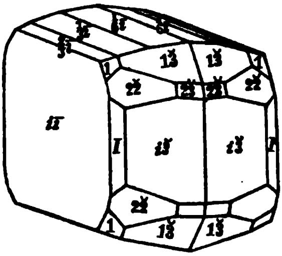
Middletown, Conn.

430



Bodenmais.

431



Greenland.

O ∧ $\frac{1}{3}$-ī=161° 30′
O ∧ $\frac{2}{3}$-ī=146 13
O ∧ 1-ĭ=140 36
O ∧ 2-ĭ=121 20
O ∧ 1=127 38
O ∧ 1-3̆=138 26
O ∧ 2-3̆=119 25
i-ī ∧ 1=127 48
i-ĭ ∧ 1=120 6
i-ī ∧ 1-3̆=104 30
i-ī ∧ *i*-2̆=157 45

i-ī ∧ *I*=140° 43′
i-ĭ ∧ *I*=129 17
i-ĭ ∧ *i*-3̆=157 50
i-ĭ ∧ 1-3̆=127 55
i-ĭ ∧ 2-ĭ=148 40
1-3̆ ∧ 1-3̆, adj.,=151
i-3̆ ∧ *i*-3̆, ov. *i*-ĭ,=135 40
i-2̆ ∧ *i*-2̆, ov. *i*-ī,=135 30
i-3̆ ∧ *i*-3̆=121 34
i-3̆ ∧ 2-3̆=150 35

Twins: composition-face 2-ĭ. Cleavage: *i*-ī and *i*-ĭ, the former most distinct. Occurs also rarely massive.

H.=6. G.=5·4–6·5. Lustre submetallic; a little shining. Color iron-black, brownish-black, grayish-black; often iridescent. Streak dark red to black. Opaque. Fracture subconchoidal, uneven. Brittle.

Comp., Var.—Columbate and tantalate of iron and manganese, of the general formula (Ḟe, Ṁn) (C̈b, T̈a), with at least twice as much atomically of columbic as of tantalic acid, and with the specific gravity increasing as the proportion of tantalic acid increases (Blomstrand, 1865; Marignac, 1866). The following are some of the ratios from Marignac's determinations: (1) From Greenland, T̈a 3·3 p. c.; C̈b : T̈a=35 : 1. (2) Acworth, N. H., La Vilate, near Limoges, and the *dianite* of Bodenmais, T̈a 15·8—13·4; C̈b : T̈a=7 or 8 : 1. (3) Another fr. Bodenmais, T̈a 27·1; C̈b : T̈a=3 : 1. (4) A third fr. Bodenmais, T̈a 35·4; C̈b : T̈a=about 2 : 1. (5) From Haddam, T̈a 30·4, and another 31·5; C̈b : T̈a=2 5 : 1. (6) In another from Haddam he found only 10 p. c. of tantalic acid, but queries the result. Blomstrand obtained for a Haddam specimen (anal

3) $\ddot{\bar{\mathrm{C}}}\mathrm{b} : \ddot{\bar{\mathrm{T}}}\mathrm{a} = 3 : 1$, with G.=6·151; for one fr. Bodenmais (anal. 16), $\ddot{\bar{\mathrm{C}}}\mathrm{b} : \ddot{\bar{\mathrm{T}}}\mathrm{a} = 4 : 1$, with G= 6·75; another fr. B. (anal. 17), $\ddot{\bar{\mathrm{C}}}\mathrm{b} : \ddot{\bar{\mathrm{T}}}\mathrm{a} = 2·5 : 1$, with G.=6·26; for one fr. Greenland, no $\ddot{\bar{\mathrm{T}}}\mathrm{a}$ with G.=5·395. His results all give for the O. ratio of bases and acids 1 : 5.

No. 3, above, gives the formula 3 ($\dot{\mathrm{F}}\mathrm{e}$, $\dot{\mathrm{M}}\mathrm{n}$) $\ddot{\bar{\mathrm{C}}}\mathrm{b}$+($\dot{\mathrm{F}}\mathrm{e}$, $\dot{\mathrm{M}}\mathrm{n}$) $\ddot{\bar{\mathrm{T}}}\mathrm{a}$; and No. 4, 2 ($\dot{\mathrm{F}}\mathrm{e}$, $\dot{\mathrm{M}}\mathrm{n}$) $\ddot{\bar{\mathrm{C}}}\mathrm{b}$+($\dot{\mathrm{F}}\mathrm{e}$, $\dot{\mathrm{M}}\mathrm{n}$) $\ddot{\bar{\mathrm{T}}}\mathrm{a}$; while 1 gives 35 ($\dot{\mathrm{F}}\mathrm{e}$, $\dot{\mathrm{M}}\mathrm{n}$) $\ddot{\bar{\mathrm{C}}}\mathrm{b}$+($\dot{\mathrm{F}}\mathrm{e}$, $\dot{\mathrm{M}}\mathrm{n}$) $\ddot{\bar{\mathrm{T}}}\mathrm{a}$. $\dot{\mathrm{F}}\mathrm{e}\,\ddot{\bar{\mathrm{C}}}\mathrm{b}$ corresponds to columbic acid 78·83, protoxyd of iron 21·17=100.

The following are the G. of the specimens employed for the analyses below:

Connecticut, anal. 2, 5·469—5·495; 3, 5·708; 4, 5·8; 5, 5·58—5·59; 6, 6·028—6·048; 7, 5·85. *Bavaria*, anal. 9, 6·39; 11, 5·7; 12, 6·02—6·06; 13, 5·976; 14, 5·971; 15, 5·698. *Ilmen Mts.*, anal. 19, 5·49—5·73; 20, 5·461; 21, 5·447. *Greenland*, anal. 22, 23, 5·875; 24, 5·40—5·42. *Chanteloube*, anal. 27, 5·60—5·727. Other G. are as follows:

C. fr. Northfield, Mass., 6·5, Shepard; fr. Monte Video, S. A., 5·660, Maskelyne; fr. Haddam, 5·967, Schrauf; fr. Middletown, 5·590 and 5·645, id.; fr. Greenland, 5·395, id.; fr. Bodenmais, 6·115, id.

The Bodenmais specimens, having the highest G., give a black powder; and others, of less, a dark reddish-brown, but as a result of partial alteration, Rose.

The angles of the crystals vary considerably. The angles above given are those calculated by Schrauf after a study of the crystals of various localities, adopting for the basis i-$\bar{i}$ ∧ 1-$\breve{3}$=104° 30′ (obs. on Greenland crystals), and i-$\bar{i}$ ∧ i-$\breve{3}$=112° 10′ (112° 20′, obs on Gr. cryst.). The author obtained somewhat different results from a Middletown crystal, f. 429 (this Min., edit. of 1837, et seq., Am. J. Sci., xxxii. 150, 1837): i-$\bar{i}$ ∧ 1-$\breve{3}$=104° 52′; i-$\bar{i}$ ∧ I=140° 40′, whence I ∧ I=100° 40′; i-$\bar{i}$ ∧ i-$\breve{3}$=158° 6′, whence i-$\bar{i}$ ∧ i-$\breve{3}$=111° 54′; O ∧ $\frac{1}{2}$-$\bar{i}$=160° 34′, whence i-$\bar{i}$ ∧ $\frac{1}{2}$-$\bar{i}$=109° 26′; O ∧ 1-$\breve{3}$=136° 36′; O ∧ 2-$\breve{i}$=119° 40′; 1-$\breve{3}$ ∧ 1-$\breve{3}$, adj.,=150° 17′. The angles I ∧ I=100° 40′, O ∧ $\frac{1}{2}$-$\bar{i}$=160° 34′, correspond to the dimensions $a : b : c = 1·0584 : 1 : 1·2059$. Schrauf's measurements gave him for i-$\bar{i}$ ∧ I=140° 30′. fr. Greenland and Bodenmais; i-$\bar{i}$ ∧ $\frac{1}{2}$-$\bar{i}$=108°, fr. B.

The crystals from Bavaria, Miask, Connecticut, Chesterfield, Mass., and Monte Video, have the general form shown in f. 429, 430, though sometimes with the basal plane wanting; while those of Greenland have the habit generally of f. 431 (fr. Schrauf's paper). Occasionally the octahedral planes are very much elongated, producing crystals with long pyramidal summits, as a kind from Acworth, N. H. (Shep., Am. J. Sci., xvii. 358, 1880).

Analyses: 1, Wollaston (Phil. Trans., 1809, 246); 2, Schlieper (Pogg., lxiii 317); 3, H. Rose (ib.); 4, Hermann (J. pr. Ch., xliv. 207); 5, C. F. Chandler (Inaug. Dissert.); 6, Oesten (Pogg., xcix 617); 7, T. S. Hunt (Am. J. Sci., II. xiv. 340); 8, Blomstrand (Mem. Univ. Lund., 1865, J. pr. Ch., xcix. 44); 9–11, H. Rose (l. c.); 12. Avdejef (Pogg., lxiii. 317); 13, Jacobson (ib.); 14, Chandler (l. c.); 15, Warren (Pogg., lxxxv. 438); 16, 17, Blomstrand (l. c.); 18, H. Müller (J. pr. Ch., lviii. 183, lxxix, 27); 19, Hermann (J. pr. Ch., xxxviii. 121); 20, Bromeis (Pogg., lxxi. 157); 21–23, Oesten (l. c.); 24, Hermann (Bull. Soc. Nat. Moscou, xxxix. 67, 1866); 25, Müller (l. c.); 26, Blomstrand (l. c.); 27, Damour (C. R., xxviii. 853); 28, A. Nordenskiöld (Beskrifn. Finl. Min., 1855, 40):

		$\ddot{\bar{\mathrm{C}}}\mathrm{b}$	$\ddot{\bar{\mathrm{T}}}\mathrm{a}$	$\ddot{\mathrm{S}}\mathrm{n}$	$\dddot{\mathrm{W}}$	$\dot{\mathrm{F}}\mathrm{e}$	$\dot{\mathrm{M}}\mathrm{n}$	$\dot{\mathrm{C}}\mathrm{u}$	$\dot{\mathrm{C}}\mathrm{a}$
1.	**Connecticut**	80		—	—	15	5	—	—=100 Wollaston.
2.	**Middletown**	78·83		0·29	—	16·66	4·71	0·07	0·45, $\dot{\mathrm{M}}\mathrm{g}$ 0·22=101·28 Schlieper.
3.	"	79·62		0·47	—	16·37	4·44	0·06	*tr.*=100·96 Rose.
4.	"	78·22		0·4	0·26	14·06	5·63	—	—, $\dot{\mathrm{M}}\mathrm{g}$ 0·49=99·06 Hermann.
5.	"	76·79		0·60	—	18·23	3·14	—	0·48=99·24 Chandler.
6.	"	79·80		0·56	—	15·00	4·50	—	—=99·86 Oesten.
7.	**Haddam**	80·60		*tr.*	—	15·57	3·25	0·50	—=99·92 Hunt.
8.	"	51·53	28·55	0·34	0·76	13·54	4·55	—	—, $\ddot{\mathrm{Z}}\mathrm{r}$ 0·34, $\dot{\mathrm{M}}\mathrm{g}$ 0·42, $\dot{\mathrm{H}}$ 0·16=100·19 B
9.	**Bodenmais**	81·07		0·45	—	14·30	3·85	0·13	*tr.*=98·80 Rose.
10.	"	81·34		0·19	—	13·89	3·77	0·10	*tr.*=99·29 Rose.
11.	"	79·68		0·12	—	15·10	4·65	0·12	*tr.*=99·67 Rose.
2.	"	80·64		0·10	—	15·33	4·65	—	0·21=100·93 Avdejef.
13.	"	79·78		0·10	—	14·77	4·77	1·51	—=100·89 Jacobson.
4.	"	75·02		0·47	0·39	17·22	3·59	—	0·22=96·91 Chandler.
5.	"	78·51		0·03	1·47	15·77	2·31	—	0·30, $\dot{\mathrm{M}}\mathrm{g}$ 1·57=99·96 Warren.
6.	"	56·43	22·79	0·58	1·07	15·82	2·39	—	—, $\ddot{\mathrm{Z}}\mathrm{r}$ 0·28, $\dot{\mathrm{M}}\mathrm{g}$ 0·40, $\dot{\mathrm{H}}$ 0·35=100·11 B
7.	"	48·87	30·58	0·91		15·70	2·95	—	—, $\dot{\mathrm{M}}\mathrm{g}$ 0·14, $\dot{\mathrm{H}}$ 0·40=99·55 Bl.
8.	**Tirschenreuth**	78·6		0·17	—	15·1	5·2	—	—=99·07 Müller.
9.	**Ilmen Mts.**	80·47		—	—	8·50	6·09	$\dot{\mathrm{M}}\mathrm{g}$2·44	—, $\dot{\mathrm{Y}}$ 2·0, $\dot{\mathrm{U}}$ 0·50=100 Herm
0.	"	78·60		—	—	12·76	4·48	$\dot{\mathrm{M}}\mathrm{g}$3·01	0·75, $\dot{\mathrm{U}}$ 0·56=100·17 Bromeis.
1.	"	76·66		0·42	—	14·29	[7·55]	—	0·54, $\dot{\mathrm{U}}$ 0·54=100 Oesten.
2.	**Greenland**	76·04		0·39	—	16·91	4·34	—	0·54=98·22 Oesten.
3.	"	77·80		0·17	—	16·52	4·95	—	0·39=99·83 Oesten.

	C̈b	T̈a	S̈n	Ẅ	Ḟe	Ṁn	Ċu	Ċa
24. Greenland	52·76	25·64*	—	—	16·41	4·50	—	—, Ṁg 0·60=99·91 Hermann.
25. " Evigtok	78·74		0·16	—	16·40	5·12	—	—=100·42 Müller.
26. "	77·97		0·73	0·13	17·33	3·28	—	*tr.*, Z̈r 0·13, Ṁg 0·23, Ṗb 0·12=99·92 B
27. Chanteloube	78·74		—	—	14·50	7·17	—	—=100·41 Damour.
28. Björkskär, Finl.	82·5		1·0	—	13·2	5·5	—	—=102·2 Nordenskiöld.

* Ilmenic acid of Hermann.

Wollaston's analysis was made on four grains of the original specimen in the British Museum, sent out from Connecticut by Governor Winthrop to Sir Hans Sloane.

Pyr., etc.—Like tantalite. Von Kobell states that when decomposed by fusion with caustic potash, and treated with muriatic and sulphuric acids, it gives, on the addition of zinc, a blue color much more lasting than with tantalite; and the variety dianite, when similarly treated, gives on boiling with tin-foil, and dilution with its volume of water, a sapphire-blue fluid, while, with tantalite and ordinary columbite, the metallic acid remains undissolved. The variety from Haddam, Ct., is partially decomposed when the powdered mineral is evaporated to dryness with concentrated sulphuric acid, its color is changed to white, light gray, or yellow, and when boiled with muriatic acid and metallic zinc it gives a beautiful blue. The remarkably pure and unaltered columbite from Arksut-fiord in Greenland is also partially decomposed by sulphuric acid, and the product gives the reaction test with zinc, as above.

Obs.—Occurs at Rabenstein, Bavaria, near Zwiesel, not far from Bodenmais, in granite, with iolite and magnetite; at Tirschenreuth, Bavaria; at Tammela, in Finland; at Chanteloube, near Limoges, in pegmatite with tantalite; near Miask, in the Ilmen Mts., with samarskite; at Hermanskär, near Björskär, in Finland; in Greenland, in cryolite, at Evigtok, in brilliant crystals; disseminated through or among the wolfram of Auvergne, and detected by acting with aqua-regia, which dissolves the wolfram and leaves untouched the columbite (Phipson, Chem. News, 1867, 160); at Monte Video, S. A.

In the United States, at Haddam, 2 m. from the village, in a granite vein, some of the crystals several pounds in weight; also at the chrysoberyl locality, but not now accessible; also at the iolite locality, Haddam; near Middletown, in the "feldspar" or "china-stone quarry," with albite, abundant in fine crystals some very large; figure 429 represents one ¾ in. long; another, described by Professor Johnston (Am. J. Sci, **xxx.** 387), weighed, before it was broken, 14 pounds; and the part figured about 6 in. in length and breadth, weighed 6 lbs. 12 oz.; it exhibits the faces *i-ī*, *i-ĭ*, *i-2̆*, *I*, *i-3̆*, ⅓-*ī*, and another imperfect plane, which appears to be 1-3̆. At Chesterfield, Mass., some fine crystals, associated with blue and green tourmalines and beryl, in a vein of albitic granite; Acworth, N. H.; also Beverly, Mass.; Northfield, Mass., with beryl; Plymouth, N. H., with beryl; Greenfield, N. Y., with chrysoberyl.

The Connecticut crystals are usually rather fragile from partial change; while those of Greenland are very firm and hard.

The occurrence of columbite in America was first made known by Mr. Hatchett's examination of a specimen sent by Governor Winthrop to Sir Hans Sloane, then President of the Royal Society, which was labelled as found at Neatneague. Dr. S. L. Mitchill stated (Med. Repos., vol. viii.) that it was taken at a spring at New London, Conn. No locality has since been detected at that place. But the rediscovery of it at Haddam, first published by Dr. Torrey (Am. J. Sci., iv. 52), and since near Middletown, about 7 m. distant, has led to the belief that the original locality was at one of these places, which are about 30 m. W. of New London.

For recent papers on cryst. see Descl., Ann. d. M., V. viii. 395; Schrauf, Ber. Ak. Wien, xliv. 445, 1861; Maskelyne, Phil. Mag., IV. xxv. 41. The crystallographic identity of the American mineral with the Bavarian was first shown by Dr. J. Torrey (Ann. Lyc. N. Y., i. 89, 1824).

The metal of columbite was named columbium by Hatchett in 1802, from Columbia, a name of America, whence his specimen was received, and thus came the name *columbite* given by Jameson and Thomson (see further under tantalite). Rose, after investigating the metal and its compounds, named it anew, calling it *niobium*, and this gave rise to the name *niobite*. *Baierite* is from the German name of Bavaria. *Torrelite* Thomson, named after Dr. J. Torrey, is the ordinary Middletown columbite: and *Greenlandite* Breith., is that from Greenland; both names originated partly in erroneous views of the crystals of the minerals. *Dianite* is the Bodenmais columbite, in which v. Kobell supposed he had discovered the acid of a new metal, which he called *dianium*.

No good reason has been given for substituting *niobium* for *columbium;* and yet most English chemists, as well as European, have thus far followed Rose in rejecting the name given by the English discoverer. The rule of priority demands recognition.

475. TAPIOLITE. Tapiolit *A. E. Nordenskiöld*, Œfv. Ak. Stockh., 443, 1863. Tantalite (f
Sukula) *Arppe*, Act. Soc. Sci. Fenn., vi. 590, 1861.

Tetragonal. $O \wedge 1\text{-}i = 147°\ 7'$; $a = 0{\cdot}6464$. $1 \wedge 1$ in same pyramid $123°\ 1'$, over base $84°\ 52'$; $O \wedge 1 = 137°\ 34'$; $1 \wedge 1\text{-}i = 151°\ 30'$. Cleavage indistinct.

H.=6. G.=7·35—7·37, Nord.; 7·17—7·36, Arppe. Lustre strong adamantine, approaching metallic. Color pure black.

Comp.—$\dot{F}e^5 \dddot{T}a^4$=Tantalic acid 83·1, protoxyd of iron 16·9=100. Analyses: 1, Arppe (l. c.) 2, Nordenskiöld (l. c.):

	$\dddot{T}a$	$\ddot{S}n$	$\dot{F}e$
1. Sukula	(½) 83·18	0·82	15·77=99·77 Arppe.
2. "	(½) 83·06	1·07	15·78=99·91 Nordenskiöld. *Tr.* of $\dddot{W}$ with $\ddot{S}n$.

Pyr., etc.—B.B. behaves like tantalite, but gives no reaction for manganese.

Obs.—Occurs near the Kulmala farm, in the village of Sukula, in the parish of Tammela, Finland, in white pegmatyte granite, with beryl, tourmaline, and arsenopyrite.

Named from an ancient Finnish divinity.

476. HIELMITE. Hjelmit *A. E. Nordenskiöld*, Pogg., cxi. 286, 1860.

Crystallization indistinct. Massive, without apparent cleavage.

H.=5. G.=5·82. Lustre metallic. Color pure black. Streak grayish-black. Fracture granular.

Comp.—A stanno-tantalate of iron, uranium, and yttria. Analysis: Nordenskiöld (l. c.):

$\dddot{T}a$	$\ddot{S}n$, $\dddot{W}$	$\dot{C}u$	$\dot{U}$	$\dot{F}e$	$\dot{M}n$	$\dot{C}e$	$\dot{Y}$	$\dot{M}g$	$\dot{C}a$	$\dot{H}$
62·42	6·56	0·10	4·87	8·06	3 32	1·07	5·19	0·26	4·26	3·26=99·37.

Pyr., etc.—In the closed tube decrepitates and yields water. B.B. infusible, but turns brown in O.F. With salt of phosphorus easily dissolved to a bluish-green glass. With borax dissolves to a clear glass, which remains unchanged on flaming. With soda on charcoal gives metallic spangles (Nordenskiöld).

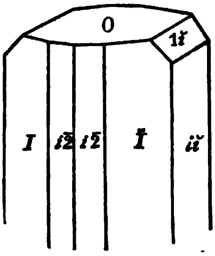
Obs.—From the Kararfvet mine, near Fahlun, Sweden, along with garnet, pyrophysalite, gadolinite, asphaltum, in a pegmatyte granite.

477. YTTROTANTALITE. Yttrotantal *Ekeberg*, Ak. H. Stockh., xxiii. 80, 1802. Tantale oxidé yttrifère *H.*, Tr., 1822. Yttroilmenit *Herm.*, J. pr. Ch., xxxviii. 119, 1846.

Orthorhombic. $I \wedge I = 123°\ 10'$; $O \wedge 2\text{-}\bar{i} = 103°\ 26'$; $a : b : c = 2{\cdot}0934 : 1 : 1{\cdot}8482$. Observed planes: O; vertical, $i\text{-}\breve{i}$, I, $i\text{-}2$, $i\text{-}\breve{2}$, $i\text{-}\breve{5}$; domes, $1\text{-}\breve{i}$, $2\text{-}\bar{i}$. $O \wedge 1\text{-}\breve{i} = 131°\ 26'$, $i\text{-}\breve{i} \wedge 1\text{-}\breve{i} = 138°\ 34'$, $i\text{-}\breve{i} \wedge I = 118°\ 25'$, $i\text{-}\breve{i} \wedge i\text{-}\breve{2} = 137°\ 16'$, $i\text{-}\breve{i} \wedge i\text{-}2 = 105°\ 9'$, $i\text{-}\breve{2} \wedge i\text{-}\breve{2}$, ov. $i\text{-}\breve{i}$, $= 94°\ 32'$, $i\text{-}\breve{2} \wedge i\text{-}2$, adj., $= 149°\ 42'$, $i\text{-}\breve{i} \wedge i\text{-}\breve{5} = 159°\ 43'$. Crystals often tabular parallel to $i\text{-}\breve{i}$. Also massive; amorphous.

H.=5—5·5. G.=5·4—5·9. Lustre submetallic to vitreous and greasy. Color black, brown, brownish-yellow, straw-yellow. Streak gray to colorless. Opaque to subtranslucent. Fracture small conchoidal to granular.

432



Ytterby.

Var.—1. The *black* yttrotantalite, of Ytterby, is iron-black, submetallic in lustre, and has G.=5·395, Berz.; 5·67, Peretz; after ignition 6·40, Peretz; 7·09, Nordenskiöld. Often in crystals.

2. The *yellow* of Ytterby is amorphous or indistinctly crystallized, and has G.=5·882, Ekeberg; ·458, Chandler; after ignition, 6·40, Peretz; 5·845, Chandler. 3. The *yellow* from Kararfvet as G.=5·640, Chydenius. This variety contains much uranium.

Hermann calls the mineral of anal. 5, 6, 7, *yttrotantalite*, and that of his own analysis *yttroilmenite*, giving G.=4·88.

Comp.—Tantalate of yttria and lime, or yttria, lime, and iron, with some protoxyd of uranium; $(\dot{\text{Y}}, \dot{\text{Fe}}, \dot{\text{Ca}}, \dot{\text{U}})^{10}\dddot{\text{Ŧa}}^{3}=$, if $\dot{\text{Y}} : \dot{\text{Ca}} : \dot{\text{Fe}} : \dot{\text{U}} = 6 : 2 : 1 : 1$, Tantalic acid 62·5, yttria 22·6, lime 5·2, protoxyd of iron 3·4, prot. uranium 6·3=100. Analyses: 1–4, Berzelius (Afhandl., iv. 268, 27, Schw. J., xvi. 451); 5, Peretz (Pogg., lxxii. 155); 5A, same, with 4·86 $\dot{\text{Ħ}}$, the mean loss by ignition (Ramm. Min. Ch., 400); 6, Chandler (Inaug. Dissert.); 7, Potyka (Inaug. Dissert.); 8, Nordenskiöld (Pogg., cxi. 280); 9, J. J. Chydenius (ib., 284); 10–12, Hermann (Bull. Soc. Nat. Mosc., xxxviii. 358);

			$\dddot{\text{Ŧa}}$	$\dddot{\text{W}}$	$\ddot{\text{Sn}}$	$\dot{\text{U}}$	$\dot{\text{Y}}$	$\dot{\text{Fe}}$	$\dot{\text{Mg}}$	$\dot{\text{Ca}}$	$\dot{\text{Cu}}$	$\dot{\text{Ħ}}$		
1.	Ytterby,	*yellow*	60·12	1·04	——	$\ddot{\text{Ʉ}}$ 6·62	29·78	$\dddot{\text{F̶e}}$ 1·16	——	0·50	——	——	=99·22	Berz.
2.	“	“	59·50	1·25	——	“ 3·23	29·90	“ 2·72	——	3·29	——	——	=99·89	Berz.
3.	“	*black*	57·00	8·25	——	“ 0·50	20·25	“ 3·50	——	6·25	——	——	=95·75	Berz.
4.	“	*brnh.-bk.*	51·82	2·59	——	“ 1·11	38·52	“ 0·55	——	3·26	——	——	=97·85	Berz.
5.	“	*black*	58·65	0·60	——	“ 3·94	21·25	6·29	1·40	7·55	0·40	——	=100·08	Per.
5A.	“	“	55·80	0·57	——	3·75	20·22	5·96	1·38	7·18	0·40	4·86	=100·07	Per.
6.	“	*yellow*	57·27	1·85	0·10	5·10	18·64	4·82	0·75	4·78	0·69	6·00	=100	Chandl.
7.	“	“	55·60	0·49	0·10	7·00	25·52	0·77	0·19	3·60	0·43	4·11	=99·67	Pot.
8.	“	*black*	56·56	3·87	——	0·82	19·56	8·90	——	4·27	*tr*	6·68	=100·66	N.
9.	Kararfvet,	*brown*	56·44	——	$\dot{\text{Zn}}$ 0·42	1·19	30·43	3·27	——	2·27	0·27	4·83	=99·12	Chyd.

		$\dddot{\text{Ŧa}}$[a]	$\ddot{\text{Cb}}$[b]	$\ddot{\text{Ti}}$	$\ddot{\text{Th}}$	$\dot{\text{U}}$	$\dot{\text{Y}}$	$(\dot{\text{Ce}}, \dot{\text{La}}, \dot{\text{Di}})$	$\dot{\text{Fe}}$	$\dot{\text{Mn}}$	$\dot{\text{Mg}}$	$\dot{\text{Ca}}$	$\dot{\text{Ħ}}$		
10.	Ytterby	61·33		1·50	——	5·64	19·74	*tr.*	8·06	1·00	——	2·08	1·66	=101·01	H.
11.	“	57·81		5·00	——	1·87	18·30	2·27	13·61	0·33	——	0·50	——	=100·59	H.
12.	“	31·29	23·80	3·00	2·83	3·01	21·03	2·48	11·07	0·26	0·80	——	——	=99·57	H.

[a] Hermann's ilmenic acid. [b] Niobous acid of Hermann.

Blomstrand has found 16 p. c. of columbic acid in the yellow yttrotantalite; he regards Hermann's ilmenic acid as having no existence. Marignac confirms this statement, and has shown ilmenic acid (G. 3·8) to be columbic acid mixed with titanic acid, while his "niobic" acid (G.=5) contained tantalic acid. In anal. 1, 2, 4·64 p. c. of $\dot{\text{Ħ}}$ were found, and in 3, 5·43.

Pyr., etc.—In the closed tube yields water, the black varieties turn yellow. On intense ignition both varieties become white and give off traces of fluorine. B.B. infusible. With salt of phosphorus dissolves with at first a separation of a white skeleton of tantalic acid, which with a strong heat is also dissolved; the black variety from Ytterby gives a glass faintly tinted rose-red from the presence of tungstic acid; the dark and yellow varieties give a faint green bead on cooling, due to the presence of uranium. The mineral from Finbo and Kararfvet gives an iron glass. With soda reacts for manganese. With soda and borax on charcoal gives traces of metallic tin (Berzelius). Not decomposed by acids. Decomposed on fusion with bisulphate of potash, and when the product is boiled with muriatic acid metallic zinc gives a pale blue color to the solution which soon fades.

Obs.—Occurs in Sweden at Ytterby, near Vaxholm, in red feldspar; at the Kararfvet mine, and at Finbo and Broddbo, near Fahlun, imbedded in quartz and albite, associated with garnet, mica, and pyrophysalite.

On cryst. see A. E. Nordenskiöld, Œfv. Ak. Stockh., 1860, 28, cited in Pogg., cxi. 280, and J. pr. Ch., lxxxi. 193.

The name *yttrotantalite* alludes to the composition. *Yttroilménite* was given to a variety by Hermann upon the discovery in it of his *supposed* new metal ilmenium.

478. SAMARSKITE. Uranotantal *H. Rose*, Pogg., xlviii. 555, 1839. Samarskit *H. Rose*, Pogg., lxxi. 157, 1847. Uranoniobit *H. Rose*, Pogg., lxxi. 166, 1847. Yttroilmenit *Herm.*, xlii. 129, 1847, J. pr. Ch., xliv. 216, 1848.

Orthorhombic. Angle of prism *i*-2, 135° to 136° (whence $I \wedge I$=100° 40′ to 101° 40′, near that of columbite). Usually in flattened grains.

H.=5·5—6. G.=5·614—5·75; 5·45—5·69, North Carolina. Lustre of surface of fracture shining and submetallic. Color velvet black. Streak dark reddish-brown. Opaque. Fracture subconchoidal.

Comp.—Analyses: 1, 2, 3, Peretz, under the direction of Rose (Pogg., lxxi. 157); 4, Chandler (Inaug. Dissert.); 5, Hermann (J. pr. Ch., l. 178); 6, T. S. Hunt (Am. J. Sci., II. xiv. 341):

	$\ddot{\mathrm{C}}\mathrm{b}$	$\ddot{\mathrm{W}}$	$\mathrm{U}(\bar{\mathrm{U}}?)$	$\dot{\mathrm{F}}\mathrm{e}$	$\dot{\mathrm{Y}}$	$\dot{\mathrm{M}}\mathrm{g}$	$\dot{\mathrm{C}}\mathrm{a}, \dot{\mathrm{M}}\mathrm{n}$
1. Miask	56·38		14·16	15·43	9·15	0·80	0·92=96·84 Peretz.
2. "	56·00		16·70	15·90	11·04	0·75	1·02=101·41 Peretz.
3. "	55·91		16·77	15·94	8·36	0·75	1·88=99·61 Peretz.
4. "	55·10	0·48	19·22	15·05	4·91	0·26	1·00, $\ddot{\mathrm{S}}\mathrm{n}$ 0·26, $\dot{\mathrm{C}}\mathrm{u}$ 0·07=96·85 Chandler
5. "	56·36		$\bar{\mathrm{U}}$ 16·63	8·87	13·29	0·50, $\dot{\mathrm{C}}\mathrm{e}$, $\dot{\mathrm{L}}\mathrm{a}$ 2·85, $\dot{\mathrm{M}}\mathrm{n}$ 1·20, ign. 0·33=100·03 H.	
6. N. Carolina	54·81		" 17·03	14·07	11·11, $\dot{\mathrm{C}}\mathrm{e}$, $\dot{\mathrm{L}}\mathrm{a}$ 3·95, ign. 0·24=101·21 Hunt.		

Later Finkener and Stephans have obtained from the Miask mineral (H. Rose in Verh. Min St. Pet., 1863, 13):

$\ddot{\mathrm{C}}\mathrm{b}$	$\ddot{\mathrm{W}}$	$\bar{\mathrm{U}}$	$\ddot{\mathrm{Z}}\mathrm{r}$	$\ddot{\mathrm{S}}\mathrm{n}$	$\ddot{\mathrm{T}}\mathrm{h}$	$\dot{\mathrm{F}}\mathrm{e}$	$\dot{\mathrm{M}}\mathrm{n}$	$\dot{\mathrm{C}}\mathrm{u}$	$\dot{\mathrm{C}}\mathrm{e}$	$\dot{\mathrm{Y}}$	$\dot{\mathrm{M}}\mathrm{g}$	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\mathrm{H}}$
47·47	1·36	11·60	4·35	0·5	6·05	11·02	0·96	0·25	3·31	12·61	0·14	0·78	0·45=100·55
50·17		11·08	4·25	0·63	5·55	10·55	1·60	—	15·90		0·04	0·64	0·40=100·82

Giving for the O. ratio between the $\ddot{\mathrm{C}}\mathrm{b}$ [$+\ddot{\mathrm{W}}$] and the other ingredients 9·49 : 9·65=1 : 1, whence the general formula $(\dot{\mathrm{R}}^3, \bar{\mathrm{R}}, \ddot{\mathrm{R}}^{\frac{3}{2}})^6\ \ddot{\mathrm{C}}\mathrm{b}^3$.

Pyr., etc.—In the closed tube decrepitates, glows like gadolinite, cracks open, and turns black, and is of diminished density. B.B. fuses on the edges to a black glass. With borax in O.F. gives a yellowish-green to red bead, in R.F. a yellow to greenish-black, which on flaming becomes opaque and yellowish-brown. With salt of phosphorus in both flames an emerald-green bead. With soda yields a manganese reaction. Decomposed on fusion with bisulphate of potash, yielding a yellow mass which on treatment with dilute muriatic acid separates white tantalic acid, and on boiling with metallic zinc gives a fine blue color. Samarskite in powder is also sufficiently decomposed on boiling with concentrated sulphuric acid to give the blue reduction test when the acid fluid is treated with metallic zinc or tin.

Obs.—Uranotantalite occurs in reddish-brown feldspar, with crystallized æschynite, in the Ilmen mountains, near Miask in the Ural. The largest pieces met with were of the size of hazel-nuts.

If the occurring prism of Samarskite is *i*-3̆ instead of *i*-2 (as in mengite), then *I* ∧ *I* becomes 100° 57′ to 102° 20′.

Named after the Russian, v. Samarski.

479. EUXENITE. Euxenit *Scheerer*, Pogg., l. 149, 1840, lxxii. 566.

Orthorhombic. Form a rectangular prism (*i*-ī, *i*-ĭ) with lateral edges eplaced by *I*, and a pyramid at summit, also with a macrodome *m*-ī. ∧ *I*=126°, *i*-ī ∧ *m*-ī=154° 30′, *i*-ī ∧ pyramid=107°, Dahl; *I* ∧ *I*=120°?, -ī ∧ *m*-ĭ=153°, *i*-ĭ ∧ *m*-ĭ=124°, *i*-ī ∧ pyr.=136°, Greg; prism of 141°, nacrodome of 59° 15′, Breith. Cleavage none. Commonly massive.

H.=6·5. G.=4·60, Jölster, Scheerer; 4·73—4·76, Tvedenstrand, id.; ·94—4·99, ib., Breith.; 4·89—4·99, Alve, Forbes; 4·96, Chydenius. ustre brilliant, metallic-vitreous, or somewhat greasy. Color brownish-lack; in thin splinters a reddish-brown translucence lighter than the treak. Streak-powder yellowish to reddish-brown. Fracture subconhoidal.

Comp.—A columbo-tantalate, containing titanic acid, yttrium, and uranium. O. ratio for $\dot{\mathrm{R}}$, $\ddot{\mathrm{T}}\mathrm{i}$, b+$\ddot{\mathrm{T}}\mathrm{a}$= (from mean of anal. 3, 4) 8 : 6 : 7; and if the titanic is basic, the ratio for the bases and b+$\ddot{\mathrm{T}}\mathrm{a}$ is 2 : 1, which would give the formula $(\dot{\mathrm{R}}^2, \ddot{\mathrm{T}}\mathrm{i})^6(\ddot{\mathrm{C}}\mathrm{b}, \ddot{\mathrm{T}}\mathrm{a})$. If $\ddot{\mathrm{T}}\mathrm{i}$ is acid, the ratio is 8 : 13. ermann makes it isomorphous and similar in formula with æschynite. Analyses: 1, 2, Scheerer c.); 3, Forbes & Dahl (Ed. N. Phil. J., II. i. 62); 4, Strecker (J. pr. Ch., lxiv. 384); 5, Chynius (Bull. Soc. Ch., vi. 434, 1866):

	$\ddot{\mathrm{C}}\mathrm{b}, \ddot{\mathrm{T}}\mathrm{a}$	$\ddot{\mathrm{T}}\mathrm{i}$	$\bar{\mathrm{A}}\mathrm{l}$	$\dot{\mathrm{U}}$	$\dot{\mathrm{F}}\mathrm{e}$	$\dot{\mathrm{C}}\mathrm{e}$	$\dot{\mathrm{L}}\mathrm{a}$	$\dot{\mathrm{Y}}$	$\dot{\mathrm{M}}\mathrm{g}$	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\mathrm{H}}$
Jölster	49·66	7·94	—	6·34	—	2·18	0·96	25·09	0·29	2·47	3·97 Scheerer.
Tvedenstrand	53·64		—	7·58	2·60	2·91		28·97	—	—	4·04=99·74 Scheerer.
Alve	38·58	14·36	8·12	5·22	1·98	3·31	—	29·36	0·19	1·37	2·88=100·37 F. & D.
Tromoen	87·16	16·26	—	8·45	8·03		26·46		—	5·25	2·68=100·39 Strecker.
Arendal	54·28		—	—	—	$\ddot{\mathrm{T}}\mathrm{h}$ 6·28		34·58	—	—	2·60=97·74 Chydenius.

The Jölster euxenite contains the most titanic acid; yet Scheerer does not doubt the identity of the two minerals.

Chydenius has shown that the mineral contains thoria, and only traces of oxyd of cerium. Marignac (Bib. Univ., xxv. 29, 1866) found 52·23 of metallic acid, consisting of about 32·5 p. c. of $\ddot{\mathrm{Cb}}$ and 29·7 of titanic, the ratio of the two being stated at 268 : 243.

Pyr., etc.—B.B. infusible. Dissolves in borax and salt of phosphorus, giving a yellow bead while hot; with salt of phosphorus shows a yellowish-green (uranium reaction) on cooling, if sufficiently saturated (Scheerer). When decomposed by fusion with caustic potash, and subsequently treated with water, and this solution neutralized with muriatic acid, it gives a precipitate, which, boiled with concentrated muriatic acid and tin-foil, gives a clear sapphire-blue fluid, which changes to an olive-green, and finally bleaches. If the residue of the fusion after leaching is treated with muriatic acid and boiled with tin-foil, it yields on dilution a pale rose-red color (v. Kobell). The mineral is sufficiently attacked, on evaporation with sulphuric acid, to give a whitish residue, which, treated with metallic zinc or tin, affords the characteristic blue reduction test.

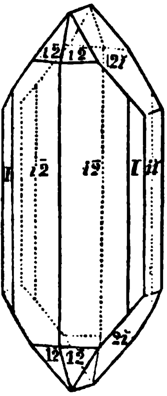
Obs.—Occurs at Jölster in Norway, imbedded in feldspar and sometimes in scaly mica, the largest crystals 2 in. long and ½ in. wide, but usually much smaller; also near Tvedenstrand; at Alve, island of Tromoen, near Arendal; at Mōretjär, near Naskilen.

Named by Scheerer from εὔξενος, *a stranger*, in allusion to the rarity of its occurrence.

480. ÆSCHYNITE. *Æschynit Berz.*, Jahresb., ix. 195, 1828.

Orthorhombic. *I* ∧ *I*=91° 34½′, *O* ∧ 1-ĭ=145° 18′. Kokscharof; *a* : *b* : *c* =0·69244 : 1 : 1·0279. Observed planes: *O* (not common); vertical, *i*-2̆, *I*, *i*-ĭ; brachydome, 2-ĭ; octahedral, 1-2̆. Crystals usually long prismatic and striated. Cleavage: *i*-ĭ in traces, or none; none observable according to Kokscharof.

438



i-2̆ ∧ *i*-2̆=128° 6′
i-2̆ ∧ *i*-ĭ=115 57
I ∧ *i*-ĭ=134 13½
2-ĭ ∧ 2-ĭ, top,=73 10
2-ĭ ∧ *i*-ĭ=143° 25′
1-2̆ ∧ 1-2̆, adj.,=136 56½
i-2̆ ∧ 1-2̆=146 60
2-ĭ ∧ 1-2̆=128 16

H.=5—6. G.=4·9—5·14; 5·118, Miask, Kokscharof. Lustre submetallic—resinous, nearly dull. Color nearly black, inclining to brownish-yellow when translucent. Streak gray, or yellowish-brown, almost black. Subtranslucent—opaque. Fracture small subconchoidal.

Comp.—Doubtful. The mineral described by Berzelius and analyzed by Hartwall differs much in the pyrognostic and other characters given from that from the same locality investigated by Hermann, and the identity of the two is not yet certain. Scheerer found no zirconia. Analyses: 1, Hartwall (Pogg., **xvii.** 48; Jahresb., ix. 195); 2–4, Hermann (J. pr. Ch., **xxxi.** 89, **xxxvii.** 116, l. 170, lxviii. 97); 5, id. (Bull. Soc. Nat. Moscou, xxxviii. 472, J. pr. Ch., xcix. 288); 6, id. (Bull. Soc. Nat. Moscou, **xxxix.** 55, 1866):

	$\dddot{\mathrm{Ta}}$,$\ddot{\mathrm{Cb}}$	$\ddot{\mathrm{Ti}}$	$\ddot{\mathrm{Zr}}$	$\ddot{\mathrm{Sn}}$	$\ddot{\mathrm{Th}}$	$\dot{\mathrm{Fe}}$	$\bar{\mathrm{Ce}}$	$\dot{\mathrm{Ce}}$	$\dot{\mathrm{La}}$	$\dot{\mathrm{Y}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{H}}$
1.	——	56·0	20·0	0·5	——	——	15·0	——	——	——	3·8	——, $\ddot{\mathrm{Fe}}$ 2·6=97·9 B
2.	33·39	11·94?	17·52	——	——	17·65	——	2·48	4·76	9·35	2·40	1·56=101·05 Herm
3.	35·05	10·56?	17·58	——	——	4·32	——	15·59	11·13	4·62	——	1·66=100·51 Herm
4.	33·20	25·90	——	——	——	5·45	22·20	5·12	6·22	1·28	——	1·20=100·57 Herm
5.	32·30[a]	15·05	——	——	22·91	6·00		15·96[c]		5·30	1·50	1·70=100·72 Herm
6.	33·59[b]	16·12	——	——	22·57	5·58		14·36[c]		4·30	2·16	1·50=100·18 Herm

[a] Made 29·00 ilmenic acid (or, later, 12·28 ilmenic, and 16·72 ilmenous acid) plus 8·30 niobous acid.

[b] Made 30·16 ilmenic acid plus 3·43 niobous acid.

[c] Ce O, La O, Di O.

Hermann's analyses afford for the O. ratio of bases, $\ddot{\mathrm{Ti}}$, $\ddot{\mathrm{Cb}}$+$\dddot{\mathrm{Ta}}$ 7·9 : 6 0 : 8·2, as deduced by him, or 13·9 : 8·2 for bases + $\ddot{\mathrm{Ti}}$, and $\ddot{\mathrm{Cb}}$ + $\dddot{\mathrm{Ta}}$. His ilmenic acid is made tantalic and columbic.

Pyr., etc.—In the open tube yields water and traces of fluorine. B.B. in the forceps swells up and changes its color from black to a rusty brown. In borax dissolves easily in O.F., givin a yellow bead while hot, and on cooling becomes colorless; in R.F. with tin gives a blood-red bead. More difficultly soluble in salt of phosphorus; with a small amount of the assay gives a colorless bead, while with a larger quantity there separates a white substance which clouds the bead; in R.F., with tin on charcoal, yields an amethystine glass (Berzelius). Decomposed on fusion with potash; yields reactions similar to those mentioned under euxenite (v. Kobell). It is also sufficiently decomposed by sulphuric acid to show the reduction test with zinc.

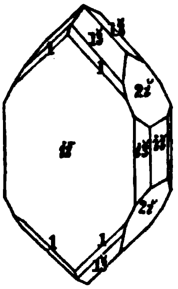
Obs.—From Miask in the Ilmen Mts., in feldspar with mica and zircon; also with euclase in the gold sands of "Kaufmann's Bakakin," in the Orenburg District, Southern Ural.

Named from αἰσχύνη, *shame*, by Berzelius, in allusion to the inability of chemical science, at the time of its discovery, to separate the two unlike substances, titanic acid and zirconia.

On cryst. see Brooke, Phil. Mag., x. 188; Rose, Reis. Ural., ii. 70; Descloizeaux, Ann. d. M. IV ii. 349; Kokscharof, Min. Russl., iii. 384, iv. 53, 100. Rose made $i\text{-}\breve{2} \wedge i\text{-}\breve{2} = 127° 19'$, and $2\text{-}\breve{i} \wedge 2\text{-}\breve{i} = 73° 44'$, which he says are approximations only, the faces being rough. Fig. 433 is by Rose.

481. POLYCRASE. Polykras *Scheerer*, Pogg., lxii. 430, 1844.

434



Orthorhombic. $I \wedge I = 95°$, $O \wedge 1\text{-}\bar{i} = 134° 15'$; $a : b : c = 1{\cdot}02655 : 1 : 1{\cdot}0913$. Observed planes as in the figure.

$O \wedge 2\text{-}\breve{i} = 118° 0'$
$O \wedge 1 = 125 41\frac{1}{2}$
$O \wedge 1\text{-}\breve{3} = 139 59$
$1\text{-}\breve{3} \wedge 1\text{-}\breve{3}$, mac., $= 96 40$
$1\text{-}\breve{3} \wedge 1\text{-}\breve{3}$, brach., $= 152$

$1 \wedge 1$, mac., $= 112° 32'$
$1 \wedge 1$, brach., $= 106 24$
$i\text{-}\breve{3} \wedge i\text{-}\breve{3}$, ov. $i\text{-}\breve{i}$, $= 140$
$i\text{-}\breve{i} \wedge i\text{-}\breve{3} = 160$
$2\text{-}\breve{i} \wedge i\text{-}\breve{i} = 152$

Crystals thin linear. Cleavage none.

H.=5·5. G.=5·09—5·12. Lustre bright. Color black; in splinters brownish. Streak grayish-brown. Fracture conchoidal.

Comp.—According to Scheerer, contains columbic acid, oxyd of uranium, titanic acid, zirconia, oxyd of iron, yttria, and protoxyd of cerium, with a little alumina, and traces of lime and magnesia.

Pyr., etc.—In the closed tube decrepitates, and gives traces of water. B.B. in the forceps glows, and turns to a light grayish-brown color, but is infusible. Soluble in borax, giving in O.F. a clear yellow bead, which in R.F. with tin turns brown. In salt of phosphorus gives a clear yellow glass, which on cooling is greenish; in R.F. the color becomes darker. With soda no reaction for manganese, and on charcoal no metallic particles. Decomposed by evaporation with concentrated sulphuric acid; the product, treated with muriatic acid, gives on boiling with metallic zinc or tin a deep azure-blue solution, which does not fade. The dilute solution gives a deep orange to turmeric paper (zirconia).

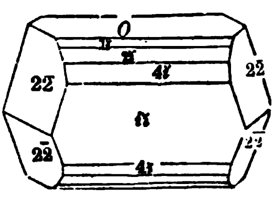
Obs.—From Hitteröe, Norway, in granite with gadolinite and orthite; crystals ½ to 1½ in. long; also near Dresden.

Named from πολύς, *many*, and κρᾶσις, *mixture*.

N. B. Moller makes the so-called polycrase of Brevig certainly, and that of Hitteröe probably, identical with polymignite (J. pr. Ch., lxix. 318). Scheerer mentions a prism of 93° 32′ (B. H. Ztg., xvii. 22), and Breithaupt one of 59° and 121°.

482. POLYMIGNITE. *Berzelius*, Ak. H. Stockh., 338, 1824.

435



Orthorhombic. $I \wedge I = 91° 44'$, $O \wedge 1\text{-}\bar{i} = 144° 3'$; $a : b : c = 0{\cdot}7252 : 1 : 1{\cdot}0308$. Observed planes: O; $1\text{-}\breve{i}$, $2\text{-}\breve{i}$, $4\text{-}\breve{i}$, $i\text{-}\breve{i}$; 2-2.

$O \wedge 1\text{-}\breve{i} = 144° 53'$
$O \wedge 2\text{-}\breve{i} = 125 15$
$O \wedge 2\text{-}2 = 121 49$
$i\text{-}\breve{i} \wedge 4\text{-}\breve{i} = 160 26$
$i\text{-}\breve{i} \wedge 2\text{-}2 = 111 46$

$2\text{-}2 \wedge 2\text{-}2$, mac., $= 136° 28'$
$2\text{-}2 \wedge 2\text{-}2$, brach., $= 99 14$
$2\text{-}2 \wedge 2\text{-}2$, bas., $= 116 22$
$1\text{-}\breve{i} \wedge 1\text{-}\breve{i}$, ov. O, $= 109 46$
$i\text{-}\breve{i} \wedge 1\text{-}\breve{i} = 125 7$

Cleavage: i-$\bar{i}$ and O in traces. Crystals generally slender and thin, and striated longitudinally.

H.=6·5. G.=4·77—4·85. Lustre submetallic but brilliant. Color black. Streak dark brown. Opaque. Fracture perfect conchoidal, presenting, like the surface, a brilliancy almost metallic.

Comp.—According to an analysis by Berzelius (Ak. H. Stockh., ii. 339, 1824), imperfect because of the difficult separation of the titanic acid and zirconia:

$\ddot{\mathrm{T}}\mathrm{i}$ 46·30 $\ddot{\mathrm{Z}}\mathrm{r}$ 14·14 $\bar{\mathrm{F}}\mathrm{e}$ 12·20 $\dot{\mathrm{C}}\mathrm{a}$ 4·20 $\dot{\mathrm{M}}\mathrm{n}$ 2·70 $\bar{\mathrm{C}}\mathrm{e}$ 5·00 $\dot{\mathrm{Y}}$ 11·50=96·04,

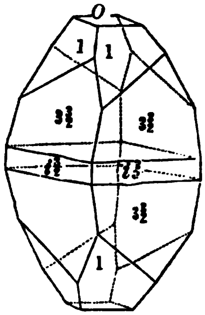
with a trace of potash, magnesia, silica, and oxyd of tin. The blowpipe reactions indicate the probable presence also of *columbic* or *tantalic acid* as an essential constituent (Brush).

Pyr., etc.—B.B. infusible, and unchanged in color. With borax dissolves readily, giving an iron bead; with more of the assay becomes brownish-yellow on flaming, and opaque on cooling; with tin in R.F. turns reddish-yellow. With salt of phosphorus not easily acted upon, gives a reddish tinge in R.F., which is unchanged by tin. With soda shows traces of manganese (Berzelius). The powdered Fredericksvärn mineral, heated with concentrated sulphuric acid, gives a whitish residue, which, treated with muriatic acid and tin-foil, gives a beautiful azure-blue color, indicating, as under polycrase, the presence of some other metallic acid in addition to titanic, which of itself gives only a violet color. The dilute acid solution gives with turmeric paper the orange color characteristic of zirconia.

Obs.—Occurs at Fredericksvärn in Norway, imbedded in feldspar and zircon-syenite. Its crystals sometimes exceed an inch in length. Reported by Shepard as occurring at Beverly, Mass.

483. FERGUSONITE. *Haidinger*, Ed. Phil. Trans., x. 274, 1826.

436.



Tetragonal, hemihedral. $O \wedge 1$-i=124° 20; a=1·464. Observed planes as in the annexed figure. $O \wedge 1$=115° 46′, $1 \wedge 1$=100° 54′, and 128° 28′, 3-$\frac{3}{2}$ $\wedge$ 3-$\frac{3}{2}$=91° 59′, i-$\frac{3}{2}$ $\wedge$ 3-$\frac{3}{2}$=169° 17′. Cleavage: 1, in distinct traces.

H.=5·5—6. G.=5·838, Allan; 5·800, Turner. Lustre externally dull, on the fracture brilliantly vitreous and submetallic. Color brownish-black; in thin scales pale liver-brown. Streak pale brown. Subtranslucent—opaque. Fracture imperfect conchoidal.

Comp., Var.—Varies much in composition, according to the analyses, like other columbium minerals, and probably as a result of alteration. The description above given is from (1) the *Greenland* fergusonite

2. A *mineral from Ytterby*, according to Nordenskiöld, is very similar in its hemihedral crystallization and form, but contains 6 p. c. of water (anal. 3, 4); as pyrochlore is sometimes hydrous this peculiarity may be one of the effects of alteration. It has an imperfect basal cleavage; a vitreous to greasy lustre; a dark brown color; H.=4·5; G.=4·89; and is feebly subtranslucent.

3. *Tyrite* Forbes (Ed. N. Phil. J., i. 67, 1855, and Phil. Mag., IV. xiii. 91) occurs in square pyramidal crystals like those of fergusonite, and sometimes 2 inches long, with occasionally, according to Kenngott, planes corresponding to O, 1, 3, $\frac{3}{2}$, and hemihedral; but with the faces too uneven for exact measurement. It has one cleavage distinct, and traces of two others; color brownish-black; H.=6·5; G.=5·13—5·56, Forbes; 5 555, Kenngott. It contains water, but approaches fergusonite in composition (anal. 5, 6). It is from Hampemyr and Helle, near Arendal, Norway, and the crystals often stand on plates of black mica.

4. A mineral from the Norwegian locality of tyrite, and supposed to be that species (the specimen having been sent as such from Krantz to H. Rose), has been analyzed with still different results by J. Potyka (Pogg., cvii. 590), he finding in it 7 p. c. of potash (anal. 7). It was an irregular mass imbedded in reddish feldspar, had no cleavage, a submetallic lustre, a black color, reddish-brown at the edges in thin splinters, a reddish-brown streak, and H.=4, G.=5·124.

This last mineral, the tyrite, the Ytterby mineral, and fergusonite, may be four distinct species, but it does not appear probable.

5. *Bragite* of Forbes and Dahl, from Helle, Narestö, Alve, and Askerö, Norway, has been referred to fergusonite by J. A. Michaelson (J. pr. Ch., xc. 108). F. & D. describe the mineral as etragonal, with H.=6—6·5; G.=5·13—5·36; color brown; streak yellowish-brown; lustre submetallic; thin splinters translucent; and as losing water when heated; but infusible B.B., and ecoming yellow; and as affording, with salt of phosphorus, a skeleton of silica; characters which uggest a relation to hydrous or altered zircon, where it is placed on p. 276. Michaelson's minral is grayish-brown, has H.=4·5, G.=5·40, and contains no silica (anal. 8).

Analyses: 1, Hartwall (Ak. H. Stockh., 167, 1828); 2, Weber (Pogg., cvii. 190); 3, Nordensiöld (J. pr. Ch., lxxxi. 200); 4, Berzelius (Afh. i. Fys., etc., iv. 251). *Tyrite:* 5, 6, D. Forbes l. c.); 7, Potyka (Pogg., cvii. 590); 8, Michaelson (l. c.):

	C̈b	Ẅ	S̈n	Z̈r	Äl	Ẏ	Ċe	L̇a	U̇	Ḟe	Ċa	Ḣ	
Greenland	47·75	—	1·00	3·02	—	41·91	4·68	—	0·95	0·31	—	—	=99·62 H.
"	48·84	—	0·35	6·93	—	38·61	8·05	—	0·35	1·83	—	—	=99·46 W.
Ytterby	46·33	2·85		—	—	39·80	—	—	1·12	0·70	3·15	6·44	=100·39 N.
"	48·86	2·44		—	—	36·31	—	—	1·01	0·47	3·07	5·71	=97·87 B
Hampemyr, *Tyr.*	44·90	—		*tr.*	5·66	29·72	5·35	—	8·03	6·26	0·81	4·52	=100·25 F.
Helle, "	44·48	—	*tr.*	2·78	8·55	27·83	5·63	1·47	5·99	2·11	1·68	4·66	=100·18 F.
Norway, "	43·49	1·35	0·09	0·80	—	31·90	3·68	—	4·12	1·12	1·95	3·71	K̇ 7·23, Ṗt 0·41, Ċu 0·35=100·20 Pot
Helle, *Bragite?*	48·10	—	—	1·45	—	32·71	C̈e 7·43	—	4·95	1·37	1·82	1·03	Ṁn 0·11. Ṁg 0·39, Ṗb 0·09, Mich.

Weber's analysis gives for the O. ratio of protoxyds, zirconia and tin-oxyd, and columbic acid, ·5 : 1 : 5; and, if the zirconia is basic, for bases and acid nearly 1 : 1=$(\dot{R}^2, \ddot{R})^5\,\ddot{C}b^2$. The tterby mineral also affords very closely the ratio 1 : 1; tyrite about 9 : 11; Potyka's mineral : 9½, or very nearly 1 : 1. Whence all, the water disregarded, may perhaps come under the bove general formula.

Blomstrand finds 5 p. c tantalic acid in the Ytterby mineral.

Pyr., etc.—Fergusonite from Greenland gives in the closed tube a little water. B.B. infusible; charcoal its color becomes pale yellow. With borax dissolves with difficulty, giving a yellow ead while hot, the insoluble portion being white; the saturated bead is yellowish-red, and is ade opaque by flaming. Slowly dissolved by salt of phosphorus, leaving a white insoluble resie; in O.F. the bead is yellow, while in R.F. it is colorless, or, if saturated, slightly reddish, beming opaque on cooling; treated with tin the bead remains uncolored, while the insoluble residue made flesh-red. Decomposed by soda without dissolving, leaving a reddish slag; with soda on arcoal affords globules of metallic tin (Berzelius). When evaporated with sulphuric acid yields white residue, which, treated with muriatic acid and metallic zinc, gives a bluish-green color. yrite decrepitates and yields much water in the closed tube (Forbes).

Obs.—Fergusonite was discovered by Giesecké, near Cape Farewell in Greenland, disseminated quartz, and named after Robert Ferguson of Raith. Also found at Ytterby, Sweden, as mened above.

Tyrite is associated with euxenite at Hampemyr on the island of Tromoe, and Helle on the mainnd; at Næskul, about ten miles east of Arendal.

484. ADELPHOLITE. Adelfolit *N. Nordenskiöld*, Beskrifn. Finl. Min., 1855, Jahrb. Min., 313, 1858; *A. E. Nord.*, Pogg., cxxii. 615, 1864.

Tetragonal. Angles undetermined.

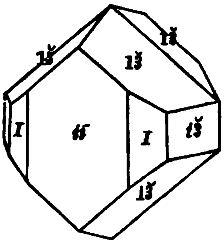
H.=3·5—4·5. G.=3·8. Lustre greasy. Color brownish-yellow to brown and black. Streak ite or yellowish-white. Subtranslucent.

A columbate of iron and manganese, containing 41·8 p. c. of metallic acids, and 9·7 p. c. of ter. From Laurinmäki in Tammela, Finland, with columbite.

5. MENGITE. Ilmenite *Brooke* Phil. Mag., x. 187, 1831. Mengit *G. Rose*, Reis. Ural, ii. 83, 1842.

Orthorhombic. $I \wedge I=100°\ 28'$, $O \wedge 1\text{-}\bar{i}=133°\ 42'$; $a : b : c=1·0463 : 1·2071$.

437



O ∧ 1-ĭ=136° 50′   *i*-ĭ ∧ *i*-ĭ, adj.,=136° 20′
I ∧ *i*-ī=140 14   1-ĭ ∧ 1-ĭ, mac.,=151 26
i-ī ∧ *i*-ĭ=111 50   1-ĭ ∧ 1-ĭ, brach.,=101 10

Occurs in short prisms, often terminated by four sided pyramids. No distinct cleavage.

H.=5–5·5. G.=5·48. Lustre submetallic, splendent, of surface of fracture subvitreous. Color iron-black. Streak chestnut-brown. Fracture uneven.

Comp.—Contains, according to G. Rose (l. c.), zirconia, oxyd of iron, and titanic acid.

Pyr., etc.—B.B infusible, but becomes magnetic. With salt of phosphorus, in the outer flame, gives a greenish-yellow clear glass; in the inner a yellowish-red, which is made deep red by adding tin. With soda a manganese reaction.

Obs.—Occurs in granite veins in the Ilmen mountains. The crystals are imbedded in albite, and the largest are but two or three lines long.

Brooke's name *Ilmenite* being preoccupied, Rose changed it to ***Mengite***, after Menge, the discoverer of the mineral. The mengite of Brooke is monazite.

486. RUTHERFORDITE. *Shepard*, Am. Assoc., iv. 312, 1851, Am. J. Sci., II. xii. 209.

Monoclinic, with *I* ∧ *I*=93°, according to Shepard. In crystals and grains, without cleavage.

H.=5·5, Hunt. G.=5·58–5·69, Shepard; 5·55, Hunt. Lustre of fracture shining vitreo-resinous, and color blackish-brown. Opaque, but thin fragments translucent and smoky orange-brown by transmitted light. Streak and powder yellowish-brown, near fawn-color. Fracture conchoidal. Brittle.

Comp.—According to Shepard, contains titanic acid, oxyd of cerium, and possibly oxyd of uranium and yttria. According to some unfinished trials by T. S. Hunt (Am. J. Sci., II. xiv. 344), it contains probably 58·5 p. c. or more of titanic acid, with 10 p. c. of lime, with other ingredients undetermined.

Obs.—Occurs at the gold mines of Rutherford Co., North Carolina, along with rutile, brookite, zircon, and monazite.

---

3. PHOSPHATES, ARSENATES, ANTIMONATES, NITRATES.

A. PHOSPHATES, ARSENATES, ANTIMONATES.

In the anhydrous Phosphates and Arsenates the hardness is from 3 to 6; colors various, comprising, besides white or colorless, shades of green, yellow, blue, brown, violet, black, several of them bright; crystalline forms of each of the systems, except the isometric. The hydrous species have a still wider range of crystallization and colors, including the isometric system in the former, and reddish shades among the latter; while the limits of hardness are lower, being between 1 and 5; a much larger proportion of the species are clinohedral. In composition, the oxygen ratio for bases and acid which is far the most common, is 3 : 5; next to this, 6 : 5; the ratios 2 : 3, 4 : 5, 3 : 2 are rare; while 1 : 1 is unknown, except problematically in two or three species of doubtful composition.

The pyrognostic reactions for phosphates B.B. are the following: If the acid is combined with a base which of itself imparts no color to the flame, it will give a characteristic bluish-green color, and this may be made more intense by moistening with sulphuric acid before ignition. If the phosphate is soluble in nitric acid, the dilute solution will give with acetate of lead a white precipitate, which after washing yields B.B. on charcoal in R.F. a crystalline polyhedral bead of phosphate of lead. Further, according to Bunsen, if a phosphate, or a substance containing but a small amount of phosphoric acid, be heated in a wide closed glass tube, with three parts of dry soda and a small fragment of sodium, it is on fusion converted into a phosphid, which after cooling yields phosphuretted hydrogen when moistened with water. Most phosphates in the state of powder are reduced to phosphids by simple fusion with sodium.

Arsenates are easily recognized by the alliaceous odor given when treated on charcoal, especially when fused with soda.

I. ANHYDROUS.

ARRANGEMENT OF THE SPECIES.

I. XENOTIME GROUP. O. ratio for bases and acid 3 : 5. Crystallization tetragonal.

490. **Xenotime**	$\dot{\mathrm{Y}}^3\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{P}}$	$(\mathrm{P}\Theta)_2\|\Theta_6\ \|\text{Ɏ}_3$
491. **Cryptolite**	$\dot{\mathrm{C}}\mathrm{e}^3\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{P}}$	$(\mathrm{P}\Theta)_2\|\Theta_6\ \|\text{Ȼe}_3$

II. APATITE GROUP. Oxygen ratio for bases and acid 3 : 5, but with the addition of a fluorid or chlorid, which, if included with the bases, makes the ratio 10 : 15=2 : 3. Crystallization hexagonal. Formula A on the ratio 3 : 5, and B that of 2 : 3.

492. **Apatite** A	$3\,\dot{\mathrm{C}}\mathrm{a}^3\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{P}}+\mathrm{Ca}(\mathrm{Cl},\mathrm{F})$	$(\mathrm{P}\Theta)_2\|\Theta_6\ \|\text{Ȼa}_3+\tfrac{1}{3}\,\text{Ȼa}(\mathrm{Cl}_2,\mathrm{F}_2)$
B	$(\tfrac{9}{10}\,\dot{\mathrm{C}}\mathrm{a}+\tfrac{1}{10}\,\mathrm{Ca}(\mathrm{Cl},\mathrm{F}))^{10}\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{P}}{}^3$	$\mathrm{P}_6\Theta_4(\mathrm{Cl}_2,\mathrm{F}_2)\|\Theta_{20}\|\text{Ȼa}_{10}$
493. **Pyromorphite** A	$3\,\dot{\mathrm{P}}\mathrm{b}^3\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{P}}+\mathrm{Pb\,Cl}$	$(\mathrm{P}\Theta)_2\|\Theta_6\ \|\text{Ᵽb}_3+\tfrac{1}{3}\,\text{Ᵽb}\,\mathrm{Cl}_2$
B	$(\tfrac{9}{10}\,\dot{\mathrm{P}}\mathrm{b}+\tfrac{1}{10}(\mathrm{Pb\,Cl}))^{10}\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{P}}{}^3$	$\mathrm{P}_6\Theta_4\mathrm{Cl}_2\|\Theta_{20}\|\text{Ᵽb}_{10}$
494. **Mimetite** A	$3\,\dot{\mathrm{P}}\mathrm{b}^3\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{As}}+\mathrm{Pb\,Cl}$	$(\mathrm{As}\Theta)_2\|\Theta_6\ \|\text{Ᵽb}_3+\tfrac{1}{3}\,\mathrm{Pb\,Cl}$
B	$(\tfrac{9}{10}\,\dot{\mathrm{P}}\mathrm{b}+\tfrac{1}{10}(\mathrm{Pb\,Cl}))^{10}\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{As}}{}^3$	$\mathrm{As}_6\Theta_4\mathrm{Cl}_2\|\Theta_{20}\|\text{Ᵽb}_{10}$

III. WAGNERITE GROUP. O. ratio for bases and acid 3 : 5, but with the addition, in wagnerite, of a fluorid, which, if included with the bases, makes the ratio 4 : 5. Crystallization clinorhombic, with *I* ∧ *I*=91°—95°.

495. **Wagnerite** A	$\dot{\mathrm{M}}\mathrm{g}^3\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{P}}+\mathrm{Mg\,F}$	$(\mathrm{P}\Theta)_2\|\Theta_6\ \|\text{M̶g}_3+\text{M̶g}\,\mathrm{F}_2$
B	$(\tfrac{3}{4}\,\dot{\mathrm{M}}\mathrm{g}+\tfrac{1}{4}\,\mathrm{Mg\,F})^4\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{P}}$	$(\mathrm{P\,F})\ \|\Theta_4\ \|\text{M̶g}_2$
496. **Monazite**	$(\dot{\mathrm{C}}\mathrm{e},\dot{\mathrm{L}}\mathrm{a},\dot{\mathrm{D}}\mathrm{i},\ddot{\mathrm{T}}\mathrm{h}\tfrac{1}{2})^3\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{P}}$	$(\mathrm{P}\Theta)_2\|\Theta_6\ \|(\text{Ȼe},\text{Ƚa}\ \text{Đi},\gamma\text{Ŧh})_3$
497. **Turnerite**		

IV. TRIPLITE GROUP. O. ratio as in the Wagnerite group. Crystallization orthorhombic, with *I* ∧ *I*=97°—101°.

498. **Triphylite**	$(\dot{\mathrm{F}}\mathrm{e},\dot{\mathrm{M}}\mathrm{n},\dot{\mathrm{L}}\mathrm{i})^3\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{P}}$	$(\mathrm{P}\Theta)_2\|\Theta_6\ \|(\mathrm{Fe},\text{M̶n},\mathrm{Li}_2)_3$

499. Triplite A $(\dot{\mathrm{Fe}}, \dot{\mathrm{Mn}})^3 \overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\mathrm{P}}} + \mathrm{R\,F}$ $(\mathrm{P}\,\Theta)_2 \| \Theta_6 \| (\bar{\mathrm{Fe}}, \bar{\mathrm{Mn}})_3 + \bar{\mathrm{R}}\,\mathrm{F}_2$
B $(\frac{3}{4}(\dot{\mathrm{Fe}}, \dot{\mathrm{Mn}}) + \frac{1}{4}\,\mathrm{R\,F})^4 \overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\mathrm{P}}}$ $(\mathrm{P\,F}) \| \Theta_4 \| (\bar{\mathrm{Fe}}, \bar{\mathrm{Mn}})_2$

500. Hopeite

V. BERZELIITE GROUP. O. ratio for bases and acid 2 : 3.

501. Berzeliite $(\dot{\mathrm{Ca}}, \dot{\mathrm{Mg}}, \dot{\mathrm{Mn}})^{10} \overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\mathrm{As}}}{}^3$ $\mathrm{As}_6\, \Theta_5 \| \Theta_{20} \| (\bar{\mathrm{Ca}}, \bar{\mathrm{Mg}}, \bar{\mathrm{Mn}})_{10}$

VI. CARMINITE GROUP. Contains sesquioxyds. Crystals orthorhombic.

502. Carminite $\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\mathrm{As}}}, \overset{\cdot\cdot\cdot}{\bar{\mathrm{Fe}}}, \dot{\mathrm{Pb}}$

VII. AMBLYGONITE GROUP. Contains alumina, lithia, and fluorine. Crystallization triclinic; $I \wedge I = 73°—74°$.

503. Amblygonite $\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\mathrm{P}}}, \overset{\cdot\cdot\cdot}{\bar{\mathrm{Al}}}, \dot{\mathrm{Li}}, \mathrm{F}$

VIII. HERDERITE GROUP.

504. Herderite $\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\mathrm{P}}}, \overset{\cdot\cdot\cdot}{\bar{\mathrm{Al}}}, \dot{\mathrm{Ca}}, \mathrm{F}$

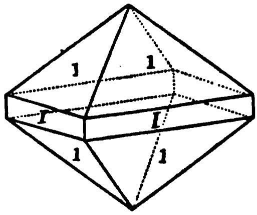
IX. MONIMOLITE GROUP. Antimonates. Crystallization tetragonal.

505. Monimolite $(\dot{\mathrm{Pb}}, \dot{\mathrm{Fe}}, \mathrm{Mn}, \dot{\mathrm{Ca}})^4 \overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\mathrm{Sb}}}$ $\mathrm{Sb}_2\, \Theta \| \Theta_8 \| (\bar{\mathrm{Pb}}, \bar{\mathrm{Fe}}, \bar{\mathrm{Mn}}, \bar{\mathrm{Ca}})_4$
506. Romeite $\dot{\mathrm{R}}^3, \mathrm{Sb\,O}^3, \mathrm{Sb\,O}^5$
507. Ammiolite $\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\mathrm{Sb}}}, \dot{\mathrm{Hg}}, \dot{\mathrm{Cu}}$

Appendix.—508, 509. Arsenates of Nickel.

490. XENOTIME. Phosphorsyrad Ytterjord *Berz.*, Ak. H. Stockh., ii. 334, 1824. Phosphorsaure Yttererde *Germ.* Phosphate of Yttria. Xenotime *Beud.*, Tr., ii. 552, 1832. Ytterspath *Glocker*, Handb., 959, 1831. Castelnaudite *Damour*, L'Institut, 78, 1853. Wiserin *Kenngott*, Jahrb. Min. 1864, 454.

438



Tetragonal. $O \wedge 1 = 138°\ 45'$; $a = 0{\cdot}6201$. Observed planes as in the annexed figure. $1 \wedge 1$, pyram., $= 124°\ 26'$; basal, $= 82°\ 30'$; $I \wedge 1 = 131°\ 15'$. Cleavage: I, perfect.

H.=4–5. G.=4·45–4·56; 4·557, Berz.; 4·54, Georgia, Smith. Lustre resinous. Color yellowish-brown, reddish-brown, hair-brown, flesh-red, grayish-white, pale yellow; streak pale brown, yellowish, or reddish. Opaque. Fracture uneven and splintery.

Comp.—$\dot{\mathrm{Y}}^3 \overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\mathrm{P}}}$=Phosphoric acid 37·86, yttria 62·14=100.

Analyses: 1, Berzelius (l. c.); 2, E. Zschau (Jahrb. Min. 1855, 518); 3, J. L. Smith (Am. J Sci., II. xviii. 378); 4, Damour (Bull. G. Fr., II. xiii. 542); 5, Wartha (Pogg., cxxviii. 166):

	$\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\mathrm{P}}}$	$\overset{\cdot\cdot\cdot}{\bar{\mathrm{Fe}}}$	$\dot{\mathrm{Y}}$	$\dot{\mathrm{Ce}}$	
1. Hitteröe	33·49 [a]	——	62·58	——	, subphosph. iron 3·93=100 Berzelius.
2. "	30·74	*tr.*	60·25	7·98	, $\ddot{\mathrm{Si}}$ *tr.*=98·97 Zschau.

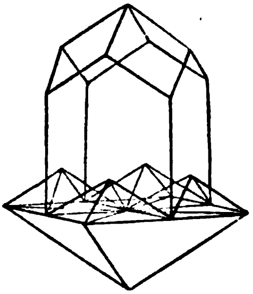
	$\ddot{\bar{P}}$	$\bar{F}e$	$\dot{Y}$	$\dot{C}e$	
3. Georgia	32·45	2·06	54·13	11·03[b]	, $\ddot{S}i$ 0·89=100·56 Smith.
4. "	31·64	1·20[c]	60·40	——	, $\ddot{T}i$, $\ddot{Z}r$ 7·40=100·64 Damour.
5. Wiserine	35·08	——	48·33	——	, specular iron, with trace $\ddot{T}i$, 6·59=100 Wartha.

[a] With *tr.* of H F. [b] Includes a little La O, Di O. [c] Includes some $U^2 O^3$.

Pyr., etc.—B.B. infusible. When moistened with sulphuric acid colors the flame bluish-green Difficultly soluble in salt of phosphorus. Insoluble in acids.

Obs.—From a granite vein at Hitteröe, with polycrase, malacon, and orthite, where the crystals are sometimes symmetrically compounded with crystals of zircon, as in the annexed figure (E. Zschau, Am. J. Sci., II. xx. 273), which is zircon above and xenotime below, the two species being closely isomorphous; at Ytterby, Sweden; the Fibir Berge, S.W. from St. Gothard; Binnenthal in Upper Valais, Switzerland (*wiserine*). In the United States, in the gold washings of Clarksville, Georgia (f. 438), associated with zircon, rutile, and cyanite; in McDowell Co., N C; in grayish-white and pale yellow crystals in the diamond sands of Bahia, Brazil (castelnaudite).

439



Beudant named the species *xenotime* (apparently from ξενός, *stranger to*, and τιμή, *honor*), but in the next line gives the derivation "κενός, *vain*, et τιμή, honneur," as if the word were *kenotime*, and adds afterward that his name is intended to recall the fact that the mineral was erroneously supposed by Berzelius (in 1815) to contain a new metal (the metal which he named thorium, before the later thorium was discovered). There is a sneer at the great Swedish chemist in the name, which should have occasioned its immediate rejection. Fortunately the word was misspelt from the first; and in its accepted form may be regarded as referring to the fact that the crystals are small, rare, not showy, and were long unnoticed.

191. CRYPTOLITE. Kryptolith *Wöhler*, Gel. Anz. Gött., 1846, 19, Pogg., lxvii. 424. Phosphocerite *H. Watts*, Qu. J. Ch. Soc., ii. 131, 1849.

In acicular prisms and minute grains; those of cryptolite perhaps hexagonal, Wöhler; those of phosphocerite tetragonal octahedrons and square prisms, Watts and Chapman.

G.=4·6, cryptolite; 4·78, phosphocerite. Color wine-yellow; of phosphocerite, pale sulphur yellow or colorless. Transparent—translucent.

Comp.—$\dot{C}e^3 \ddot{\bar{P}}$ (like monazite), the cerium replaced in part by didymium. The analysis of yptolite affords better $\dot{C}e^{10} \ddot{\bar{P}}^3$. Analyses: Wöhler and Watts (l. c.):

	$\ddot{\bar{P}}$	$\dot{C}e$, $\dot{D}i$	$\dot{F}e$
1. Cryptolite	27·37	73·70	1·51=102·58 Wöhler.
2. Phosphocerite	29·66	67·38	$\bar{F}e$ 2·95=100 Watts.

The excess in anal. 1 is supposed to be due to oxydation of the protoxyd of cerium in the urse of the analysis.

Pyr., etc.—Cryptolite is not altered by moderate heating. Soluble in concentrated sulphuric id. Phosphocerite, according to Chapman, vitrifies partially on the edges, tinging the flame at e same time slightly green. Affords the reaction of phosphoric acid and also of cerium, producing, however, with borax and salt of phosphorus a glass which is pale violet-blue when cold, her due to the presence of didymium or a minute portion of cobalt ore

Obs.—Cryptolite occurs in the green and red apatite of Arendal, Norway, and is discovered on tting the apatite in dilute nitric acid; constitutes 2 or 3 p. c. of the mass; it was found especially in the red apatite, or in reddish points of the green, and associated with particles of magtic iron, hornblende, and another cerium ore of a hyacinth-red color, supposed to be monazite. is mineral was looked for in the yellowish apatites of Snarum without success. Occurs also th apatite in the Tyrol (?); and in the apatite of the Slüdianka in Siberia. Phosphocerite, ording to Watts and Chapman, may be the grayish-yellow powder in the cobalt ore of Tunaberg. e crystalline forms most common in the powder are an octahedron and a square or rectangular sm, terminating in a four-sided pyramid parallel with the lateral planes, resembling fig. 248, der zircon. Genth has observed a mineral, probably cryptolite, in the Hurdstown apatite.

Named from κρυπτός, *concealed*.

492. APATITE. *Crystallized from Spain.* Chrysolite ordinaire *de Lisle* (with figs.), Crist., 1772, ii. 271, 1783;=Spargelgrüne Steinkrystalle aus Spanien nähern Apatit *Wern.*, Bergm. J., 74, 1790;=Spargelstein *Wern.;* Asparagus Stone; Pierre d'Asperge *Fr.;* Asparagolithe *Abildgaard*, Ann. Ch., xxxii. 195, 1800. Chaux phosphatée *Vauq.*, Ann. Ch., xxvi. 123, 1798. Phosphate of Lime.

Cryst. fr. Saxony. Aquamarin (celandine-green, fr. Schneckenstein) *Brunnich*, his Cronst., 1770. Améthiste basaltine (mostly violet, fr. Mines d'etain de Saxe) *Sage*, Min. i., 281, 1777; *de Lisle*, Crist., ii. 254, 1783;=Apatit *Wern.*, Gerhard's Grundr., 281, 1786, Bergm. J., 576, 1788, 378, 1789. Phosphorsaurer-Kalk *Klapr.*, ib., 294, 1788. Sachsischer Beryll, Agustit (with announcem. of supposed new earth, Agusterde), *Trommsdorf*, Trommsd. J. d. Pharm., 1800.

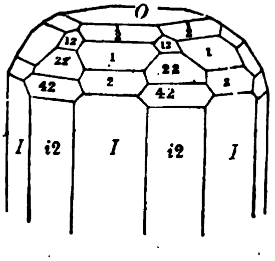
Cryst. fr. Norway, etc. Moroxit (fr. Arendal) *Abildgaard*, Moll's Jahrb. B. H., ii. 432, 1798. Francolite (fr. Devonshire) *Brooke; T. H. Henry*, Phil. Mag., III. xxxvi. 1850. Lazur-Apatit *N. Nordensk.*, Bull. Nat. Moscou, xxx. 224, 1857.

Massive. La Pierre Phosphorique (fr. Lagrosan. Estremadura) *Davila*, p. 60, Madrid;=Phosphate calcaire *Proust*, J. de Phys., xxxii. 241, 1788; *Pelletier*, Ann. Ch., vii. 1790;=Phosphorite *Kirw.*, Min., i. 129, 1794: id. *Karst.*, Tab., 52, 1808. Eupyrchroite (fr. N. Y.) *Emmons*, Rep. G. N. Y., 1838. Osteolith *Bromeis*, Ann. Ch. Pharm., lxxix. 1851=Bone-phosphate.

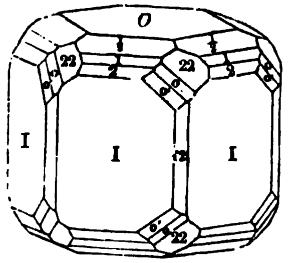
Apatite (incl. the Saxon and the Spanish crystallized (Spargelstein) and massive Phosphorite, excl. Moroxite) *Karst.*, Tab., 36, 1800; id. (incl. the same and also Moroxite) *H.*, Tr., ii. 1801.

Hexagonal; often hemihedral. $O \wedge 1 = 139° 41' 38''$, Kokscharof; $a = 0{\cdot}734603$. Observed planes: O; prismatic, I, i-2, i-$\frac{3}{2}$, i-$\frac{5}{4}$; pyramidal, $\frac{1}{2}$, 1, 2: 1-2, 2-2, 4-2; 3-$\frac{3}{2}$, 4-$\frac{4}{3}$; 2-$\frac{4}{3}$. Figs. 440, 441, 442; f. 441, hemihedral in the planes, 3-$\frac{3}{2}$, 4-$\frac{4}{3}$; f. 442, actual form of a crystal of which f. 441 is the normal form; $o = 3$-$\frac{3}{2}$, $o' = 4$-$\frac{4}{3}$.

440



441

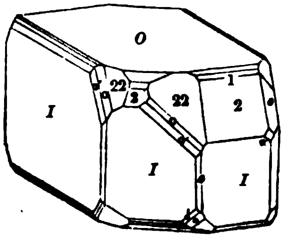


St. Gothard.

$I \wedge i$-$2 = 150°$

$O \wedge \frac{1}{2} = 157° 1'$
$O \wedge 2 = 120\ 31$
$O \wedge 3 = 111\ 27$
$O \wedge \frac{3}{2} = 128\ 10$
$O \wedge 4$-$\frac{4}{3} = 108\ 6$
$O \wedge 3$-$\frac{3}{2} = 114\ 1$
$O \wedge 2$-$\frac{4}{3} = 123\ 11$
$O \wedge 1$-$2 = 143\ 42$
$O \wedge 2$-$2\ \ 124\ 14\frac{1}{2}$
$I \wedge 2$-$2 = 135\ 35$
$I \wedge 4$-$\frac{4}{3} = 157\ 19$
$I \wedge 3$-$\frac{3}{2} = 149\ 40$
$1 \wedge 1$, pyr., $= 142\ 16$
$1 \wedge 1$, bas., $= 80\ 36$

442



St. Gothard.

Cleavage: O, imperfect; I, more so. Also globular and reniform, with a fibrous or imperfectly columnar structure; also massive, structure granular.

H.=5, sometimes 4·5 when massive. G.=2·92—3·25. Lustre vitreous, inclining to subresinous. Streak white. Color usually sea-green, bluish-green; often violet-blue; sometimes white; occasionally yellow, gray, red, flesh-red, and brown; none bright. Transparent—

opaque. A bluish opalescence sometimes in the direction of the vertical axis, especially in white varieties. Cross fracture conchoidal and uneven. Brittle.

Var.—1. *Ordinary.* Crystallized, or cleavable and granular massive. (*a*) The *asparagus stone* (originally from Murcia, Spain) and *moroxite* (from Arendal) are ordinary apatite. The forme was yellowish-green, as the name implies; the latter was in greenish-blue and bluish crystals and the names have been used for apatite of the same shades from other places.

G.=3·211, fr. Ehrenfriedersdorf, in Saxony, G. Rose; emerald mine on the Tokovaia River Urals, 3·212, Koksch.; of Pargas (anal. 14) 3·19, Arppe; of Tammela, bluish-green (anal. 15) 3·18, Arppe; of Miask, yellow (anal. 17), 3·234, v. Rath; ib., 3·215, Alexejef; of Murcia, Spain, 3·235, Rose; of Arendal, Norway, 3·194, Rose; of Snarum, 3·174, Rose; of Greiner, Tyrol, 3·175, Rose; of St. Gothard, 3·197, Rose.

The above measurements are by Kokscharof, on crystals from the emerald mine on the Tokovaia, a fluor-apatite (anal. 27). According to him, apatite from Achmatovsk, and that of L. Laach, affords *O* ∧ 1=139° 54′ and 1 ∧ 1=142° 25′; that from Blagodat, 139° 44′ and 142° 18½′; that from Murcia, 139° 47′ and 142° 20′; that of St. Gothard, 142° 19′; that of Ehrenfriedersdorf the same as that from the Tokovaia emerald mine.

(*b*) *Lasurapatite* is a sky-blue variety; it occurs in crystals with lapis-lazuli at Bucharei in Siberia. (*c*) *Francolite*, from Wheal Franco, near Tavistock, Devonshire, occurs in small crystalline stalactitic masses, grayish green to brown, and in minute curving crystals.

2. *Fibrous, concretionary, stalactitic.* The name *Phosphorite* was used by Kirwan for all apatite, but in his mind it especially included the fibrous concretionary and partly scaly mineral from Estremadura, Spain, and elsewhere. It has H.=4·5; G.=2·92—3, Forbes, but 2·98—3·12 after ignition. Eupyrchroite (from Crown Point, N. Y.) belongs here; it is concentric in structure, consisting of convex subfibrous layers, more or less easily separable; H.=4½; G.=3·053; ash-gray and bluish-gray in color, and gives a green phosphorescence when heated (whence the name, from εὖ, *well*, πῦρ, *fire*, and χρόα, *a color*.

3. *Earthy apatite; Osteolite.* Mostly altered apatite (see beyond). Coprolites are mainly impure phosphate of lime.

4. *Fluor-apatite.* 5. *Chlor-apatite.* Apatite also varies as to the proportion of fluorine to chlorine, one of these elements sometimes replacing nearly or wholly the other.

Pseudoapatite of Breithaupt is pseudomorphous apatite from Kurprinz, near Freiberg, and Schlackenwald in Bohemia.

Comp.—Phosphate of lime, with chlorid or fluorid of lime, or both; $\dot{C}a^3\ddot{\bar{P}}+\frac{1}{3}Ca(Cl, F)$; or $(\frac{9}{10}\dot{C}a+\frac{1}{10}Ca(Cl, F))^{10}\ddot{\bar{P}}^3$=, for *chlor-apatite*, Phosphoric acid 40·92, lime 48·43 (=89·35 $\ddot{\bar{P}}$, $\dot{C}a$), chlorine 6·81, calcium 3·84 (=10·65 Cl, Ca); and for *fluor-apatite*, $\ddot{\bar{P}}$ 42·26, $\dot{C}a$ 50·00 (=92·26 $\ddot{\bar{P}}$, $\dot{C}a$), F 3·77, Ca 3·97 (=7·74 F, Ca); and the analyses should give for the former $\ddot{\bar{P}}$ 40·92, $\dot{C}a$ 53·81, Cl 6·81; for the latter $\ddot{\bar{P}}$ 42·26, $\dot{C}a$ 55·56, F 3·77 (Rammelsberg). In most kinds both fluorine and chlorine are present. The amount of fluorine has not been determined with accuracy; in the larger part of the analyses it has been deduced from the loss; and where this is the case, the amount of fluorine is not given in the table of analyses beyond. G. Rose first detected the fluorine and chlorine, and published the following as the composition of different specimens (Pogg., ix. 185):

	1. Snarum, Norway.	2. Murcia, Spain.	3. Arendal, Norway	4. Greiner, Tyrol.	5. St. Gothard, Tyrol.
Phosphate of lime	91·13	92·066	92·189	92·16	92·31
Chlorid of calcium	4·28	0·885	0·801	0·15	*tr.*
Fluorid of calcium	4·59	7·049	7·01	7·69	7·69
	G.=3·174	G.=2·235	G.=3·194	G.=3·175	G.=3·197

His determinations were, in 1, Cl 2·71, $\dot{C}a$ 54·75, $\ddot{\bar{F}}e$ 0·25; in 2, Cl 0·56, $\dot{C}a$ 55·30; in 3, Cl 0·51, a 55·89; in 4, Cl 0·09, $\dot{C}a$ 55·57; in 5, Cl 0·03, $\dot{C}a$ 55·66.

Other analyses: 6. Weber (Pogg., lxxxiv. 306): 7, 8, Rammelsberg (Pogg., lxviii. 506, lxxxv. 97); 9, G. Rose (Pogg., lxxxiv. 303); 10, Joy (Inaug. Dissert., 45); 11–13, Völcker (J. pr. Ch., xxv. 384); 14, 15, Arppe (An. Finska Min., 4); 16, Henry (Phil. Mag., III. xxxvi. 1850); 17, v. Rath (Pogg., xcvi. 331); 18, v. Alexejeff (Verh. Min. St. Pet., 59, 1862, Kokscharof's Min. Russl. v.); 19, Jackson (Am. J. Sci., II. xi. 402); 20, J. D. Whitney (Am. J. Sci., II. xvii. 209); 21, Daubeny (Ann. Ch. Pharm., lv. 116): 22, Garzo & Penuelas (Bull. Soc. G., xvii. 157); 23, Mayer Ann. Ch. Pharm., ci. 281); 24, Jackson (Am. J. Sci., II. xii. 73); 25, Petersen (Jahrb. Min. 1867, 01); 26, Foster (ib., 1866, 716); 27, 28, P. v. Pusirevski (Verh. Min. St. Pet., 1862, 59, and Kokscharof's Min. Russl., iv.):

	$\overset{\cdots}{\bar{\mathrm{P}}}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$	Cl	F	$\dot{\mathrm{H}}$	
6. Snarum	41·54	1·79	—	53·46	2·66	—	—	Weber.
7. Schwarzenstein	—	—	—	55·31	0·07	—	—	Ramm.
8. Schlackenwald	—	0·27	—	53·97	0·05	—	—	Ramm.
9. Faldigl, Tyrol	—	—	—	55·87	0·06	—	—	Rose.
10. " "	43·01	0 09	—	55·24	0·05	—	—	Joy.
11. Krageröe, *white*	41·25	0·29	—	53·84	4·10	—	0·42,	$\ddot{\bar{\mathrm{Al}}}$ 0·38, alk. 0·17, insol. 0·82 V
12. " "	42·28	0·92[a]	—	54·44	1·38	—	0·49,	insol. 0·99 Völck.
13. " *red*	41·81	1·05[a]	—	54·59	1·03	—	0·83,	alk. 0·30, insol. 1·10 Völck.
14. Pargas, *blue*	40·76	0·81	—	54·74	*tr.*	—	—,	$\overset{\cdots}{\bar{\mathrm{P}}}$, $\dot{\mathrm{Fe}}$, $\ddot{\bar{\mathrm{Al}}}$ 0·99 Arppe.
15. Tammela, *blh.-gn.*	41·39	1·72	—	55·40	—	—	—	Arppe.
16. Wheal Franco	41·57	3·09[a]		53·10	*tr.*	—	—	Heury.
17. Miask, *yellow*	42·08	0·17	—	55·17	*tr.*	—	0·16	v. Rath
18. " "	42·99	—	—	55·00	*tr.*	—	—	Alexejeff.
19. Hurdstown, *cryst.*	42·34	0·04	—	55·08	0·34	—	—	Jackson.
20. " "	43·23	*tr.*	—	53·87	1·02	—	—	Whitney.
21. Estremadura, *Phosph.*	37·18	3·15	—	54·08	0·20	—	—,	$\ddot{\mathrm{Si}}$ 1 70 Daubeny.
22. " "	40·12	0·61	—	53·50	0·06	2·16	—,	$\ddot{\mathrm{Si}}$, $\ddot{\bar{\mathrm{Al}}}$ 3·10, loss 0·79 G. & P.
23. Amberg, "	43·53	0·90	0·10	53·55	—	2·09	—,	$\dot{\mathrm{K}}$, $\dot{\mathrm{Na}}$ 0·73 Mayer.
24. *Eupyrchroite,* "	45·75	$\dot{\mathrm{F}}$2·00	—	49·94	0·13	0·60	0·50,	$\ddot{\mathrm{C}}$ 1·22 Jackson.
25. Diez, Nassau, "	36·78	$\bar{\mathrm{F}}$0·61[b]	0·19	53·30	—	2·46	1·65,	Cl & I 0·03, $\dot{\mathrm{K}}$ 0·14, $\dot{\mathrm{Na}}$ 0·31. $\ddot{\mathrm{C}}$ 4·25, insol. 1·05=100·77 Pet.
26. Staffel, "	34·48	6·42	0·16	45·79	—	3·45	2·45,	$\ddot{\bar{\mathrm{Al}}}$ 1·08, $\ddot{\mathrm{Si}}$ 4·83, $\ddot{\mathrm{C}}$ 1·51, $\dot{\mathrm{Na}}$ 0·42, $\dot{\mathrm{K}}$ 0·58=101·17 Foster.
27. Tokovaia, Ural	41·99	—	—	55·95	0·01	4·20	—	Pusirevski.
28. Slüdianka, *Morox.*	41·98	—	—	55·91	0·11	4·02	—	Pusirevski.

[a] With some Mg O and Fe O. [b] With some alumina.

The earliest examination of apatite was that of Proust, in 1788 (l. c.), on the phosphorite of Estremadura, which led him to call it a *calcareous phosphate;* and that of Klaproth, in the same year (l. c.), on the Saxon apatite, in which he found $\overset{\cdots}{\bar{\mathrm{P}}}$ 45, $\dot{\mathrm{Ca}}$ 55. Pelletier in 1790 (l. c.) made a complete, although not entirely accurate, analysis of the phosphorite, detecting even the fluorine and chlorine, obtaining $\overset{\cdots}{\bar{\mathrm{P}}}$ 34, $\dot{\mathrm{Ca}}$ 59, fluoric acid 2·5, muriatic acid 0·5, $\dot{\mathrm{Fe}}$ 1. $\ddot{\mathrm{Si}}$ 2, $\ddot{\mathrm{C}}$ 1=100. The asparagus stone of Spain was not analyzed until 1798, by Vauquelin (l. c.): he found only phosphoric acid and lime, respectively 45·72 and 54·28 p. c. His results proved its identity with the Saxon mineral, and from this time they were united, along with phosphorite, under Werner's name of *apatite*, first given in 1786 to the Saxon mineral.

Forbes found in the eupyrchroite (Phil. Mag., IV. xxix 340) $\overset{\cdots}{\bar{\mathrm{P}}}$ 44·12. Phosphorite of different localities has afforded a trace of iodine, and that from Amberg gave H. Reinsch in addition a trace of *bromine*. Apatite from Krageröe, according to Völcker (anal. 11), contains no fluorine. That of Jumilla afforded de Luna 1·75 p. c. of cerium, lanthanum, and didymium.

Near Coquimbo, Chili, at the mines of Tambillos, occur clear turquois-blue crystals, containing, according to F. Field (Chem. Gaz., No. 400, 1860, p. 224), $\overset{\cdots}{\bar{\mathrm{P}}}$ 37·69, $\dot{\mathrm{Ca}}$ 36·64, $\dot{\mathrm{Cu}}$ 20·93 Ca Cl 2·33. $\dot{\mathrm{H}}$ 2·32=99·91, the copper being present as phosphate.

Lechartier has shown (C. R., lxv. 172) that an arsenic acid apatite may be made by fusion together of arsenate of lime and chlorid of calcium; and that from the same at a lower temperature an arsenic acid wagnerite is obtained in crystals.

Pyr., etc.—B.B. in the forceps fuses with difficulty on the edges (F.=4·5—5), coloring the flame reddish-yellow; moistened with sulphuric acid and heated colors the flame pale bluish-green (phosphoric acid); some varieties react for chlorine with salt of phosphorus, when the bead has been previously saturated with oxyd of copper, while others give fluorine when fused with this salt in an open glass tube. Gives a phosphid with the sodium test.

Dissolves in muriatic and nitric acid, yielding with sulphuric acid a copious precipitate of sulphate of lime; the dilute nitric acid solution gives with acetate of lead a white precipitate, which B.B. on charcoal fuses, giving a globule with crystalline facets on cooling. Some varieties of apatite phosphoresce on heating.

Obs.—Apatite occurs in rocks of various kinds and ages, but is most common in metamorphic crystalline rocks, especially in granular limestone, granitic and many metalliferous veins, particularly those of tin, in gneiss, syenite, hornblendic gneiss, mica schist, beds of iron ore; occasionally in serpentine, and in igneous or volcanic rocks; sometimes in ordinary stratified limestone. beds of sandstone or shale of the Silurian, Carboniferous, Jurassic, Cretaceous, or Tertiary formations. It has been observed as the petrifying material of wood.

Among its localities are Ehrenfriedersdorf in Saxony, Schwarzenstein and Pfitsch in the Tyrol; region of St. Gothard in Switzerland; Mussa-Alp in Piedmont, white or colorless, and of like form and color on the Mittaghorn in Upper Valais; Rabenstein and Amberg in Bavaria; Zinn wald and Schlackenwald in Bohemia; in England, in Cornwall, with tin ores; in Cumberland, at Carrock Fells, in celandine-green crystals in gilbertite; in Devonshire, cream-colored at Bovey Tracey, and at Wheal Franco (*francolite*); in Ireland, in a basaltic dike near Kilroot in Antrim, also in Down, Dublin, and Killiney Hill. The greenish-blue variety, called *moroxite*, occurs at Arendal, Snarum, and Krageröe in Norway, at the latter place in hornblendic gneiss, in part flesh-red, and looking much like feldspar; with magnetic iron of a greenish-yellow color at Mt. Blagodat in the Ural; with black tourmaline on the Schaitanka in Katharinenburg; on the Slüdianka (*lasurapatite*) at the emerald mine of the Takovaia, 85 versts N. E. of Katharinenburg on the Kiräba, 70 versts S. W. of Miask, containing *no* chlorine (Pusirevsky), with G.=3·126; in Pargas, Finland. The *asparagus stone* or *spargelstein* of Jumilla, in Murcia (not C. de Gata), Spain, is pale yellowish-green in color; and a variety from Zillerthal is wine-yellow. The *phosphorite*, or massive radiated variety, is obtained abundantly near the junction of granite and argillite, in Estremadura, Spain; at Schlackenwald in Bohemia; at Krageröe, whence it has been largely exported to England; at Amberg, in Jurassic limestone, nodular and stalactitic.

In *Maine*, on Long Island, Blue-hill Bay, in veins 10 in. wide, intersecting granite. In *N. Hamp.*, crystals, often large, are abundant, 4 m. S. of the N. village meeting-house, Westmoreland, in a vein of feldspar and quartz, in mica slate, along with molybdenite; fine crystals at Piermont, in white limestone, on the land of Mr. Thomas Cross In *Mass.*. crystals occasionally 6 in long, at Norwich (N. E. part), in gray quartz; at Bolton abundant, the forms seldom interesting; sparingly at Chesterfield, Chester, Sturbridge, Hinsdale, and Williamsburgh. In *New York*, large crystals of apatite are found in St. Lawrence Co., in granular limestone, with scapolite, sphene, etc.; one crystal from Robinson's farm, in Hammond, was nearly a foot in length, and weighed 18 lbs.; in crystals 1 m. S. E. of Governeur and 2 m. N.; in Rossie, with sphene and pyroxene, 2 m. N. of the village of Oxbow; also on the bank of Vrooman Lake, Jefferson Co., in white limestone, green prisms ½–5 in. long; Sanford mine, East Moriah, Essex Co., in magnetic iron ore, which is often thickly studded with six-sided prisms; also at Long Pond, Essex Co.; near Edenville, Orange Co., in prisms ½–12 in. long, bright asparagus-green, in white limestone; in the same region, blue, grayish-green, and grayish-white crystals; 2 m. S. of Amity, emerald- and bluish-green crystals; at Long Pond, Essex Co., with garnet and idocrase; at Greenfield, Saratoga Co., St. Anthony's Nose, and Corlaer's Hook, less interesting; fibrous mammillated (*eupyrchroite*) at Crown Point, Essex Co., about a mile south of Hammondsville, in large quantities, quarried for agricultural purposes. In *New Jersey*, on the Morris Canal, near Suckasunny, of a brown color, in massive pyrrhotite; with the magnetite of Bryam mine; Mt. Pleasant mine near Mt. Teabo, in a low hill ear the junction of Rockaway R. and Burnt Meadow Cr., ¾ m. from the canal, in masses sometimes 6 in. through; at Hurdstown, Sussex Co., where a shaft has been sunk and the apatite mined; masses brought out weigh occasionally 200 lbs., and some cleavage prisms have the planes in. wide. In *Penn.*, at Leiperville, Delaware Co.; in Chester Co.. at New Garden; in Bucks Co., t Southampton. In *Maryland*, near Baltimore. In *Delaware*, at Dixon's quarry, Wilmington, of rich blue color.

In *Canada*, in North Elmsley, and passing into South Burgess, in an extensive bed 10 ft. broad, ft. of which are pure sea-green apatite, and outside of this mixed with limestone, and sometimes ccurring in prisms a foot long and 4 in. through, with pyroxene and phlogopite—a *fluor-apatite* ontaining only 0·5 chlorine (Hunt); similar in Ross; at the foot of Calumet Falls, in blue crystals; so near Blaisdell's mill on the Gatineau; in crystals in doleryte; at St. Roch, on the Achigan, ear rose-red, amethystine, and colorless crystals, with augite.

Apatite was named by Werner from ἀπατάω, *to deceive*, older mineralogists having referred it to quamarine, chrysolite, amethyst, fluor, schorl, etc.

For recent articles on cryst., Kokscharof, Min. Russl., ii. 39, 189, iii. 86; v. Rath, Pogg., cviii. 3; Pfaff, Pogg., cxi. 276; Hessenberg, Min. Not., Nos. ii. and iv.

Alt.—492A. OSTEOLITE is massive impure altered apatite, as stated by A. H. Church (Ch. ews, xvi. 150, 1867), after analyses of specimens from various localities. The ordinary compact riety looks like lithographic stone of white to gray color. It also occurs earthy. H.=1—2 =2·8—3·1, fr. Hanau, Bromeis; 2·86, fr. Hanau, Church; lustre feeble or wanting. Excepting purities, it has the composition of apatite, although most analyses, excepting those of Church, ve not detected the fluorine or chlorine.

Analyses: 1–3, Bromeis, Rütz, and Ewald (Ann. Ch. Pharm., lxxix. 1); 4, Schröder (ib., lxxxix. 1, ci. 283); 5, Durré (Pogg., cv. 155):

	P̈	Ca	S̈i	Äl	F̈e	Ṁg	Ṅa	K̇	C̈	Ḣ
Hanau	36·88	49·41	4·50	0·93	1·85	0·47	0·62	0·76	1·81	2·28=99·51 Bromeis.
"	37·41	49·24	2·75	1·25	2·78	0·79	0·46	0·81	2·34	3·45=101·28 Rütz.
"	37·16	48·20	2·03	*tr.*	2·31	1·85	0·43	0·73	2·55	3·63=98·80 Ewald.
Redwitz?	42·00	48·16	4·97	—	1·56	0·75	0·02	0·04	2·21	1·31=101·02 Schröder.
Schönwald	34·64	44·76	8·89	6·14	0·50	0·79	—	—	—	2·97, Cl *tr.*=98·69 D.

No. 1 was of the compact part; 2, of the earthy; 3, of the intermediate. Klaproth found in an earthy apatite from Siegeth, Hungary (Beitr., iv. 373), 2·5 p. c. of fluoric acid. A kind from a bed in the Tertiary formation of the Fichtelgebirge, white and earthy, with G.=2·82, gave Schmidt (B. H. Ztg., xx. 390) 76 p. c. $\dot{C}a^3\ddot{P}$. Church found the white, hard osteolite of Eichen, Hanau to afford much fluorine, and more lime than would saturate the phosphoric and carbonic acids; whence he deduces from his analysis $\dot{C}a^3\ddot{P}$ 87·25, $\dot{C}a\ddot{C}$ 5·70, Ca F 4·92, $\dot{H}$ 2·34=100·21, making it true apatite.

Found in fissures or cavities in doleryte or related rocks, as if a secondary product; also in beds among stratified rocks.

Occurs at Ostheim, near Hanau (G.=2·89—3·08), and near Schönwald in Bohemia (G.=2·828), in doleryte; at Redwitz? in the Fichtelgebirge (G.=2·89, 2·82). It is named from ὀστέον, bone, and λίθος, bones consisting largely of the same phosphate.

492B. **Phosphatic Nodules. Coprolites.** Phosphatic nodules occur in many fossiliferous rocks, which are probably in all cases of organic origin. They sometimes present a spiral or other interior structure, derived from the animal organization that afforded them, and in such cases their coprolitic origin is unquestionable. In other cases there is no structure to aid in deciding whether they are true coprolites or not. The following are analyses of some coprolites:

	1. Burdie-house.	2. Fife-shire.	3. Burdie-house.	4. Burdie-house.	5. Kosch-titz.	6. Oberlau-genau.
Phosphate of lime	9·58	63·60	85·08	83·31	50·89	15·25
Carbonate of lime	61·00	24·25	10·78	15·11	32·22	4·57
Carbonate of magnesia	13·57	2·89	——	——	——	2·75
Sesquioxyd of iron	6·40	*tr.*	——	——	2·08	——
Alumina	——	——	——	——	6·42	——
Silica	4·13	*tr.*	0·34	0·29	0·14	——
Organic material		3·38	3·95	1·47	7·38	74·03
Water	5·33	3·33	——	——	——	——
Lime of organic part	——	——	——	——	——	1·44
Chlorid of sodium	——	——	——	——	——	1·96
	100·01	97·45	100·15	100·18	99·03	100·00

Nos. 1 and 2, by Gregory and Walker; 3 and 4, by Connell; 5, by Quadrat; 6, Rochleder. See other analyses by R. Hoffmann, J. pr. Ch., xc. 469.

Phosphatic nodules, from the Lower Silurian rocks of Canada, contain sometimes fragments of shells of Lingula and Orbicula, which shells, unlike most others, consist largely of phosphate. They are found in the Chazy formation at Allumette Id. (G.=2·875), Hawkesbury, R. Ouelle (G.=3·15), and elsewhere. They have afforded T. S. Hunt (Logan's Rep. Can., 1851–52, 1863 and Am. J. Sci., II. xvii. 235, 1854) the following results:

	Allumette I.	Hawkesbury.	R. Ouelle.
Phosphate lime	36·38	44·70	40·34
Carb. lime, with some fluorid	5·00	6·60	5·14
Carb. magnesia	——	4·76	9·70
Sesquiox. iron and little $\bar{A}l$	[7·02]	8·60	12·62
Magnesia		——	——
Insol.	49·90	27·90	25·44
Volatile	1·70	5·00	2·13
	100·00	97·56	95·37

They are blackish externally, and yellowish-brown to blackish-brown or bluish-brown within. A phosphatic nodule, in brown coal beds near Roth, afforded Hassencamp (Jahrb. Min. 1856, 422) Phosph. lime 45·57, ph. magn. 2·04, ph. iron 27·71, magnesia 1·34, lime 4·20, alumina 0·6, organic acid 3·33, water 7·50, $\ddot{C}$ and loss 7·68=100. H.=2·5; G.=2·313. Color externally pitch-black; within, honey-yellow.

492C. *Staffelite* of Stein (Jahrb. Min. 1866, 716) occurs incrusting the phosphorite of Staffel, i botryoidal, reniform, or stalactitic masses, fibrous and radiating. H.=4. G.=3·1284. Col leek to dark green, greenish-yellow. Analysis afforded Forster (l. c.) $\ddot{P}$ 39·05, $\ddot{C}$ 3·19, $\bar{A}l$ 0·02 $\bar{F}e$ 0·037, $\dot{C}a$ 54·67, F 3·05, $\dot{H}$ 1·40=101·423. Stein regards it as a result of the action of carbo ated waters on phosphorite.

492D. GUANO. Guano is bone-phosphate of lime, or osteolite, mixed with the hydrous phosphate, brushite, and generally with some carbonate of lime, and often a little magnesia, alumina, iron, silica, gypsum, and other impurities. It often contains 9 or 10 p. c. of water. It is often granular or oolitic; also compact through consolidation produced by infiltrating waters, in which case it is frequently lamellar in structure, and also occasionally stalagmitic and stalactitic. Its colors are usually grayish-white, yellowish and dark brown, and sometimes reddish, and the lustre of a surface of fracture earthy to resinous. Shepard's *Pyroclasite* (Am. J. Sci., II. xxii. 97) is nothing but the hard guano from Monk's Island, Caribbean sea, the mass of which he named *Pyroguanite*, under the wrong idea of its having undergone the action of heat; and Phipson's *Sombrerite* (J. Ch. Soc., xv. 277, 1862) is the same thing from Sombrero, as shown by A. A. Julien (Am. J. Sci., II. xxxvi. 423). The waters which have filtrated through the guano at Sombrero have altered the coral rock adjoining, turning it more or less completely into phosphate of lime of a yellowish or brownish color; and phosphatic stalagmites and stalactites resinous in fracture are common.

Shepard's massive *Glaubapatite*, yellowish-brown to chocolate-brown in color, and in fibrous stalactites, from Monk's Island (l. c.), is also in all probability merely the guano rock above described. He says the mineral contains 15·1 p. c. of sulphate of soda, with 74·0 of phosphate of lime, and 10·3 of water; but such a compound is hardly a possibility, and the fact of its existence needs confirmation. The name, from glauber and apatite, alludes to the composition. The mineral includes also "tabular crystals," which may possibly be *brushite*, although the composition is against it.

492E. EPIPHOSPHORITE *Breith.* (B. H. Ztg., xxv. 194). Occurs reniform, of scaly-granular structure, inclining to fibrous, vitreous lustre, leek- to celandine-green color, with H.=4·5—5, G.=3·125. According to Richter it fuses with much difficulty, and affords indications of phosphoric acid, lime, protoxyd of iron, alumina, and a very little silica; not tested for fluorine or chlorine, because of too little material. Occurs with garnets and graphite in a crystalline rock, but locality unknown.

492F. TALC-APATITE *Hermann* (J. pr. Ch., xxxi. 101). An apatite from chlorite slate in the Schischimskian mountains, near Slatoust, containing a large percentage of magnesia in place of part of the lime, and low in specific gravity. It occurs in 6-sided prisms, grouped or single: H.=5; G.=2·7—2·75; lustre dull to earthy; color milk-white, yellowish externally; feebly translucent.

Composition, according to Hermann (l. c.), excluding 9·50 of insoluble material as impurities: $\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\mathrm{P}}}$ 43·11, $\dot{\mathrm{C}}\mathrm{a}$ 41·44, $\dot{\mathrm{M}}\mathrm{g}$ 8·55, $\ddot{\bar{\mathrm{F}}}\mathrm{e}$ 1·10, Cl 0·92, $\dddot{\bar{\mathrm{S}}}$ 2·32, fluorine undetermined; whence the formula $3\,\dot{\mathrm{C}}\mathrm{a}^3\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\mathrm{P}}} + \dot{\mathrm{M}}\mathrm{g}^3\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\mathrm{P}}}$, with chlorid and fluorid. Berzelius suggests that the magnesia may have come from the gangue. According to Volger it is an altered impure apatite. Some magnesia is present in many apatites (Bischof.).

492G. HYDROAPATITE *Damour* (Ann. d. M., V. x. 65). In mammillary concretions, looking a little like chalcedony. H.=5·5, G.=3·10. Color milk-white. Subtransparent. Composition that of a *hydrous apatite*; $3\,\dot{\mathrm{C}}\mathrm{a}^3\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\mathrm{P}}} + \mathrm{Ca\,F} + \dot{\bar{\mathrm{H}}}$. Analysis by Damour (l. c.):

$\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\mathrm{P}}}$ 40·00 $\dot{\mathrm{C}}\mathrm{a}$ 47·31 F 3·36 Ca 3·60 $\dot{\bar{\mathrm{H}}}$ 5·30.

Heated in a tube it decrepitates and gives out ammoniacal water.

Found near St. Girons in the Pyrenees, in the fissures of a brownish, ferruginous, argillaceous schist, a rock which not far distant affords wavellite.

493. PYROMORPHITE. Grön Blyspat, Minera plumbi viridis pt., *Wall.*, Min., 296, 1748. Mine de Plomb verte *Fr. Trl.* Wall, i. 536, 1853. Grünbleierz, Braunbleierz, *Schültze*, Dresden Mag., ii. 70, 1761, ii. 467, 1765 (with obs. on identity). Grün Bleyerz, PHOSPHORSAUREHALTIG (fr. Zschopau), *Klapr.*, Crell's Ann., i. 394, 1784. Green Lead Ore, Brown Lead Ore; Phosphate of Lead. Phosphorsaures Blei, Phosphorblei, Buntbleierz, *Germ.* Plomb phosphaté *Fr.* Polychrom, Pyromorphit, *Hausm.*, Handb., 1089, 1090, 1813. Traubenblei *id.*, ib., 1098. Polysphærit *Breith.*, Char., 54, 1832. Nussierite *Danhauser*, Barruel, Ann. Ch. Phys., lxii. 217, 1836. Miesit *Breith.*, Handb., 285, 1841. Cherokine *Shep.*, Rep. Canton Mine, 1856, Min., 407, 1857, Am. J. Sci., II. xxiv. 38, 1857.

Hexagonal. $O \wedge 1 = 139°\ 38'$; $a = 0{\cdot}7362$. Observed planes: O, I, i-2, 1, 2, 4, 2-2.

$O \wedge 4 = 106°\ 23'$ $O \wedge$ 2-2 $= 124°\ 11'$ $1 \wedge 1$, pyr., $= 142°\ 12'$

$O \wedge 2 = 120\ \ 28$ $I \wedge i$-2 $= 150$ $I \wedge$ 2-2 $= 135\ \ 46$

Cleavage: *I* and 1 in traces. *I* commonly striated horizontally. globular, reniform, and botryoidal or verruciform, with usually a lumnar structure; also fibrous, and granular.

H.=3·5—4. G.=6·5—7·1, mostly when without lime; 5—6·5, containing lime. Lustre resinous. Color green, yellow, and bro different shades; sometimes wax-yellow and fine orange-yellow grayish-white to milk-white. Streak white, sometimes yellowish. transparent—subtranslucent. Fracture subconchoidal, uneven. B

Var.—1. *Ordinary.* (*a*) *In crystals.* J. Schabus found the angles 1 ∧ 1, in green cry Zschopau, =142° 26′ and 80° 11′; and in brown from Bleistadt, 142° 14′ and 80° 40 300). (*b*) In *acicular* and *moss-like* aggregations. (*c*) *Concretionary* groups or masses of having the surface angular. (*d*) *Fibrous.* (*e*) *Granular massive.* (*f*) *Earthy;* incrustin

2. *Polysphærite.* Containing lime; color brown of different shades, yellowish-gray, pa to nearly white; streak white; G.=5·89—6·44. Rarely in separate crystals; usually i globular, mammillary, verruciform. *Miesite*, from Mies in Bohemia, is a brown variety. is similar and impure, from Nussière, near Beaujeu, France; color yellow, greenish, or G.=5 0415. *Cherokine* is milk-white or pinkish-white in color, and occurs in slightly ac prisms, and also botryoidal and massive; G.=4·8 (?); from the Canton mine, Cher Georgia. 3. *Chromiferous;* color brilliant red and orange. 4. *Arseniferous;* color white; G.=5·5—6·6. 5. *Pseudomorphous;* (*a*) after galenite; (*b*) cerussite.

Both the green and brown colors occur among the pure phosphates of lead, as well containing lime.

Comp.—3 $\dot{\mathrm{P}}\mathrm{b}^3\ddot{\bar{\mathrm{P}}}+\mathrm{Pb\,Cl}$, or $(\frac{9}{10}\dot{\mathrm{P}}\mathrm{b}+\frac{1}{10}\mathrm{Pb\,Cl})^{10}\ddot{\bar{\mathrm{P}}}^3$, with lime often replacing part of fluorid of calcium part of the chlorid of lead, and arsenic acid sometimes part of the p acid, =Phosphoric acid 15·7, oxyd of lead 74·1, chlorine 2·6, lead 7·6=Phosphate of l chlorid of lead 10·2=100. Analyses: 1–3, Kersten (Schw. J., lxi. 1, Pogg, xxvi. 4 Lerch (Ann. Ch. Pharm., xlv. 328); 6, 7, Sandberger (J. pr. Ch., xlvii. 462); 8, Struve Min. Russl., iii. 42); 9, Wöhler (Pogg. iv. 161); 10, 11, Kersten (l. c.); 12, G. Barruel Wöhler (l. c.); 14, Struve (l. c.); 15, 16, Seidel (Jahrb. Min. 1864, 222):

1. *With little or no phosphate of lime* ($\dot{\mathrm{C}}\mathrm{a}^3\ddot{\bar{\mathrm{P}}}$).

		$\dot{\mathrm{P}}\mathrm{b}^3\ddot{\bar{\mathrm{P}}}$	Pb Cl	Ca F	$\dot{\mathrm{C}}\mathrm{a}^3\ddot{\bar{\mathrm{P}}}$
1.	Mies, *brown cryst.*	89·27	9·66	0·22	0·85=100 Kersten. G.=6·983.
2.	Bleistadt, "	89·17	9·92	0·14	0·77=100 Kersten. G.=7·009.
3.	Poullaouen, *cryst.*	89·91	10·09	——	——=100 Kersten. G.=7·050.
4.	Bleistadt, *brown cryst.*	87·38	10·23	0 07	0·86, $\dot{\mathrm{F}}\mathrm{e}^3\ddot{\bar{\mathrm{P}}}$ 0·77=99·31 Lerch. G.=
5.	" "	88·42	9·57	0·20	1·58, $\dot{\mathrm{F}}\mathrm{e}^3\ddot{\bar{\mathrm{P}}}$ 0·50=100·27 Lerch.
6.	Ems, *yellow cryst.*	89·07	11·33	——	——=100·40 Sandberger.
7.	Krausberg, *green*	89·16	10·47	——	——=99·63 Sandberger.
8.	Beresovsk, *ywh.-gn.*	89·18	9·94	——	——, $\ddot{\bar{\mathrm{F}}}\mathrm{e}$, $\ddot{\bar{\mathrm{C}}}\mathrm{r}$ 0 59, $\dddot{\mathrm{V}}$ *tr.*=99·71 Struve. (
9.	Leadhills, *orange-red*	90·09	9·91	——	——=100 Wöhler.

2. *With much phosphate of lime* (*Polysphærite*).

10.	Freiberg, *brown*	77·02	10·84	1·09	11·05=100 Kersten. G.=6·092.
11.	Mies, "	81·65	10·64	0·25	7·46=100 Kersten. G.=6·444.
12.	*Nussierite*	56·40	7·65	——	22·20, $\ddot{\mathrm{S}}\mathrm{i}$ 7·20, $\ddot{\bar{\mathrm{A}}}\mathrm{s}$, $\ddot{\bar{\mathrm{F}}}\mathrm{e}$ 6 50=99·95 Barr

3. *Containing arsenic acid.*

		$\ddot{\bar{\mathrm{P}}}$	$\ddot{\bar{\mathrm{A}}}\mathrm{s}$	$\dot{\mathrm{P}}\mathrm{b}$	Pb Cl
13.	Zschopau, *white*	[15·17]	2·30	72·44	10·09=100 Wöhler.
14.	Altai, *yellow*	12·90	2·61	73·40	10·13=99·04 Struve. G.=5·537.
15.	Badenweiler, *wax-yellow*	16·11	0·66	77·46	——, $\dot{\mathrm{C}}\mathrm{a}$ 2·40, Cl 2·64=99·27 Seidel.
16.	" *dark orange*	15·88	0·69	77·45	——, $\dot{\mathrm{C}}\mathrm{a}$ 2·45, Cl *undet.* Seidel.

Hunt found the cherokine (a specimen received from Shepard) to consist of *lead* and *acid*, with less than 1 p. c. of other material (Am. J. Sci., II. xxiv. 275).

Specimens of pyromorphite from Huelgoet are often mixed with plumbogummite, an alumina up to 16 p. c. (Damour, Ann. d. M., III. xvii. 191, 1840).

Pyr., etc.—In the closed tube gives a white sublimate (chlorid of lead). B.B. in the forceps fuses easily (F.=1·5), coloring the flame bluish-green; on charcoal fuses without reduction to a globule, which on cooling assumes a crystalline polyhedral form, while the coal is coated white from chlorid, and, nearer the assay, yellow from oxyd of lead. With soda on charcoal yields metallic lead; some varieties contain arsenic, and give the odor of garlic in R.F. on charcoal. With salt of phosphorus, previously saturated with oxyd of copper, gives an azure-blue color to the flame when treated in O.F. (chlorine). Soluble in nitric acid.

Obs.—Pyromorphite occurs principally in veins, and accompanies other ores of lead.

Occurs at Poullaouen and Huelgoet in Brittany: at Zschopau and other places in Saxony; at Przibram, Mies, and Bleistadt, in Bohemia; at Sonnenwirbel near Freiberg; Clausthal in the Harz; in fine crystals at Nassau; Beresof in Siberia; Cornwall (green and brown), Devon (gray), Derbyshire (green and yellow), Cumberland (golden-yellow), in England; Leadhills (red and orange formerly), in Scotland; Wicklow (clove-brown and yellowish-green) and elsewhere, Ireland.

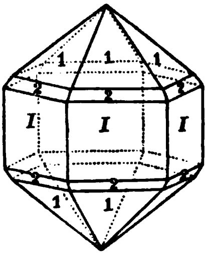
Pyromorphite has been found in good specimens at the Perkiomen lead mine near Philadelphia, and very fine at Phenixville; also in Maine, at Lubec and Lenox; in New York, a mile south of Sing Sing; sparingly at Southampton, Massachusetts, and Bristol, Conn.; in good crystallizations of bright green and gray colors, in Davidson Co., N. C.

Named from πῦρ, *fire*, μορφή, *form*, alluding to the crystalline form the globule assumes on cooling. This species passes into the following.

Alt.—Occurs altered to galenite (Pb S), cerusite ($\dot{\mathrm{P}}\mathrm{b}\,\ddot{\mathrm{C}}$), calamine ($\dot{\mathrm{Z}}\mathrm{n}^3\,\dddot{\mathrm{S}}\mathrm{i}+\dot{\mathrm{H}}$), calcite, and limonite; to galenite, probably through the action of sulphuretted hydrogen.

494. MIMETITE. Minera plumbi Viridis pt., Plumbum arsenico mineralisatum, *Wall.*, Min., 296, 1748. Plomb vert arsenical (fr. Andalusia) *Proust.*, J. de Phys., xxx. 394, 1787. Idem (fr. Roziers, with anal.) *Fourcroy*, Mem. Ac. Sci. Paris, 1789. Arsenikalisches Bleyerz *Lenz*, Min., ii. 224, 1794. Grünbleierz pt., Buntbleierz pt., Flockenerz, Traubenblei pt., Arsensaures Blei. *Germ.* Arsenate of Lead, Green Lead Ore pt. Plomb arseniaté *Fr.* Pyromorphite pt. *Mohs.* Mimetèse *Beud.*, Tr., ii. 594, 1832; Mimetene *Shep.*, Min., 1835; Mimetesit *Breith.*, Handb., 289, 1841; Mimetit *Haid.*, Handb., 1845, *Glocker*, Syn., 1847. Hedyphane *Breith.*, Schw. J., iii. 11, 1830. Kampylit *Breith.*, Handb., ii. 291, 1841.

443



Hexagonal. $O \wedge 1=139°\ 58'$; $a=0{\cdot}7276$. Observed lanes as in pyromorphite. $O \wedge 2=120°\ 46'$, $O \wedge 2\text{-}2$ $=124°\ 30'$, $1 \wedge 1$, pyr.,$=142°\ 29'$, bas.,$=80°\ 4'$ (mean f measurements by Schabus). Cleavage: 1, imperfect. H. = 3·5. G. = 7·0 – 7·25, mimetite; 5·4 – 5·5, edyphane. Lustre resinous. Color pale yellow, assing into brown; orange-yellow; white or coloress. Streak white or nearly so. Subtransparent—anslucent.

Var.—1. *Ordinary.* (*a*) *In crystals.* Schabus found 1 ∧ 1 in crystals om Johanngeorgenstadt 142° 37′, 79° 44′, 142° 32′, 79° 56′, 142° 29′, 80° 4′, 142° 13′, 80° 43′; om England, 142° 45′, 79° 24′; from Phenixville, Pa., 142° 18′, 80° 30′ (Pogg., c. 297). (*b*) *Capary* or filamentous, especially marked in a variety from St. Prix-sous-Beuvray, France; somewhat e asbestus, and straw-yellow in color. (*c*) *Concretionary.*

2. *Calciferous.* *Hedyphane*, which belongs here, is colorless and translucent, in crystals and assive; lustre between adamantine and greasy; H.=3·5–4; G.=5·4–5·5, Kersten; from ngban in Wermland, Sweden.

3. *Containing much phosphoric acid.* *Campylite*, from Drygill in Cumberland, has G.=7·218, and in barrel-shaped crystals (whence the name, from καμπυλος, *curved*), yellowish to brown and wnish-red.

Comp.—$3\,\dot{\mathrm{P}}\mathrm{b}^3\,\bar{\ddot{\mathrm{A}}}\mathrm{s}+\mathrm{Pb\,Cl}$, or $(\frac{9}{10}\,\dot{\mathrm{P}}\mathrm{b}+\frac{1}{10}\,\mathrm{Pb\,Cl})^{10}\,\bar{\ddot{\mathrm{P}}}{}^3$=Arsenate of lead 90·66, chlorid of lead 4; but with phosphoric usually replacing part of the arsenic acid, and sometimes, also, lime t of the oxyd of lead. Analyses: 1, Bergemann (Pogg., lxxx. 401); 2. J. L. Smith (Am. J. Sci., xx. 248); 3, Wöhler (Pogg., iv. 167); 4, 5, Dufrénoy (Tr., iii. 46); 6, Rammelsberg (Pogg., 310); 7, Struve (Verh. Min. Ges. St. Petersb., 1857); 8, Kersten (Schw. J., lxii. 1):

		$\dot{\mathrm{P}}\mathrm{b}^3\ddot{\bar{\mathrm{A}}}\mathrm{s}$	$\dot{\mathrm{P}}\mathrm{b}^3\ddot{\bar{\mathrm{P}}}$	$\dot{\mathrm{C}}\mathrm{a}^3\ddot{\bar{\mathrm{A}}}\mathrm{s}$	$\dot{\mathrm{C}}\mathrm{a}^3\ddot{\bar{\mathrm{P}}}$	Pb Cl	
1. Zacatecas, *yellow, cr.*		90·07	——	——	——	9·92=99·99	Bergemann.
2. Phenixville,	*ywh.*	89·52	0·84	——	——	9·38=99·73	Smith.
3. Johanngeorgenstadt,	"	82·74	7·50	——	——	9·60=99·84	Wöhler.
4. Horhausen		86·70	2·15	——	——	10·40=98·25	Dufrénoy.
5. Cornwall		84·55	4·50	——	——	9·05=98·10	Dufrénoy.
6. Cumberland, *Campylite*		71·70	19·00	——	——	9·45=100·15	Ramm.
7. Siberia	G.=6·653	76·73	13·94	——	——	9·33=100	Struve.
8. Longban, *Hedyphane*		60·10	——	12·98	15·51	10·29=98·88	Kersten.

Michaelson found for the Longban hedyphane $\ddot{\bar{\mathrm{P}}}$ 3·19, $\ddot{\bar{\mathrm{A}}}\mathrm{s}$ 28·51, $\dot{\mathrm{P}}\mathrm{b}$ 57·45, $\dot{\mathrm{C}}\mathrm{a}$ 10·50, Cl 3·06-2·93, corresponding to Pb Cl 11·70 (J. pr. Ch., xc. 108). Ratio of $\ddot{\bar{\mathrm{P}}}$ to $\ddot{\bar{\mathrm{A}}}\mathrm{s}$ in campylite, anal. 1 : 3½ (0·50 $\dot{\mathrm{C}}\mathrm{a}$ above removed); in anal. 7, 1 : 5; in hedyphane 1 : 2; and of $\dot{\mathrm{C}}\mathrm{a}$ to $\dot{\mathrm{P}}\mathrm{b}$ in th last 4 : 3.

Domeyko obtained for an impure, earthy, yellow mimetite, from Mina Grande, near Arquer in Chili (Ann. d. M., IV. xiv. 145), $\ddot{\bar{\mathrm{A}}}\mathrm{s}$ 11·55, $\ddot{\bar{\mathrm{P}}}$ 5·13, $\ddot{\mathrm{V}}$ 1·86, $\dot{\mathrm{P}}\mathrm{b}$ 58·31, $\dot{\mathrm{C}}\mathrm{a}$ 7·96, $\dot{\mathrm{C}}\mathrm{u}$ 0·92, Pb 9·05, $\ddot{\bar{\mathrm{A}}}\mathrm{l}$, $\ddot{\bar{\mathrm{F}}}\mathrm{e}$ 1·1, clay 2, $\dot{\bar{\mathrm{H}}}$ 1·12=99·00. Domeyko does not cite this analysis in the last editi of his mineralogy (1860). It is associated with a vanadate of lead and copper.

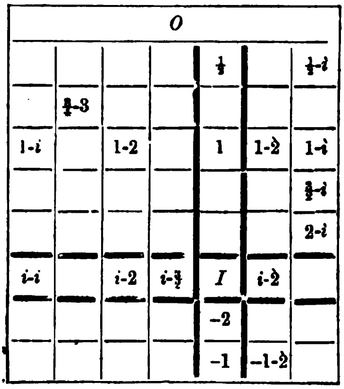
Pyr., etc.—In the closed tube like pyromorphite. B.B. fuses at 1, and on charcoal gives R.F. an arsenical odor, and is easily reduced to metallic lead, coating the coal at first with chlor of lead, and later with arsenous acid and oxyd of lead. Gives the chlorine reaction as und pyromorphite. Soluble in nitric acid.

Obs.—Occurs at Wheal Unity, near Redruth in Cornwall, and at several other of the Corni mines; also at Beeralston in Devonshire; Roughten Gill, Drygill, etc., in Cumberland; former at Leadhills and Wanloch Head in Scotland. At St. Prix in the Department of the Saone, France, in capillary crystals; at Johanngeorgenstadt, in fine yellow crystals; at Nertschins Siberia, in reniform masses, brownish-red; also at Zinnwald, and Badenweiler. The crystals fro Preobragansk Bergwerk, Siberia, were black externally, having a coating of pyrolusite, but yell within. At the Brookdale mine, Phenixville, Pa., crystals of pyromorphite capped with mimeti

Named from μιμητής, *imitator*, it closely resembling pyromorphite. Beudant's word *mimetese* inadmissible, because wrongly formed. Shepard's modification of it, *mimetene*, he has rejected f *mimetite* in his last edition. *Mimetite* is the correct form in view of the derivation. Mohs unit this species with pyromorphite.

Artif.—Formed by fusing together arsenate and chlorid of lead, and dissolving out afterwa the excess of chlorid (Lechartier, C. R., lxv. 172).

495. WAGNERITE. Wagnerit, Phosphorsaurer Talk, *Fuchs*, Schw. J, xxxiii. 269, 18
Magnésie phosphatée *Fr.* Pleuroklas *Breith.*, Char., 50, 193, 1823.



Observed Planes.

Monoclinic. $C=71°\ 53'$, $I \wedge I=9$ 25′, $O \wedge 1\text{-}\grave{i}=144°\ 25'$, B. & M.; $a : b : c$ 0·78654 : 1 : 1·045.

O ∧ ½-ì=160° 19′
O ∧ 1-i=135 18
O ∧ i-i=108 7
1-ì ∧ 1-ì, top,=108 50
i-i ∧ 1-i=116 35
1 ∧ 1, front,=112 6
−1 ∧ −1, " =127 32
1-2 ∧ 1-2, " =142 48
½ ∧ ½, " =138 54
1-2̀ ∧ 1-2̀, " =106 4
−1-2̀ ∧ −1-2̀, " =119 0
i-2 ∧ i-2, " =131 4
i-2̀ ∧ i-2̀, side, =122 25

Most of the prismatic planes deeply striated. Cleavage: *I*, and the orth diagonal, imperfect; *O* in traces.

H.=5–5·5. G.=3·068, transparent crystal; 2·985, untransparent, Rammelsberg. Lustre vitreous. Streak white. Color yellow, of different shades; often grayish. Translucent. Fracture uneven and splintery across the prism.

Comp.—$\dot{\mathrm{M}}\mathrm{g}^3\overset{\cdot\cdot}{\bar{\mathrm{P}}}+\mathrm{Mg\,F}$, or $(\frac{3}{4}\dot{\mathrm{M}}\mathrm{g}+\frac{1}{4}\mathrm{Mg\,F})^4\overset{\cdot\cdot}{\bar{\mathrm{P}}}$=Phosphoric acid 43·8, magnesia 37·1, fluorine 11·7, magnesium 7·4=100. Analyses: 1, Fuchs (l. c., revised by Rammelsberg); 2–4, Rammelsberg (Pogg., lxiv. 251, 405, Min. Ch., 349):

	$\overset{\cdot\cdot}{\bar{\mathrm{P}}}$	$\dot{\mathrm{M}}\mathrm{g}$	$\dot{\mathrm{F}}\mathrm{e}$	$\dot{\mathrm{C}}\mathrm{a}$	F
1.	41·73	46·66	4·50	——	6·17, $\dot{\mathrm{M}}\mathrm{n}$ 0·45=99·51 Fuchs.
2.	40·61	46·27	4·59	2·38	9·36=103·21 Ramm.
3.	41·89	42·04	2·72	1·65	*und.*, $\ddot{\bar{\mathrm{A}}}\mathrm{l}$ 0·55 Ramm.
4.	40·23	38·49	3·31	4·40	*und.*, " 0·96 Ramm.

Pyr., etc.—B.B. in the forceps fuses at 4 to a greenish-gray glass; moistened with sulphuric acid colors the flame bluish-green. With borax reacts for iron. On fusion with soda effervesces, but is not completely dissolved; gives a faint manganese reaction. Fused with salt of phosphorus in an open glass tube reacts for fluorine. Soluble in nitric and muriatic acids. With sulphuric acid evolves fumes of fluohydric acid.

Obs.—This rare species occurs in the valley of Höllgraben, near Werfen, in Salzburg, Austria, in irregular veins of quartz, traversing clay slate.

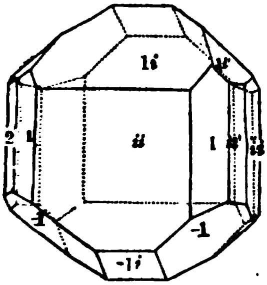
Named after the Oberbergrath WAGNER.

Alt.—In a specimen of apparently altered wagnerite, Rammelsberg found $\dddot{\mathrm{S}}\mathrm{i}$ 93·81, $\overset{\cdot\cdot}{\bar{\mathrm{P}}}$ 1·87, $\dot{\mathrm{M}}\mathrm{g}$ 1·49, $\dot{\mathrm{C}}\mathrm{a}$ 2·58, $\ddot{\bar{\mathrm{A}}}\mathrm{l}$, $\ddot{\bar{\mathrm{F}}}\mathrm{e}$ 1·41.

496. MONAZITE. Monazit *Breith.*, Schw. J., lv. 301, 1829. Monacite *bad orthogr.* Mengite *Brooke*, Phil. Mag., II. x. 139, 1831. Edwardsite *Shep.*, Am. J. Sci., xxxii. 162, 1837. Eremite *Shep.*, ib., 341, 1837. Monazitoid *Herm.*, J. pr. Ch., xl. 21, 1847. Urdit *Forbes & Dahll*, Nyt. Mag. f. Nat., xiii. 1856.

Monoclinic. *C*=76° 14′, *I* ∧ *I*=93° 10′, *O* ∧ 1-ì=138° 8′; *a* : *b* : *c*= 0·94715 : 1 : 1·0265. Observed planes: *O*, rare; vertical, *i*-*i*, *i*-ì, *I*, *i*-2, *i*-2̀; clinodomes, 1-ì, 2-ì; hemidomes, 1-*i*, –1-*i*; hemioctahedral, 1, –1, ½, 1-2, 2-2, 3-3, –2-2̀.

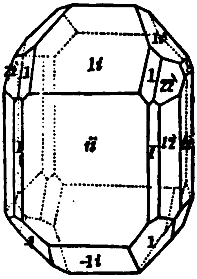
446



Norwich, Ct.

O ∧ 1-*i*=130° 6′
O ∧ –1-*i*=143 6
O ∧ *i*-*i*=103 46
O ∧ –1 =133 39
O ∧ 1=121 6

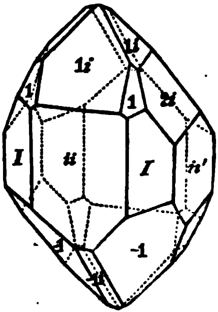
447



Watertown, Ct.

O ∧ –2-2=121° 18′
O ∧ 2-ì=119 10
O ∧ *i*-ì=90
1 ∧ 1, front,=106 36
–1 ∧ –1, " =119 22

448



Watertown, Ct.

–2-2̀ ∧ –2-2̀, front,=81° 4′
i-*i* ∧ –1-*i*=140 40
i-*i* ∧ 1-*i*=126 8
i-*i* ∧ 1-ì=100 13
i-*i* ∧ 2-ì=93 6

1-*i* ∧ −1-*i*, top, =93° 12′
1-*i* ∧ 1=143 18
i-2̆ ∧ *i*-2̆, front, =55 42
i-*i* ∧ *I*=136 40
i-*i* ∧ −1=131 53
i-*i* ∧ 1=118° 13′
i-*i* ∧ −2-2̆=120 10
−2-2̆ ∧ 2-*ì*=152 56
−1 ∧ *I*=146 17
1 ∧ *I*=138° 58′
i-*ì* ∧ 2-*ì*=150 50
i-*ì* ∧ 1-*ì*=131 52
i-*ì* ∧ *i*-2̆=152 9

Crystals usually flattened parallel to *i*-*i*. Cleavage: *O* very perfect, and brilliant. Twins: composition-face *O*.

H.=5−5·5. G.=4·9−5·26; 5·203, N. C., Genth; 5·11, Ural, Kokscharof; 5·19−5·26, urdite, Forbes. Lustre inclining to resinous. Color brownish-hyacinth-red, clove-brown, or yellowish-brown. Subtransparent—subtranslucent. Rather brittle.

Comp.—(Ċe, L̇a, Ḋi, T̈h$\frac{1}{2}$)^3 P⃛. The later analysis of Hermann (1864) gives the O. ratio for Ċe L̇a, Ḋi to T̈h to P⃛=9 : 6 : 25. Analyses: 1, Kersten (Pogg., xlvii. 385); 2, Hermann (J. pr. Ch., xxxiii. 90); 3, id. (ib., xciii. 112); 4, Damour (Ann. Ch. Phys., III. li. 445):

	P⃛	T̈h	S̈n	Ċe	L̇a	Ṁn	Ċa	
1. Slatoust	28·50	17·95	2·10	26·00	23·40	1·86	1·68,	K̇ and T̈i *tr.*=101·49 Kersten.
2. "	28·05	——	1·75	37·36	27·41	*tr.*	1·46,	Ṁg 0·80, Ḟe *tr.*=99·59 Hermann.
3. "	28·15	*tr.*	——	35·85[a]	32·42	1·55	——.	Ḣ 1·50=99·47 Hermann.
4. R. Chico	28·6	——	——	45·7	24·1	——	——,	insol. 1·6=100 Damour.

[a] Includes also Ḋi O.

Thoria was detected in monazite both by Berzelius and Wöhler, though not by Hermann. Tin was detected, with the blowpipe, by Rose in the American monazite.

Shepard found in his edwardsite (l. c.) 7·77 p. c. zirconia, 4·44 Ä̶l, 3·33 S̈i, with 56·58 Ċe, L̇a, and 26·66 P⃛; but rejects his results in the last edition of his Mineralogy, referring both edwardsite and eremite to monazite.

Var.—The crystal affording the author the above angles (f. 447) was a fine one with polished faces, well calculated for accurate measurements.* Hermann gives the angle *I* ∧ *I*=92° 30′; Breithaupt, 94° 35′.

Descloizeaux obtained for crystals from the auriferous sands of R. Chico, in Antioquia (Ann. Ch. Phys., III. li. 445), *I* ∧ *I*=93° 20′, *I* ∧ *i*-*i*=136° 30′, 76° 15′, *i*-*i* ∧ −1-*i*=127°, *O* ∧ −1-*i*=129° 30′, −1 ∧ −1=107° (nearly), −1 ∧ 1-*i*=143° 40′. Kokscharof has measured crystals from Mt. Ilmen and the river Sanarka, and found *I* ∧ *I*=93° 22′, *C*=76° 14′, *O* ∧ 2-*i*=119° 10′, *O* ∧ 1-*i*=138° 9′, 1 ∧ 1=119° 28′, −1 ∧ −1=106° 44′, *O* ∧ 1-*i*=143° 2′, *O* ∧ −1-*i*=129° 59′; the faces were not very even, and his results, he states, were therefore not very exact.

Pyr., etc.—B.B. infusible, turns gray, and when moistened with sulphuric acid colors the flame bluish-green. With borax gives a bead yellow while hot and colorless on cooling; a saturated bead becomes enamel-white on flaming. Difficultly soluble in muriatic acid.

Obs.—Monazite was first brought by Fiedler from the Ural. It occurs near Slatoust in the Ilmen Mtn., in granite, along with flesh-red feldspar; also near the river Sanarka, in the Ural; near Nöterö in Norway (*urdite*), in crystals sometimes 1 in. across; at Schreiberhau, with gadolinite (G.=4·9). In the United States it is found in small crystals from $\frac{1}{16}$ to $\frac{1}{4}$ in. long, with the sillimanite of Norwich, and sparingly with the same mineral at Chester, Ct. A few minute crystals (*eremite* of Shepard) were found in a boulder of albitic granite, containing also a few minute zircons and tourmalines, in the northeastern part of Watertown, Ct. Good crystals are obtained with the sillimanite of Yorktown, Westchester Co., N. Y.; near Crowder's Mountain, N. C.; and in gold washings on Todd's branch, Mecklenburg Co., N. C., with garnet, zircon, and diamond. Found also in the gold washings of Rio Chico, in Antioquia.

Named from μονάζω, *to be solitary*, in allusion to its rare occurrence.

Monazitoid Hermann (J. pr. Ch., xl. 21). This mineral is monazite in crystallization and external characters. H.=5. G.=5·281. Hermann states that the brown color is distinct. Hermann obtained in his analysis:

P⃛ 17·94 Ċe 49·35 L̇a 21·30 Ċa 1·50 Ḣ 1·36, subst. like tantalum 6·27, Ṁg, Ḟe *tr.*=97·72.

B.B. infusible. With the fluxes like monazite.

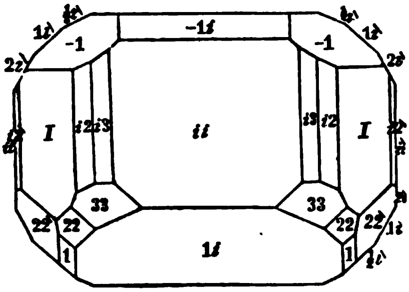
497. TURNERITE *Levy*, Ann. Phil., xviii. 241, 1823. Turnerite is isomorphous with monazite.

---

* Am. J. Sci., xxxiii, 70, 1838. Fig. 3 in that article is zircon, and not monazite.

and like it in cleavage and color, and may be the same species. It is known only in rare crystals; the original, from Mt Sorel in Dauphiny (measured by Levy, Marignac, Phillips, and Des-cloizeaux); later, from Santa Brigritta, near Ruäras in the Tavetsch valley, Alps (measured by vom Rath). The accompanying profile figure is from vom Rath (Pogg., cxix. 247), but reversed in position so as to make it correspond with the above; moreover, the plane of perfect cleavage is made the basal, as in monazite, instead of *i-i*, that so made by v. Rath. Some of the angles are as follows: those unaccredited, v. Rath's calculated results, from 1-*i* ∧ 1=141° 23′, 1-*i* ∧ 1=143° 44′, *i-i* ∧ 1-*i*=131° 58′; those with Dx. affixed, Des-cloizeaux's ditto, from *i-i* ∧ 1-*i*=100, *i-i* ∧ 1-*i*=126° 31′, 1-*i* ∧ 1-*i*=96° 20′; those with M., P., L., affixed, measurements by, respectively, Marignac, Phillips, Levy:

449



I ∧ *I*=93° 50′
O ∧ 1-*i*=130 3
O ∧ −1-*i*=142 15
O ∧ *i-i*=102 42
O ∧ −1=133 0
O ∧ 1=121 15
i-i ∧ −1-*i*=140 27
" 140 40 Dx.
i-i ∧ 1-*i*=127 15
" 126 31 Dx.
" 126 31 M.
i-i ∧ 3-3=153 25
" 153 17 Dx.
" 153 52 P.
" 152 55 M.
i-i ∧ 2-2=142 6
" 141 15 M.

i-i ∧ *I*=136° 55′
" 136 48 Dx.
" 137 22 L.
" 136 48 M.
i-i ∧ *i*-2=154° 58′
1-*i* ∧ 1=143 44
" 143 30 Dx., P.
−1-*i* ∧ −1=149 36
" 149 44 Dx.
" 149 38 P.
i-i ∧ 1-*i*= 99 24½
" 100 0 Dx.
" 99 40 L.
" 100 25 M.
i-i ∧ 2-*i*=96 8
i-i ∧ −1=131 41
" 131 55 Dx.

i-i ∧ 1=191° 12½′
" 119 8 R.
i-i ∧ 1=126 16 R.
" 126 30 Dx.
" 126 25 M.
i-i ∧ 2-*i*=150 56
" 150 49 Dx.
" 150 55 P., M.
" 150 58 R.
i-i ∧ 1-*i*=131 58
" 131 50 M.
" 131 55 P.
i-i ∧ 2-2=145 43½
" 145 57 Dx.
" 146 10 P.
" 145 53 M.
1-*i* ∧ 1-*i*, top,=86 4

Turnerite is described as having H. above 4; lustre adamantine; color yellow or brown; streak white or grayish; transparent to translucent. Children, after some imperfect trials, made out that it contained alumina, lime, magnesia, a little iron, with no titanic acid, and very little silica. At Mt. Sorel it occurs with quartz, albite, orthoclase, crichtonite, and octahedrite; and in the Tavetsch valley, with quartz crystal and octahedrite in talcose schist.

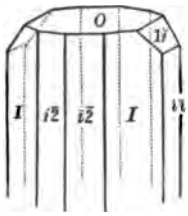
498. TRIPHYLITE. Triphylin *Fuchs*, J. pr. Ch., iii. 98, 1834, v. 319, 1835. Tetraphylin *Berz.*, Arsb., xv. 1835. Perowskyn *N. Nordenskiöld.*

Orthorhombic. *I* ∧ *I*=98°; *O* ∧ 1-ī=129° 33′, Tschermak; *a* : *b* : *c*= 1·211 : 1 : 1·1504. Observed planes: *O*; vertical, *i*-ĭ, *I*, *i*-2; domes, ½-ī, 1-ī, $\frac{3}{2}$-ī; 1-ĭ, $\frac{3}{2}$-ĭ.

I ∧ *I*, ov. *i*-ĭ,=82°
I ∧ *i*-ĭ=131
I ∧ *i*-2=162 30
I ∧ 1-ī=135 8
i-2 ∧ *i*-2=133

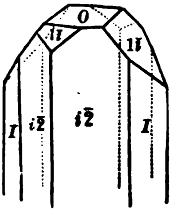
O ∧ 1-ĭ=133° 32′
O ∧ ½-ĭ=
O ∧ $\frac{3}{2}$-ī=
O ∧ $\frac{3}{2}$-ĭ=130 54
1-ĭ ∧ 1-ĭ, ov. *O*,=87 4

450



Norwich.

451



Bodenmais.

Faces of crystals usually uneven. Cleavage: *O* nearly perfect in unaltered crystals. Massive.

H.=5. G.=3·54—3·6; 3·545—3·561, Bodenmais, Oesten. Subresinous. Color greenish-gray; also bluish; often brownish-black externally Streak grayish-white. Translucent in thin fragments.

Comp.—$(\dot{F}e, \dot{M}n, \dot{L}i)^3\ddot{\overline{P}}$, Fuchs. Oesten's analysis, which was made on the pure minera wholly unaltered, sustains Fuchs's formula. O. ratio for $\dot{F}e + \dot{M}n, \dot{L}i + \dot{N}a + \dot{M}g = 2 : 1$.

Analyses: 1, Fuchs (J. pr. Ch., iii. 98, v. 319); 2, 3, Rammelsberg (Pogg., lxxxv. 439); 4, Baer (Arch. Pharm., II. lvii. 374); 5, G. O. Wittstein (Viert. pr. Pharm., i. 506); 6, Gerlach (ZS nat. Ver. Halle, lx 149); 7, Oesten (Pogg., cvii. 438); 8, imperfect anal. by Berzelius and N. Nordenskiöld (Jahresb., xv. 211):

	$\ddot{\overline{P}}$	$\dot{F}e$	$\dot{M}n$	$\dot{M}g$	$\dot{C}a$	$\dot{L}i$	$\dot{N}a$	$\dot{K}$	$\ddot{\overline{S}}i$	$\dot{H}$	
1. Bodenmais	41·47	48·57	4·70	——	——	3·40	——	——	0·53	0·68	=99·35 Fuchs.
2. "	39·35	41·42	9·48	——	——	7·08	1·07	0·35	——	1·28	=99·98 Ramm.
3. "	40·72	39·97	9·80	——	——	7·28	1·45	0·58	0·25	——	=100·05 Ramm.
4. "	36·36	44·52	5·76	0·78	1·00	5·09	5·16	1·19	1·78	——	=100·59 Baer.
5. "	41·09	35·61	11·40	0·48	——	5·47	0·87	0·07	$\ddot{\overline{F}}e$ 3·81	1·03	=99·03 Wittst.
6. "	40·32	36·54	9·05	1·97	0·58	6·84	2·51	0·35	——	——	=98·16 Gerl.
7. "	44·19	38·21	5·63	2·39	0·76	7·69	0·74	0·04	0·40	——	=100·05 Oesten.
8. Finland	42·6	38·6	12·1	1·7	——	8·2	——	——	——	——	=103·2 Berz.

The excess in the analysis of the Finland mineral (tetraphyline) is supposed to be owing to an incorrect determination of the lithia.

Pyr., etc.—In the closed tube sometimes decrepitates, turns to a dark color, and gives off traces of water. B.B. fuses at 1·5, coloring the flame beautiful lithia-red in streaks, with a pale bluish-green on the exterior of the cone of flame. The coloration of the flame is best seen when the pulverized mineral moistened with sulphuric acid is treated on a loop of platinum wire. With borax gives an iron bead; with soda a reaction for manganese. Soluble in muriatic acid.

Obs.—Triphylite occurs at Rabenstein, near Zwiesel, in Bavaria; and f. 451 is from a large somewhat distorted Bavarian crystal in the cabinet of R. P. Greg, Jr., having the appearance of being altered; also at Keityö, in Finland (perowskine or tetraphyline); Norwich, Mass.

On cryst., Tschermak, Ber. Ak. Wien, xlvii. 282; R. P. Greg, this Min., 406, 1854; Dana, ib. Named from τρίς, *three-fold*, and φυλή, *family*, in allusion to its containing three phosphates.

Alt.—Triphylite and triplite, like other minerals containing protoxyd of manganese, undergo easy alteration by oxydation and hydration; and the former also by losing its alkalies. The sesquioxyd of iron in Wittstein's analysis (anal. 5) is thus accounted for. The following have come from the alteration of one or the other of these minerals.

A. HETEROSITE. Heteposite *Alluaud*, in an Art. by *Vauquelin*, Ann. Ch. Phys., xxx. 294, 1825. Heterosite, Heterozite, *Alluaud*, Ann. Sci. Nat., viii. 346, 1826.

Cleavable massive and lamellar; cleavage stated to be in three directions, unequal, affording an oblique prism of 100°-101°. H.=5·5—6; G.=3·52, or 3·39 after further alteration, Dufrénoy; lustre resinous, or like that of apatite; color greenish- and bluish-gray, becoming violet and submetallic on exposure. Soluble in acids, with a slight residue of silica. B.B. fuses to a deep brown submetallic enamel. Found in pegmatyte near Limoges, Dept. of Haute Vienne, France, and especially at the quarries of Hureaux. Named *heterosite* from ἕτερος, *other* or *different*, but misspelt by Vauquelin.

B. PSEUDOTRIPLITE *Blum*, Orykt., 2 Aufl., 537, with anal. by Delffs. Resembles triplite; but occurs incrusting triphylite at Rabenstein, Bavaria, to the alteration of which its formation is owing.

C. ALLUAUDITE *Damour*, Ann. d. M., IV. xiii. 341, 1848 [not Alluaudite *Bernhardi*]. In nodules, or massive, with three rectangular cleavages as in triplite, two rather easy, the other less so. H.=4—5; G.=3·468, Damour. Color brown, brownish-red at the edges by transmitted light; powder brownish-yellow. B.B. fuses easily to a black magnetic globule. Dissolves in muriatic acid with evolution of chlorine. Supposed to be altered triplite, and comes from Chanteloube, near Limoges.

D. *Altered Triphylite from Norwich, Mass.* The Norwich mineral is found only in crystals, some an inch long and wide, associated with spodumene in quartz. The crystals vary much in their angles; the faces are smooth but hardly polished. The following angles were obtained by the author from 8 crystals (the right-hand *i*-2 is here accented):

	I.	II.	III.	IV.	V.	VI.	VII.	VIII.
i-2 ∧ *i*-2′	128°	131°–132°	127°–130½°	130½	126°	134°	128°	130°
i-2 ∧ *i*-ī			113	113		108	108	
i-2 ∧ *i*-ĭ		121½–122				120	115	118–119
O ∧ 1-ĭ		131	129–132					
i-2 ∧ 1-ĭ		101½–102						

	I.	II.	III.	IV.	V.	VI.	VII.	VIII.
$i\text{-}\bar{2}' \wedge 1\text{-}\bar{i}$		113½°	110°	110°–112°				
$i\text{-}\bar{2}$ (or $i\text{-}\breve{2}'$) ∧ I	159°	162						
O ∧ obtuse edge of I		94–97		90		93°	100°	90°
		86–87	86		86°		80	90
$I \wedge I$			93					

Many of the crystals have a monoclinic form, while others are orthorhombic; but the latter is the normal form; the obliquity having resulted from some movement in the enclosing rock after the crystals were made. They closely resemble in form the crystals from Bavaria. Cleavage not distinct. Color black; streak brownish-red; opaque; brittle; H.=5·5; G.=2·876, Craw. In composition, quite near alluaudite, as observed by Mallet. Brush found the interior of a crystal true triphylite, with color grayish-green; H.=5, and G.=3·534 (Am. J. Sci., II. xxxiv. 402).

Analyses: 1, Dufrénoy (Ann. Ch. Phys., xli. 342); 2, Rammelsberg (Pogg., lxxxv. 439); 3, Fuchs (J. pr. Ch., iii. 98, v. 319); 4, Delffs (l. c.); 5, Damour (l. c.); 6, 7, W. J. Craw (Am J. Sci., II. xi. 99); 8, J. W. Mallet (ib., xviii. 33):

	$\dddot{\bar{P}}$	$\dddot{\bar{Fe}}$	$\dddot{\bar{Mn}}$	$\dot{Fe}$	$\dot{Mn}$	$\dot{Ca}$	$\dot{Li}$	$\dot{H}$	$\ddot{Si}$
1. Limoges, *Heterosite*	41·77	——	——	34·89	17·58	——	——	4·40	0·22=98·85 Dufrénoy.
2. " "	32·18	31·46	30·01	——	——	——	——	6·35	——=100 Ramm.
3. Rabenstein, *Pseudotr.*	35·70	48·17	8·94	——	——	——	——	5·30	1·40=99·51 Fuchs.
4. " "	35·71	51·00	8·07	——	——	——	——	4·52	——, ins. 0·70=100 D.
5. *Alluaudite*	41·25	25·62	1·06	——	23·08	——	——	2·65	0·60, $\dot{Na}$ 5·47=99·73 D.
6. Norwich, Mass.	41·35	27·36	24·70	——	——	1·97	2·27	2·07	——, $\dot{Mg}$ *tr.*, insol. 0·29 =100·01 Craw.
7. " "	44·64	26·02	23·30	——	——	1·61	2·20	2·07	——, $\dot{Mg}$ *tr.*, insol. 0·30 =100·14 Craw.
8. " "	(⅔) 43·04	29·50	22·59	——	——	0·09	1·79	2·05	——, Mg 0·73=99·79 M.

Heterosite, by Rammelsberg's analysis, gives the O. ratio for bases, acid, and water 18·67 : 18·13 : 5·64, and was made on a brownish-violet specimen having G.=3·41; by Dufrénoy's, 3 : 6 : 1. *Pseudotriplite* corresponds nearly to 9 : 10 : 2. *Alluaudite* gives approximately, supposing the manganese to be protoxyd, as stated in the analysis, for the O. ratio for $\dot{R}$, $\dddot{\bar{R}}$, $\dddot{\bar{P}}$, $\dot{H}$= 5 : 6 : 18 : 2; and the Norwich mineral 1 : 9 : 15 : 1. It is useless to write formulas for these compounds until the state of oxydation of the iron and manganese has been more precisely ascertained; and even then they are of little value, as the mineral in the altered state is probably a mere mixture.

MELANCHLOR *Fuchs* (J. pr. Ch., xvii. 171) is altered triphylite according to Sæmann (this Min., 4th ed., 513) It is a phosphate of iron from Rabenstein, containing, in 100 parts, 38·9 sesquioxyd and 3·87 protoxyd of iron, besides protoxyd of manganese, and 9 to 10 p. c. of water; it occurs on triphylite. The name alludes to its blackish-green color.

499. **TRIPLITE.** Phosphate natif de fer melangé de manganèse (fr. Limoges) *Vauq.*, J. de M., xi. 295, 1802, Ann. Ch., xli. 242, 1802. Eisenpecherz pt. *Wern.*, 1808. Manganèse phosphaté *Lucas*, Tabl., i. 169, 1806. Phosphormangan *Karst.*, Tabl., 72, 1808. Manganèse phosphaté ferrifère, *H.*, Tabl., 1809. Triplit *Hausm.*, Handb., 1079, 1813. Eisenapatit *Fuchs*, J. pr. Ch., xviii. 499, 1839. Zwiselit *Breith.*, Handb., ii. 299, 1841. Phosphate of Iron and Manganese. Zwieselit *Glock*, Syn., 244, 1847.

Orthorhombic. Imperfectly crystalline. Cleavage: unequal in three directions perpendicular to each other, one much the most distinct.

H.=4—5·5. G.=3·44—3·8; 3·617, fr. Peilau, Berg. Lustre resinous, inclining to adamantine. Color brown or blackish-brown to almost black. Streak yellowish-gray or brown. Subtranslucent—opaque. Fracture small conchoidal.

Comp.—$\dot{R}^3 \dddot{\bar{P}} + R\,F$, v. Kobell, with $\dot{R}$ in anal. 3 $= \frac{1}{3}\dot{Fe} + \frac{2}{3}\dot{Mn}$, and R=1 Ca + 2 Mg + 3 Fe, which gives for the percentage composition, Phosphoric acid 32·7, protox. iron 16·6, protox. manganese 32·2, iron 6·4, magnesium 1·8, calcium 1·5, fluorine 8·8=100. Analyses: 1, Berzelius (Schw. J., xxvii. 70); 2, Bergemann (J. pr. Ch., lxxix. 414); 3, v. Kobell (J. pr. Ch., xcii. 390); 4, Fuchs (J. pr. Ch., xviii. 499); 5, Rammelsberg (4th Suppl., 247):

	$\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\mathrm{P}}}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Mn}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Na}}$	$\overset{\cdot\cdot\cdot}{\bar{\mathrm{Fe}}}$	$\dddot{\mathrm{Si}}$	F	$\dot{\mathrm{H}}$	
1 Limoges	32·8	31·9	32·6	—	3·2[a]	—	—	—	—	—	=100·5 Berzelius
2. Peilau	32·76	31·72	30·83	0·32	1·19	0·41[b]	1·55	0·23	—	1·28	=100·29 Bergem.
3. Schlackenwald	33·85	26·98	30·00	3·05	2·20	$\dot{\mathrm{K}}$ *tr.*	—	—	8·10	—	=104·18 Kobell.
4. *Zwieselite*	[35·60]	35·44	20·34	—	—	—	$\dot{\mathrm{Fe}}$ 4·76	0·68	3·18	—	=100 Fuchs.
5. "	30·33	41·42	23·25	—	—	—	—	—	6·00	—	=100 Ramm.

[a] Phosphate of lime. [b] With some Li O.

Von Kobell's analysis becomes, on combining the fluorine with Fe, Ca, Mg, $\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\mathrm{P}}}$ 33·85, $\dot{\mathrm{Fe}}$ 19·86, $\dot{\mathrm{Mn}}$ 30·00, Fe 5·54, Mg 1·83, Ca 1·57, F 8·10=100·75.

Pyr., etc.—B.B. fuses easily at 1·5 to a black magnetic globule; moistened with sulphuric acid colors the flame bluish-green. With borax in O.F. gives an amethystine colored glass (manganese); in R.F. a strong reaction for iron. With soda reacts for manganese. With sulphuric acid evolves fluohydric acid. Soluble in muriatic acid.

Obs.—Found by Alluaud at Limoges in France, in a vein of quartz in granite, accompanied by apatite; occurs also at Peilau in Silesia.

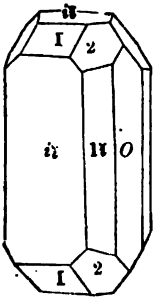
Zwieselite, a clove-brown variety, was found by Fuchs near Rabenstein, 1 league from Zwiesel, in Bavaria, in quartz (G.=3·97 Fuchs). Fuchs in his Mineralogy suggests its relation to triplite. It is stated to have a rather perfect basal cleavage; a brachydiagonal little distinct; and a prismatic parallel to a prism of 129° very imperfect.

Alt.—Often occurs coated with oxyd of manganese as a result of its alteration.

500. HOPEITE. *Brewster*, Trans. R. Soc. Edinb., x. 107, 1825. Prismatoidischer Zinkphylli *Breith.*, Char., 38, 1832.

Orthorhombic. $I \wedge I=101°$, $O \wedge 1\text{-}\bar{\imath}=133°\ 19'$, Levy; $a:b:c=1{\cdot}0607$ 1 : 1·2131. Observed planes as in the annexed figure, with also $2\text{-}\breve{\imath}$, $3\text{-}\breve{\imath}$, and $i\text{-}\breve{3}$.

452



$O \wedge 1\text{-}\bar{\imath}=138°\ 50'$
$1\text{-}\breve{\imath} \wedge 1\text{-}\breve{\imath}$, ov. $O,=97\ 40$
$O \wedge 2\text{-}\breve{\imath}=119\ 47$

$2 \wedge 2$, brach.,$=87°\ 3'$
$2 \wedge 2$, macr.,$=106\ 36$
$2 \wedge 2$, bas.,$=140$

Cleavage: $i\text{-}\breve{\imath}$ highly perfect. Plane O striated. Also in reniform masses, and amorphous.

H.=2·5—3. G.=2·76—2·85. Lustre vitreous; i-ĭ somewhat pearly. Color grayish-white; reddish-brown when compact. Streak white. Transparent—translucent.

Pyr., etc.—Dissolves without effervescence in muriatic or nitric acid and is slowly affected by sulphuric acid. B.B. gives out water, and then melts with difficulty to a clear colorless globule, tinging the flame green. The globule obtained with borax remains clear on cooling. With soda it affords a scoria which is yellow when hot, and gives out copious fumes of zinc and some of cadmium. The fused mineral forms a fine blue glass with a solution of cobalt. Hopeite is supposed, therefore, to be a hydrous compound of phosphoric acid and oxyd of zinc, with a small portion of cadmium. N Nordenskiöld, Jahresb., v. 198, 1825.

Obs.—Found in the calamine mines of Altenberg, near Aix la Chapelle.

Named in honor of Prof. Hope of Edinburgh.

The angle of $\frac{1}{2}\text{-}\bar{\imath} \wedge \frac{1}{2}\text{-}\bar{\imath}$ in hopeite is near $i\text{-}\breve{2} \wedge i\text{-}\breve{2}$ in fischerite.

501. BERZELIITE. Berzeliit *Kühn*, Ann. Ch. Pharm., xxxiv. 211, 1840. Magnesian Pharmacolite *Dana*, Min., 239, 1844. Chaux arseniatée anhydre *Dufr.* Berzelit *Haid.*, Handb., 495 1845. Kühnite *B. & M.*, Min., 481, 1852.

Massive, with cleavage in one direction.

H.=5—6. G.=2·52. Lustre waxy. Color dirty-white or honey-yellow. Brittle.

Comp.—$(\dot{\mathrm{C}}\mathrm{a}, \dot{\mathrm{M}}\mathrm{g}, \dot{\mathrm{M}}\mathrm{n})^{10} \dddot{\mathrm{A}}\mathrm{s}^{3}$. O. ratio for $\dot{\mathrm{R}}$, $\dddot{\mathrm{A}}\mathrm{s}=1:1\frac{1}{2}$. Analyses: Kühn (l. c.):

	$\dddot{\mathrm{A}}\mathrm{s}$	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\mathrm{M}}\mathrm{g}$	$\dot{\mathrm{M}}\mathrm{n}$	ign.
1.	58·51	23·22	15·68	2·13	0·30=99·84 Kühn.
2.	56·46	20·96	15·61	4·26	2·95, insol 0·23=100·47 Kühn.

Another partial analysis gave $\dot{\mathrm{C}}\mathrm{a}$ 21·31, $\dot{\mathrm{M}}\mathrm{g}$, $\dot{\mathrm{M}}\mathrm{n}$ 17·07.

Pyr., etc.—B.B. infusible, but turns gray. With soda on charcoal gives an arsenical odor, with soda on platinum foil fuses with effervescence, and gives a manganese reaction. Soluble in nitric acid.

Obs.—Occurs at Longban in Sweden, with iron ore and granular dolomite.

502. CARMINITE. Carminspath *Sandberger*, Pogg., lxxx. 391, 1859. Carmine Spar. Carminite *Dana*, Min., 410, 1854.

Orthorhombic. In clusters of fine needles. Also in spheroidal forms with a columnar structure. Cleavage parallel to the faces of a rhombic prism.

H.=2·5. G.=4·105. Lustre vitreous, but cleavage pearly. Color carmine to tile-red; powder reddish-yellow. Translucent. Brittle.

Comp.—O. ratio for $\dot{\mathrm{P}}\mathrm{b}$, $\ddot{\bar{\mathrm{F}}}\mathrm{e}$, $\dddot{\mathrm{A}}\mathrm{s}=1\frac{3}{4}:9:17$; or for bases and acid 2 : 3, or, less nearly, 3 : 5. andberger and Muller adopt the latter, and write the formula $\dot{\mathrm{P}}\mathrm{b}^{3}\dddot{\mathrm{A}}\mathrm{s}+5\,\ddot{\bar{\mathrm{F}}}\mathrm{e}\,\dddot{\mathrm{A}}\mathrm{s}$. Analysis by Müller (Pogg., ciii. 345):

$\dddot{\mathrm{A}}\mathrm{s}$ 49·11 $\ddot{\bar{\mathrm{F}}}\mathrm{e}$ 30·29 $\dot{\mathrm{P}}\mathrm{b}$ 24·55=103·95.

Pyr., etc.—B.B. on charcoal fuses easily to a steel-gray globule, giving out arsenical vapors; ith soda a globule of lead, and with borax an iron reaction. Heated in a glass tube no change. oluble in nitric acid.

Obs.—From Horhausen in Prussia, 12–16 m. N.E. of the town of Neuwied on the Rhine, with eudantite and quartz in a mine of limonite.

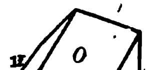
503. AMBLYGONITE. Amblygonit *Breith.*, Hoffm. Min., iv. b, 159, 1817, Handb., 483.

Triclinic. Observed planes as in the annexed figure, Dana.

I ∧ *I*=73° 20′
O ∧ *i-ī*=105
O ∧ *I*, back,=87 40
O ∧ *I′*=111 30?
O ∧ edge *I*/*I*=78 30?
O ∧ *2-ĭ*=105 20

I ∧ *i-ī*=135° 30′
I ∧ *i-2̆*=155 30
I′ ∧ *i-2̆*=97 50
I ∧ *2-ĭ*=107 30
i-ī ∧ *2-ĭ*, ov. *I*,=142 30
i-ī ∧ *1-ī*, adj.,=131 50

453



Hebron, Me.

eavage: *O* perfect; *i-ī* nearly perfect, angle between ese cleavages 104½°; also *I* imperfect. Usually massive, avable; sometimes columnar.

H.=6. G.=3—3·11; 3·046, Hebron, Brush. Lustre arly on face of perfect cleavage (*O*); vitreous on *i-ī*, less fect cleavage-face; on cross-fracture a little greasy. lor pale mountain or sea-green, white, grayish, brownish-ite. Subtransparent—translucent. Fracture uneven. tical axes very divergent; plane of axes nearly at right angles to *i-ī*; ectrix of the acute angle negative, and parallel to the edge *O*/*i-ī*; scl.

mp.—Perhaps $(\frac{1}{3}(\dot{\mathrm{L}}\mathrm{i}, \dot{\mathrm{N}}\mathrm{a})^{3}+\frac{2}{3}\,\ddot{\bar{\mathrm{A}}}\mathrm{l})^{4}\,\dddot{\mathrm{P}}$, with *one-ninth* of the oxygen replaced by fluorine. lyses: 1, Berzelius (Gilb. Ann., lxv. 321); 2, Rammelsberg (Pogg., lxiv. 265, Min. Ch., 359)

	$\dddot{\bar{\text{P}}}$	$\dddot{\bar{\text{Al}}}$	$\dot{\text{Li}}$	$\dot{\text{Na}}$	$\dot{\text{K}}$	F	
1. Chursdorf	56·69	35·69	9·11	——	——	——	Berz.
2. Arnsdorf; G.=3·11 ($\frac{2}{3}$)	47·58	36·88	6·68	3·29	0·43	8·11=102·97	Ramm.

In three trials the alumina was found to be 36·26. 36·62, and 36·89 p. c. Rammelsberg deduc the formula $(\dddot{\bar{\text{Al}}}{}^5 \dddot{\bar{\text{P}}}{}^3 + \dot{\text{R}}^5 \dddot{\bar{\text{P}}}{}^3) + (\text{Al}^2 \text{F}^3 + \text{R F})$, R standing for lithium and sodium; Rose writes (2 l $\dddot{\bar{\text{P}}} + 2\,\dddot{\bar{\text{Al}}}\,\dddot{\bar{\text{P}}}) + (\text{Al}^2 \text{F}^3 + \text{Al}^2 \text{O}^3)$.

Pyr., etc.—In the closed tube yields water, which at a high heat is acid and corrodes t glass. B.B. fuses easily (at 2) with intumescence, and becomes opaque white on cooling. Colors t flame yellowish-red with traces of green; the Hebron variety gives an intense lithia-red; mo tened with sulphuric acid gives a bluish-green to the flame. With cobalt solution assumes a de blue color (alumina). With borax and salt of phosphorus forms a transparent colorless gla In fine powder dissolves easily in sulphuric acid, more slowly in muriatic.

Obs.—Occurs at Chursdorf and Arnsdorf, near Penig in Saxony, where it is associated wi tourmaline and garnet in granite: also at Arendal, Norway. In the U. States, in Maine, at Hebro imbedded in a coarse granite in masses, sometimes well crystallized, with lepidolite, albite, quartz, re green, and black tourmaline, apatite, and rarely cassiterite; also at Mt. Mica in Paris, 8 m. fro Hebron, with tourmaline. The Hebron crystals have rather rough faces, admitting only of appro mative measurement, and are occasionally 1 in. thick and 2 in. long (Am. J. Sci., II. xxxiv. 24 The angles above are from measurements by the author of Hebron crystals. Descloizeaux o tained from the cleavages of the Hebron mineral *O* (*p*) ∧ *i*-*ī* (*m*)=105°; *O* (*p*) ∧ *I* (*t*)=88° 3 *I* (*t*) ∧ *i*-*ī* (*m*)=135° (C. R., lvii. 357, Pogg., cxxiii. 183).

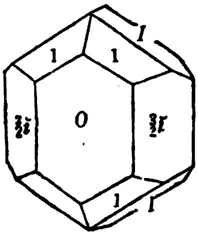
The name is from ἀμβλύς, *blunt*, and γόνυ, *angle*.

504. HERDERITE.

Herderite *Haid.*, Phil. Mag., iv. 1, 1828. Allogonit *Breith.*, Üb., 1830, Char., 78, 1832.

Orthorhombic. *I* ∧ *I*=115° 53′, *O* ∧ 1-*ī*=145° 51′; *a* : *b* : *c*=0·6783 1 : 1·5971. Observed planes as in the annexed figur with also 3, 4, and 6-*ĭ*.

454



O ∧ 1=141° 19′ 1 ∧ 1, mac.,=141° 17′
O ∧ 3=112 35 1 ∧ 1, brach.,=116 3
O ∧ $\frac{2}{3}$-*ĭ*=147 30 *O* ∧ *I*=90

Cleavage: *I* interrupted. Surfaces *I* and 1 very smoot and delicately lined parallel to their edge of interse tion.

H.=5. G.=2·985. Lustre vitreous, inclining subresinous. Streak white. Color various shades yellowish- and greenish-white. Translucent. Fracture small conchoida Very brittle. Index of refraction 1·47.

Comp.—Probably, according to trials by Turner and Plattner, an anhydrous phosphate alumina and lime with fluorine.

Pyr., etc.—B.B. fuses with difficulty to a white enamel; becomes blue with cobalt solutio Dissolves when finely powdered in muriatic acid.

Obs.—Very rare at the tin mines of Ehrenfriedersdorf in Saxony. Resembles the asparag variety of apatite.

Named after Baron von Herder, director of the Saxon mines.

505. MONIMOLITE.

Monimolit *L. J. Igelström*, Œfv. Ak. Stockh., 1865, 227.

Tetragonal. In octahedrons. Also massive and incrusting.

H.=4·5—5. G.=5·94. Lustre submetallic, greasy. Color yellow. Powder citron-yellow. Fracture granular.

Comp.—($\dot{\mathrm{Pb}}$, $\dot{\mathrm{Fe}}$, $\dot{\mathrm{Mn}}$, $\dot{\mathrm{Ca}}$, $\dot{\mathrm{Mg}}$)^4 $\ddot{\overline{\mathrm{Sb}}}$, but mainly antimonate of lead. **Analysis:** Igelström (l. c.):

$\ddot{\overline{\mathrm{Sb}}}$ 40·29	$\dot{\mathrm{Pb}}$ 42·40	$\dot{\mathrm{Fe}}$ $\dot{\mathrm{Mn}}$ 6·20	$\dot{\mathrm{Ca}}$ 7·59	$\dot{\mathrm{Mg}}$ 3 25=99·73.

Pyr., etc.—B.B. on charcoal gives a malleable lead-colored globule, which in O.F. gives a white coating of antimony, and nearer the assay the yellow of oxyd of lead. Insoluble in strong acids, or with carbonated or caustic alkalies, even on fusion. Reduced by hydrogen gas at a red heat; becomes soluble in acids.

Obs.—Occurs with tephroite at the manganese mine of Paisberg, in Wermland, Sweden.

506. ROMEITE. Romeine *Damour*, Ann. d. M., III. xx. 247, 1841; V. iii. 179, 1853.

Tetragonal. In octahedrons, near the regular octahedron in form; 1 ∧ 1, basal, 110° 50′—111° 20′; over the summit, 68° 10′—69° 10′. Occurs in groups of minute crystals. Cleavage none.

H. above 5·5. G. in grains, 4·714; in powder, 4·675. Color hyacinth or honey-yellow.

Comp.—$\dot{\mathrm{R}}^3$, SbO^3, SbO^5 Damour=Antimony 62·24, oxygen 16·32, lime 21·44=100. **Analysis** y Damour (l. c., 1853):

O 15·82	Sb 62·18	Fe 1·31	$\dot{\mathrm{Mn}}$ 1·21	$\dot{\mathrm{Ca}}$ 16·29	$\dddot{\mathrm{Si}}$ sol. 0·96	insol. 1·90=99·67.
r Sb O^5 40·79	Sb O^3 36·82	$\dot{\mathrm{Fe}}$ 1·70	1·21	16·29	0·96	1·90=99·67.

In his earlier analysis (1841) Damour obtained Sb O^3 79·31, $\dot{\mathrm{Fe}}$ 1·20, $\dot{\mathrm{Mn}}$ 2·16, $\dot{\mathrm{Ca}}$ 16·67, $\dddot{\mathrm{Si}}$ sol. ·64=99·98.

Pyr., etc.—B.B. fuses to a blackish slag. With borax affords a colorless glass in the inner lame, a violet in the outer (manganese). With soda on charcoal gives white antimonial fumes nd globules of metallic antimony; fused on platinum foil with soda gives a bluish-green man-anate. Insoluble in acids.

Obs.—Romeite was found by B. de Lom at St. Marcel in Piedmont, in small nests or veins in he gangue which accompanies manganese, consisting in part of feldspar, epidote, quartz, limonite, nd greenovite.

Named by Damour (*not* by Dufrénoy) after the crystallographer Romé de l'Isle.

07. AMMIOLITE. Antimonite de Mercure *Domeyko*, Ann. d. M., IV. vi. 183, 1844. Cinabrio subido *Domeyko*, Min., 168, 1845. Ammiolito *Dana*, Min., 534, 1850. Antimoniato de cobre con cinabrio terroso *Domeyko*, Min., 129, 1860.

Earthy powder. Color deep red, scarlet.

Comp.—Results variable; but regarded as antimonate of copper mixed with cinnabar and with her impurities. Analyses by Domeyko (Min., 129, 1860) of the material obtained in the earliest rt of a process of levigation:

$\ddot{\ddot{\overline{\mathrm{Sb}}}}$	$\dot{\mathrm{Cu}}$	Hg	S	$\overline{\mathrm{Fe}}$	quartz	$\dot{\mathrm{H}}$ and loss.
24·1	16·9	19·9	3·3	2·2	24·8	8·8
29·5	15·6	23·6	3·3	3·1	8·1	16·9
28·1	18·1	19·8	3·1	1·1		

Rivot has found in a similar substance from Chili (Ann. d. M., V. vi. 556), Sb 36·5, Cu 12·2, 22·2, Te 14·8, Fe, S *tr.*, quartz 2·5, O and loss 12·6, and observes that his result indicates presence of tellurid of mercury and antimonic acid along with antimonate of copper.

Pyr., etc.—Effervesces with nitric acid, without loss of color; but loss of color by action muriatic acid, and an abundant deposit of white antimonic acid. Heated in a matrass, a limate of mercury.

bs.—Found in many of the Chilian mines, filling cavities in the quartzose or argillo-ferruginous gangue of the mercurial tetrahedrite, and in the pores of the imperfectly compact tetrahedr itself, and has proceeded from the decomposition of this mercurial ore.

Named from ἄμμιον, *vermilion.*

F. Field has analyzed a red earthy substance from Tambillos, near Coquimbo, Chili, and ma it a compound of antimonite of mercury and sulphantimonite of mercury; but there is mu uncertainty over his results. He obtained (Q. J. Ch. Soc., xii. 27):

Sb	S	Hg	$\bar{Fe}$	$\dot{H}$	quartz
14·21	5·43	34·42	2·68	4·46	35·50=96·70.
15·26	5·98	37·94	2·94	4·98	29·78=96·88.

He takes the loss as partly oxygen, and thus makes $Sb\,O^3$, $Sb\,S^3$, $Hg\,O$, $Hg\,S$ as the constit ents. The material is probably a mixture of cinnabar, etc.

APPENDIX.

508. **Arsenate of Nickel** (Nickelerz, $\dot{Ni}^5\ddot{\bar{As}}$, *C. Bergemann*, J. pr. Ch., lxxv. 239, 185 Crystalline massive or amorphous. H.=4. G.=4·838. Color dark grass-green to brownish spots where amorphous; streak lighter.

Formula given by Bergemann (l. c.) $\dot{Ni}^5\ddot{\bar{As}}$=Arsenic acid 38·0, oxyd of nickel 62·0=1(His analysis afforded:

$\ddot{\bar{As}}$ 36·57 $\ddot{\bar{P}}$ 0·14 $\dot{Ni}$ 62·07 $\dot{Co}$ 0·54 $\dot{Cu}$ 0·34 $\ddot{\bar{Bi}}$ 0·24 $\ddot{\bar{Fe}}$ *tr.*=99·90.

Unaltered in the closed tube. B.B. on charcoal affords arsenical fumes; with borax in R. gives a gray bead (nickel); with soda on charcoal gives off arsenical fumes and yields a magne mass. From Johanngeorgenstadt, along with the following, nickel oxyd, and native bismuth.

509. **Arsenate of Nickel** (Nickelerz, $\dot{Ni}^3\ddot{\bar{As}}$, *C. Bergemann*, J. pr. Ch., lxxv. 239, 185 Amorphous. H.=4. G.=4·982. Color sulphur-yellow. Formula $\dot{Ni}^3\ddot{\bar{As}}$, Bergemann,=Arse acid 50·5, $\dot{Ni}$ 49·5=100. Analysis by Bergemann (l. c.):

$\ddot{\bar{As}}$ 50·58 $\ddot{\bar{P}}$ *tr.* $\dot{Ni}$ 48·24 $\dot{Co}$ 0·21 $\dot{Cu}$ 0·57 $\ddot{\bar{Bi}}$ 0·62=100·17.

Like the preceding in pyrognostic characters. Occurs at Johanngeorgenstadt, with the p ceding.

II. HYDROUS PHOSPHATES, ARSENATES, ANTIMONATES.

ARRANGEMENT OF THE SPECIES.

A. Phosphates and Arsenates of Bases in the Protoxyd state.

I. STRUVITE GROUP. Contain ammonia. O. ratio for bases and acid 3 : 5.

515. **Stercorite**	$(\frac{1}{3}\dot{Na}+\frac{1}{3}NH^4O+\frac{1}{3}\dot{H})^3\ddot{\bar{P}}+8\dot{H}$	$P\Theta\|\Theta_3\|(\frac{1}{3}Na+\frac{1}{3}Am+\frac{1}{3}H)_3+4$
516. **Struvite**	$(\frac{2}{3}\dot{Mg}+\frac{1}{3}NH^4O)^3\ddot{\bar{P}}+12\dot{H}$	$(P\Theta)_2\|\Theta_6\|(\frac{1}{3}Am_2+\frac{2}{3}Mg)_3+12\,aq$

II. HAIDINGERITE GROUP. Contain lime. O. ratio 3 : 5. Orthorhombic, with a pe diagonal cleavage.

517. **Haidingerite**	$(\frac{2}{3}\dot{Ca}+\frac{1}{3}\dot{H})^3\ddot{\bar{As}}+3\dot{H}$	$(As\Theta)_2\|\Theta_6\|(\frac{2}{3}Ca+\frac{1}{3}H_2)_3+3\,aq$

III. PHARMACOLITE GROUP. Contain lime or magnesia. O. ratio 3 : 5. Monoclinic, with a pearly clinodiagonal cleavage.

518.	**Brushite**	$(\frac{2}{3}\dot{\text{Ca}}+\frac{1}{3}\dot{\text{H}})^3\ddot{\bar{\text{P}}}+4\dot{\text{H}}$	$(\text{P}\,\Theta)_2\|\Theta_6\|(\frac{2}{3}\,\text{Ꞓa}+\frac{1}{3}\text{H}_2)_3+4\text{ aq}$
519.	**Metabrushite**	$(\frac{2}{3}\dot{\text{Ca}}+\frac{1}{3}\dot{\text{H}})^3\ddot{\bar{\text{P}}}+3\dot{\text{H}}$	$(\text{P}\,\Theta)_2\|\Theta_6\|(\frac{2}{3}\,\text{Ꞓa}+\frac{1}{3}\text{H}_2)_3+3\text{ aq}$
520.	**Pharmacolite**	$(\frac{2}{3}\dot{\text{Ca}}+\frac{1}{3}\dot{\text{H}})^3\ddot{\bar{\text{A}}}\text{s}+5\dot{\text{H}}$	$(\text{As}\,\Theta)_2\|\Theta_6\|(\frac{2}{3}\,\text{Ꞓa}+\frac{1}{3}\text{H}_2)_3+5\text{ aq}$
521.	**Churchite**	$(\dot{\text{Ca}},\dot{\text{Ce}})^3\ddot{\bar{\text{P}}}+4\dot{\text{H}}$	$(\text{P}\,\Theta)_2\|\Theta_6\|(\text{Ꞓa},\text{Ꞓe})_3+4\text{ aq}$
522.	**Hœrnesite**	$\dot{\text{Mg}}^3\ddot{\bar{\text{A}}}\text{s}+8\dot{\text{H}}$	$(\text{As}\,\Theta)_2\|\Theta_6\|\text{M̶g}_3+8\text{ aq}$
523.	**Rœsslerite**	$(\frac{2}{3}\dot{\text{Mg}}+\frac{1}{3}\dot{\text{H}})^3\ddot{\bar{\text{A}}}\text{s}+12\dot{\text{H}}$	$(\text{As}\,\Theta)_2\|\Theta_6\|(\frac{2}{3}\,\text{M̶g}+\frac{1}{3}\text{H}_2)_3+12\text{ aq}$

IV. VIVIANITE GROUP. Contain iron, manganese, nickel, cobalt, or zinc. O. ratio 3 5. Monoclinic, with a pearly clinodiagonal cleavage.

24.	**Vivianite**	$\dot{\text{Fe}}^3\ddot{\bar{\text{P}}}+8\dot{\text{H}}$	$(\text{P}\,\Theta)_2\|\Theta_6\|\text{Ꞙe}_3+8\text{ aq}$
25.	**Symplesite**	$\dot{\text{Fe}}^3\ddot{\bar{\text{A}}}\text{s}+n\text{ aq}$	$(\text{As}\,\Theta)_2\|\Theta_6\|\text{Ꞙe}_3+n\text{ aq}$
26.	**Erythrite**	$\dot{\text{Co}}^3\ddot{\bar{\text{A}}}\text{s}+8\dot{\text{H}}$	$(\text{As}\,\Theta)_2\|\Theta_6\|\text{Ꞓo}_3+8\text{ aq}$
27.	**Annabergite**	$\dot{\text{Ni}}^3\ddot{\bar{\text{A}}}\text{s}+8\dot{\text{H}}$	$(\text{As}\,\Theta)_2\|\Theta_6\|\text{N̶i}_3+8\text{ aq}$
29.	**Cabrerite**	$(\dot{\text{Ni}},\dot{\text{Co}},\dot{\text{Mg}})^3\ddot{\bar{\text{A}}}\text{s}+8\dot{\text{H}}$	$(\text{As}\,\Theta)_2\|\Theta_6\|(\text{N̶i},\text{Ꞓo},\text{M̶g})_3+8\text{ aq}$
30.	**Köttigite**	$(\dot{\text{Zn}},\dot{\text{Co}},\dot{\text{Ni}})^3\ddot{\bar{\text{A}}}\text{s}+8\dot{\text{H}}$	$(\text{As}\,\Theta)_2\|\Theta_6\|(\text{Ƶn},\text{Ꞓo},\text{N̶i})_3+8\text{ aq}$
31.	**Hureaulite**	$(\dot{\text{Mn}},\dot{\text{Fe}},\dot{\text{H}})^3\ddot{\bar{\text{P}}}+2\dot{\text{H}}$	$(\text{P}\,\Theta)_2\|\Theta_6\|(\text{M̶n},\text{Ꞙe},\text{H}_2)_3+2\text{ aq}$

V. CHONDRARSENITE GROUP. Contain manganese. O. ratio 1 : 1? No cleavage observed.

2.	**Chondrarsenite**	$\dot{\text{Mn}}^5\ddot{\bar{\text{A}}}\text{s}+2\frac{1}{2}\dot{\text{H}}$	$\text{As}_2\|\Theta_{10}\|\text{M̶n}_5+2\frac{1}{2}\text{ aq}$

VI. OLIVENITE GROUP. Contain $\dot{\text{Cu}}$, $\dot{\text{Zn}}$ as the protoxyd bases. General formula $\dot{\text{R}}^3(\ddot{\bar{\text{P}}},\ddot{\bar{\text{A}}}\text{s})+n$ aq, with sometimes $\dot{\text{Cu}}\,\dot{\text{H}}$, or $\dot{\text{Zn}}\,\dot{\text{H}}$, accessory. Orthorhombic, without pearly cleavage; *I* ∧ *I* near 90°.

3.	**Trichalcite**	$\dot{\text{Cu}}^3\ddot{\bar{\text{A}}}\text{s}+5\dot{\text{H}}$	$(\text{As}\,\Theta)_2\|\Theta_6\|\text{Ꞓu}_3+5\text{ aq}$
4. ?	**Thrombolite**	$\ddot{\bar{\text{P}}},\dot{\text{Cu}},\dot{\text{H}}$	
5.	**Libethenite**	$\dot{\text{Cu}}^3\ddot{\bar{\text{P}}}+\dot{\text{Cu}}\,\dot{\text{H}}$	$(\text{P}\,\Theta)_2\|\Theta_6\|\text{Ꞓu}_3+\text{Ꞓu}\,\text{H}_2\,\Theta_2$
6.	**Olivenite**	$\dot{\text{Cu}}^3(\ddot{\bar{\text{A}}}\text{s},\ddot{\bar{\text{P}}})+\dot{\text{Cu}}\,\dot{\text{H}}$	$((\text{As},\text{P})\Theta)_2\|\Theta_6\|\text{Ꞓu}_3+\text{Ꞓu}\,\text{H}_2\,\Theta_2$
7.	**Adamite**	$\dot{\text{Zn}}^3\ddot{\bar{\text{A}}}\text{s}+\dot{\text{Zn}}\,\dot{\text{H}}$	$(\text{As},\Theta)_2\|\Theta_6\|\text{Ƶn}_3+\text{Ƶn}\,\text{H}_2\,\Theta_2$
8.	**Conichalcite**	$(\dot{\text{Cu}},\dot{\text{Ca}})^3(\ddot{\bar{\text{P}}},\ddot{\bar{\text{A}}}\text{s})+\dot{\text{Cu}}\,\dot{\text{H}}+\frac{1}{2}\dot{\text{H}}$	$((\text{As}\,\text{P})\Theta)_2\|\Theta_6\|(\text{Ꞓu},\text{Ꞓa})_3+\text{Ꞓu}\,\text{H}_2\,\Theta_2+\frac{1}{2}\text{ aq}$
9.	**Bayldonite**	$(\dot{\text{Cu}},\dot{\text{Pb}})^3\ddot{\bar{\text{A}}}\text{s}+\dot{\text{Cu}}\,\dot{\text{H}}+\dot{\text{H}}$	$(\text{As}\,\Theta)_2\|\Theta_6\|(\text{Ꞓa},\text{Ꝑb})_3+\text{Ꞓu}\,\text{H}_2\,\Theta_2+\text{aq}$
0.	**Euchroite**	$\dot{\text{Cu}}^3\ddot{\bar{\text{A}}}\text{s}+\dot{\text{Cu}}\,\dot{\text{H}}+6\dot{\text{H}}$	$(\text{As}\,\Theta)_2\|\Theta_6\|\text{Ꞓu}+\text{Ꞓu}\,\text{H}_2\,\Theta_2+6\text{ aq}$

VII. LIROCONITE GROUP. Contain $\dot{\text{Cu}}$. General formula $\dot{\text{R}}^3(\ddot{\bar{\text{P}}},\ddot{\bar{\text{A}}}\text{s})+n$ aq, with mostly 2 $\dot{\text{Cu}}\,\dot{\text{H}}$ or 3 $\dot{\text{Cu}}\,\dot{\text{H}}$ accessory. Monoclinic, without a very distinct basal cleavage.

.	**Tagilite**	$\dot{\text{Cu}}^3\ddot{\bar{\text{P}}}+\dot{\text{Cu}}\,\dot{\text{H}}+2\dot{\text{H}}$	$(\text{P}\,\Theta)_2\|\Theta_3\|\text{Ꞓu}_3+\text{Ꞓu}\,\text{H}_2\,\Theta_2+2\text{ aq}$
.	**Liroconite**	$\dot{\text{Cu}}^3\ddot{\bar{\text{A}}}\text{s}+(\frac{1}{3}\dot{\text{Cu}}^3+\frac{2}{3}\ddot{\text{A}}\text{l})\,\dot{\text{H}}^3+9\dot{\text{H}}$	$(\text{As}\,\Theta)_2\|\Theta_2\|\text{Ꞓu}_3+\text{Q}+9\text{ aq}$
.	**Pseudomalachite**	$\dot{\text{Cu}}^3\ddot{\bar{\text{P}}}+3\dot{\text{Cu}}\,\dot{\text{H}}$	$(\text{P}\,\Theta)_2\|\Theta_6\|\text{Ꞓu}_3+3\,\text{Ꞓu}\,\text{H}_2\,\Theta_2$
A.	**Ehlite**	$\dot{\text{Cu}}^3\ddot{\bar{\text{P}}}+2\dot{\text{Cu}}\,\dot{\text{H}}+\dot{\text{H}}$	$(\text{P}\,\Theta)_2\|\Theta_6\|\text{Ꞓu}_3+2\,\text{Ꞓu}\,\text{H}_2\,\Theta_2+\text{aq}$
B.	**Dihydrite**	$\dot{\text{Cu}}^3\ddot{\bar{\text{P}}}+2\dot{\text{Cu}}\,\dot{\text{H}}$	$(\text{P}\,\Theta)_2\|\Theta_6\|\text{Ꞓu}_3+2\,\text{Ꞓu}\,\text{H}_2\,\Theta_2$

544. **ERINITE**	$\dot{C}u^3\dddot{A}s+2\dot{C}u\dot{H}$	$(As\Theta)_2\vert\Theta_6\vert\bar{C}u_3+2\bar{C}uH_2\Theta_2$
545. **CORNWALLITE**	$\dot{C}u^3\dddot{A}s+2Cu\dot{H}+3\dot{H}$	$(As\Theta)_2\vert\Theta_6\vert\bar{C}u_3+2\bar{C}uH_2\Theta_2+3aq$

VIII. CHALCOPHYLLITE GROUP. Contain $\dot{C}u$. A perfect basal cleavage.

546. **TYROLITE**	$\dot{C}u^3\dddot{A}s+2Cu\dot{H}+7\dot{H}$	$(As\Theta)_2\vert\Theta_6\vert\bar{C}u_3+2\bar{C}uH_2\Theta_2+7aq$
547. **CLINOCLASITE**	$\dot{C}u^3\dddot{A}s+3\dot{C}u\dot{H}$	$(As\Theta)_2\vert\Theta_6\vert\bar{C}u_3+3\bar{C}uH_2\Theta_2$
548. **CHALCOPHYLLITE** *a*	$Cu^3\dddot{A}s+5Cu\dot{H}+7\dot{H}$	$(As\Theta)_2\vert\Theta_6\vert\bar{C}u_3+5\bar{C}uH_2\Theta_2+7aq$
b	$\dot{C}u^6\dddot{A}s+3\dot{C}u\dot{H}+9\dot{H}$	$As_2\vert\Theta_{10}\vert\bar{C}u_6+3\bar{C}uH_2\Theta_2+9aq$

B. PHOSPHATES AND ARSENATES OF BASES WHOLLY, OR IN PART, IN THE SESQUIOXYD STATE

(1) Oxygen ratio for $(\dot{R}^3, \ddot{\bar{R}})$, $(\dddot{P}, \dddot{A}s)=3:5$, with water and sometimes other accessory constituents. Plumbogummite is of uncertain relations.

549. **BERLINITE**	$\ddot{\bar{A}}l\dddot{P}+\frac{1}{3}\dot{H}$	$(P\Theta)_2\vert\Theta_6\vert\beta\bar{A}l_2+\frac{1}{3}aq$
550. **CALLAINITE**	$\ddot{\bar{A}}l\dddot{P}+5\dot{H}$	$(P\Theta)_2\vert\Theta_6\vert\beta\bar{A}l_2+5aq$
551. **LAZULITE**	$\ddot{\bar{A}}l\dddot{P}+\dot{M}g\dot{H}$	$(P\Theta)_2\vert\Theta_6\vert\beta\bar{A}l_2+MgH_2\Theta_2$
552. **BARRANDITE**	$(\ddot{\bar{A}}l, \ddot{\bar{F}}e)\dddot{P}+4\dot{H}$	$(P\Theta)_2\vert\Theta_6\vert\beta(\bar{A}l, \bar{F}e)_2+4aq$
553. **SCORODITE**	$\ddot{\bar{F}}e\dddot{A}s+4\dot{H}$	$(P\Theta)_2\vert\Theta_6\vert\beta\bar{F}e_2+4aq$
554. **WAVELLITE**	$\ddot{\bar{A}}l\dddot{P}+\frac{1}{3}\ddot{\bar{A}}l\dot{H}^3+5\dot{H}$	$(P\Theta)_2\vert\Theta_6\vert\beta\bar{A}l_2+Q+5aq$
555. **TROLLEITE**	$\ddot{\bar{A}}l\dddot{P}+\frac{1}{3}\ddot{\bar{A}}l\dot{H}^3$	$(P\Theta)_2\vert\Theta_6\vert\beta\bar{A}l_2+\beta\bar{A}lH_2\Theta_2$
556. **PLUMBOGUMMITE** (?)	$\dot{P}b^3\dddot{P}+6\ddot{\bar{A}}l\dot{H}^3$	$(P\Theta)_2\vert\Theta_6\vert Pb_3+18\beta\bar{A}lH_2\Theta_2$
557. **CALCIOFERRITE**	$(\ddot{\bar{F}}e, \dot{C}a^3)\dddot{P}+\frac{1}{3}\ddot{\bar{R}}\dot{H}^3+4\dot{H}$	$(P\Theta)_2\vert\Theta_6\vert(\bar{C}a, \beta\bar{F}e)_2+\frac{1}{3}\beta\bar{R}H_2\Theta_2+4$
558. **PHARMACOSIDERITE**	$\ddot{\bar{F}}e\dddot{A}s+\frac{1}{3}\ddot{\bar{F}}e\dot{H}^3+4\dot{H}$	$(AsO)_2\vert\Theta_6\vert\beta\bar{F}e_2+\beta\bar{F}eH_2\Theta_2+4aq$

(2) O. ratio for $(\dot{R}^3, \ddot{\bar{R}})$, $\dddot{P}=4:5$.

559. **CIRROLITE**	$(\frac{1}{2}\dot{C}a^3+\frac{1}{2}\ddot{\bar{A}}l)^4\dddot{P}^3+3\dot{H}$	$P_2\Theta\vert\Theta_6\vert(\frac{1}{2}\bar{C}a+\frac{1}{2}\beta\bar{A}l)_2+aq$

Trolleite (555), *calcioferrite* (557), and *pharmacosiderite* (558), have the O. ratio 4 : 5, and if
of the alumina or iron is not present as an accessory hydrate, they should be included in
group. *Wavellite* (554) is also near it.

(3) O. ratio for $(\dot{R}^3, \ddot{\bar{R}})$, $(\dddot{P}, \dddot{A}s)=1:1$; but doubtful.

560. **CHILDRENITE**	$(\frac{4}{7}(\dot{F}e, \dot{M}n)^3+\frac{3}{7}\ddot{\bar{A}}l)^5\dddot{P}^3+15\dot{H}$	$P_2\vert\Theta_{10}\vert(\frac{4}{7}(Fe, Mn)+\frac{3}{7}\beta\bar{A}l)_5+5$
561.? **ATTACOLITE**	$\dddot{P}, \ddot{\bar{A}}l, \dot{C}a, \dot{M}n, \dot{F}e, \dot{H}$	

(4) O. ratio for $(\dot{R}^3, \ddot{\bar{R}})$, $(\dddot{P}, \dddot{A}s)=6:5$.

562. **AUGELITE**	$\ddot{\bar{A}}l^2\dddot{P}+3\dot{H}$	$\beta\bar{A}l_6\Theta\vert\Theta_{10}\vert P_2+3$
563. **TURQUOIS**	$\ddot{\bar{A}}l^2\dddot{P}+5\dot{H}$	$\beta\bar{A}l_6\Theta\vert\Theta_{10}\vert P_2+5$
564. **PEGANITE**	$\ddot{\bar{A}}l^2\dddot{P}+6\dot{H}$	$\beta\bar{A}l_6\Theta\vert\Theta_{10}\vert P_2+6$
565. **FISCHERITE**	$\ddot{\bar{A}}l^2\dddot{P}+8\dot{H}$	$\beta\bar{A}l_6\Theta\vert\Theta_{10}\vert P_2+8$
566. **TAVISTOCKITE**	$(\ddot{\bar{A}}l, \dot{C}a^3)^2\dddot{P}+3\dot{H}$	$(\bar{C}a, \beta\bar{A}l)_6\Theta\vert\Theta_{10}\vert P_2+3$
567. **CHENEVIXITE**	$(\ddot{\bar{F}}e, \dot{C}u^3)^2\dddot{A}s+3\dot{H}$	$(\bar{C}u, \beta\bar{F}e)_6\Theta\vert\Theta_{10}\vert As_2+3$
568 **DUFRENITE**	$\ddot{\bar{F}}e^2\dddot{P}+2\frac{1}{2}\dot{H}$	$\beta\bar{F}e_6\Theta\vert\Theta_{10}\vert P_2+\frac{1}{2}$
569. **CACOXENITE**	(?) $\ddot{\bar{F}}e^2\dddot{P}+12\dot{H}$	$\beta\bar{F}e_6\Theta\vert\Theta_{10}\vert P_2+12$

570. **Arseniosiderite**	$(\overset{...}{\bar{F}e}, \dot{C}a^3)^3 \overset{.....}{A}s + 6\dot{H}$	$(\bar{C}a, \beta Fe)_6\,\Theta\vert\Theta_{10}\vert As_2 + 6\,aq$
571. **Evansite**	$\overset{...}{\bar{A}l}^2 \overset{.....}{P} + \overset{...}{\bar{A}l}\,\dot{H}^3 + 15\dot{H}$	$\beta \bar{A}l_6\,\Theta\vert\Theta_{10}\vert P_2 + 3(\beta \bar{A}l\,H_3\Theta_3) + 16\,aq$
572. **Torbernite**	$\overset{...}{\bar{U}}^2 \overset{.....}{P} + \dot{C}u\,\dot{H} + 7\dot{H}$	$\beta \bar{U}_6\,\Theta\vert\Theta_{10}\vert P_2 + \bar{C}u\,H_2\Theta_2 + 7\,aq$
573. **Autunite**	$\overset{...}{\bar{U}}^2 \overset{.....}{P} + \dot{C}a\,\dot{H} + 7\dot{H}$	$\beta \bar{U}_6\,\Theta\vert\Theta_{10}\vert P_2 + \bar{C}a\,H_2\Theta_2 + 7\,aq$

(5) O. ratio for $(\dot{R}^3, \overset{...}{\bar{R}}), (\overset{.....}{P}, \overset{.....}{A}s) = 3 : 2$.

574. **Amphithalite**	$(\overset{...}{\bar{A}l}, \dot{C}a^3)^5 \overset{.....}{P}^2 + 7\dot{H}$	$(\bar{C}a, \beta \bar{A}l)_{15}\,\Theta_5\vert\Theta_{20}\vert P_4 + 7\,aq$
575. **Sphærite**	$\overset{...}{\bar{A}l}^5 \overset{.....}{P}^2 + 15\dot{H}$	$\beta \bar{A}l_{15}\,\Theta_5\vert\Theta_{20}\vert P_4 + 16\,aq$
576. **Borickite**	$(\overset{...}{\bar{F}e}, \dot{C}a^3)^5 \overset{.....}{P}^2 + 15\dot{H}$	$(\bar{C}a, \beta Fe)_{15}\,\Theta_5\vert\Theta_{20}\vert P_4 + 15\,aq$

C. Phosphates or Arsenates combined with Sulphates.

580. **Diadochite**	$\overset{.....}{P}, \dddot{S}, \overset{...}{\bar{F}e}, \dot{H}$
581. **Pitticite**	$\overset{.....}{A}s, \dddot{S}, \overset{...}{\bar{F}e}, \dot{H}$
582. **Beudantite**	$\overset{.....}{P}, \overset{.....}{A}s, \dddot{S}, \overset{...}{\bar{F}e}, \dot{P}b, \dot{H}$
583. **Lindackerite**	$\overset{.....}{A}s, \dddot{S}, \dot{C}u, \dot{N}i, \dot{H}$
584. **Svanbergite**	$\overset{.....}{P}, \dddot{S}, \overset{...}{\bar{A}l}, \dot{C}a, \dot{N}a, \dot{H}$
585. **Ficinite**	$\overset{.....}{P}, \dddot{S}, \dot{F}e, \dot{M}n, \dot{H}$

D. Antimonates.

586. **Bindheimite**	$\overset{.....}{S}b, \dot{P}b, \dot{H}$

In the preceding formulas the value of Q may be learned from the corresponding formula in the other column. In many of the phosphates of copper the member $n\,\dot{C}u\,\dot{H}$ is made an accessory, as done by Rammelsberg and others.

515. STERCORITE. Stercorite *Herapath*, Q. J. Ch. Soc., 1849. Microcosmic Salt. Native Salt of Phosphorus.

In crystalline masses and nodules. G.=1·6151. Lustre vitreous. Color white, stained yellowish-brown. Transparent. Fragile. Not efflorescent. Easily soluble in hot and cold water.

Comp.—$\dot{N}a\,NH^4O\,\overset{.....}{P} + 9\dot{H}$=Phosphoric acid 34·05, ammonia 12·40, soda 14·92, water 38·63=00. Analysis by T. J. Herapath (l. c.):

$\overset{.....}{P}$ 34·325 Am. 7·680 $\dot{N}a$ 15·752 $\dot{H}$ 42·243=100.

Mixed with about 9 p. c. of impurities, consisting of organic matters along with chlorid of sodium, carbonate of lime, carbonate of magnesia, phosphate of lime, sand, etc.

Pyr., etc.—B.B. intumesces, blackens, and gives off water and ammonia, colors the flame momentarily a faint green, and fuses to a transparent colorless glass, soluble in boiling water.

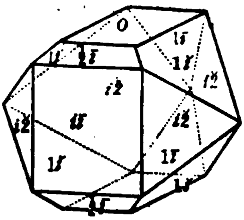
Obs.—Found in guano at the island of Ichaboe on the west coast of Africa, and named from the Latin *stercus*, *dung*.

This species is identical with the *Salt of Phosphorus*, used as a flux in blowpipe analysis.

16. STRUVITE. Struvit *Ulex*, Œfv. Ak. Stockh., 1845, iii. 32, Ann. Ch. Pharm., lxvi. 41. Guanite *E. F. Teschemacher*, Phil. Mag., III. xxviii. 546, 1846.

Orthorhombic. Hemihedral, two opposite sides having unlike $I \wedge I=101° 42'$, $O \wedge$ 1-ī$=132° 32'$; $a : b : c=1·0900 : 1 : 1·228$ served planes as in the annexed figure.

458



$O \wedge$ 1-ĭ$=138° 25'$
$O \wedge$ ½-ī$=151 25$
$O \wedge$ i-ī$=90$

i-2 ∧ i-2, ov. i-ī,=
1-ĭ ∧ 1-ĭ, ov. O,=
½-ī ∧ ½-ī, ov. i-ī,=

Cleavage: O, perfect. Twins: composit i-ī.

H.=2. G.=1·65–1·7. Color slightly ish to brown; white. Lustre vitreous. cent; sometimes opaque. Brittle. Tasteles but slightly soluble.

Comp.—$\mathrm{NH^4O\,\dot{M}g^2\,\dddot{\bar{P}}+12\,\dot{\bar{H}}}$=Phosphoric acid 29·0, magnesia 16·3, ammonia 10·6, =100. Ulex obtained (Jahrb. Min. 1851, 51):

$\dddot{\bar{P}}$	$\dot{M}g$	$\dot{F}e$	$\dot{M}n$	Am. $\dot{\bar{H}}$
28·56	13·46	3·06	1·12	53·76

Pyr., etc.—In the closed tube gives off water and ammonia and becomes opaque. the flame green, and fuses easily to an enamel, which, heated with cobalt solution, beautiful purple color. Soluble in acids.

Obs.—Found in guano from Saldanha Bay, coast of Africa, imbedded in patches of also under an old church in Hamburg, where quantities of cattle dung existed in the a bed of peat which contained the crystals. This salt forms when a tribasic phosph salt of ammonia are dissolved together, and a salt of magnesia is added to the mixture

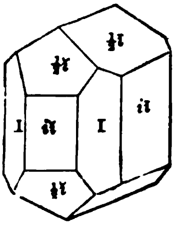
The dimensions of the crystals are nearly those of barytes if 1-ī be taken as ½-ī.

Named after the Russian statesman v. Struve.

517. HAIDINGERITE. *Turner* Edinb. J. Sci., iii. 303, 1825.

Orthorhombic. $I \wedge I=100°$ (80° over i-ĭ), $O \wedge$ 1-ī$=148° 16'$; $=0·595 : 1 : 1·1918$. Observed planes: vertical, I, i-ī, i-ĭ; domes, ½-ĭ, 1-ĭ; octahedral, 4-2, $\frac{5}{2}$-$\frac{5}{4}$. ½-ī ∧ ½-ī, top,= 1-ĭ ∧ 1-ĭ$=126° 58'$, $I \wedge$ i-ī$=140°$, $I \wedge$ i-ĭ$=130°$. age: i-ĭ highly perfect. Mostly in minute crysta gated into botryoidal forms and drusy crusts.

459



H.=1·5–2·5. G.=2·848. Lustre vitreous. white. Color white. Transparent—translucen tile; thin laminæ slightly flexible.

Comp.—$(\frac{2}{3}\dot{C}a+\frac{1}{3}\dot{H})^3\,\dddot{\bar{A}}s+3\,\dot{H}$=Arsenic acid 58·1, lime 13·6=100. Turner (l. c.) obtained, arsenate of lime 85·681, 14·319. Dissolves easily in nitric acid.

Pyr.—B.B. like pharmacolite.

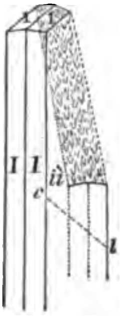
Obs.—Supposed to be from Baden or Joachimsthal, according to R. P. Greg, Jr., net contained the only specimen that has been observed; probably the latter place, Vogl (Min. Joach., 186). It is associated with pharmacolite.

Named after W. Haidinger.

518. BRUSHITE. *G. E. Moore*, Proc. Acad. Cal., iii. 167, 1864, Am. J. Sci., II. x

Monoclinic. $C=62° 45'$, $I \wedge I=142° 26'$; $a : b : c=0·5396$:

460



I ∧ *i-ì*=108° 47′, 1 ∧ *i-ì*=101° 40′, 1 ∧ 1=156° 46′ (156° 20′ by approximate measurement), −1 ∧ −1 (unobserved planes) = 164° 22′, angle between edge *I* / *I* and lines of cross cleavage *cl* (=*O* on orthodiagonal section or plane *i-i*) 117°—117½°, and between same edge *I* / *I* and edge 1 / 1 (=*i-i* on 1-*i*)= 95°—95½°; whence *O* ∧ 1-*i*=about 147° 30′, Dana. Cleavage: clinodiagonal, perfect and pearly; *O* (parallel to *cl*) perfect, crystals often breaking transversely along this plane. Crystals small and slender. Also concretionary massive, consisting of lamellar individuals, and having pearly cleavages.

H.=2—2·5. G.=2·208. Lustre of *i-ì* pearly, elsewhere vitreous, and in part splendent; when massive, earthy, or more or less resinous. Colorless to pale yellowish. Transparent—translucent.

Comp.—$(\frac{2}{3}\dot{\mathrm{C}}\mathrm{a}+\frac{1}{3}\dot{\bar{\mathrm{H}}})^3\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\mathrm{P}}}+4\dot{\bar{\mathrm{H}}}$, or, of the general formula, $\dot{\mathrm{R}}^3\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\mathrm{P}}}+\mathrm{aq}$. Analyses: 1, 2, Moore (l. c.); 3, Julien (ib., xl. 379):

	$\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\mathrm{P}}}$	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\bar{\mathrm{H}}}$
1. Aves I.	41·50	32·65	26·33=100·48 Moore.
2. "	41·32	32·73	26·40=100·45 Moore.
3. Sombrero	39·95	32·11	25·95, $\dddot{\bar{\mathrm{A}}}\mathrm{l}$, $\dddot{\bar{\mathrm{F}}}\mathrm{e}$ 0·33, $\dddot{\mathrm{S}}$ 0·78, hygrosc. 1·23=100·35 Julien.

Pyr., etc.—Heated in a closed tube whitens, and at an incipient red heat gives off water. B.B. in the platinum forceps fuses easily with intumescence, tinging the flame green; the button crystalline with brilliant facets on cooling. Dissolves readily in dilute nitric and muriatic acids.

Obs.—Occurs on the rock guano of Aves Island and Sombrero in the Caribbean Sea, in groups and crusts consisting of delicate and mostly transparent crystals. Named after G. J. Brush.

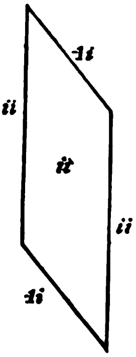
The species may be regarded as isomorphous with *vivianite;* 2*a* : *b* : ½*c* of brushite equalling 1·0792 : 1 : 1·307, which is very near the ratio in vivianite given on page 557. The two agree in formula, except that one has 4$\dot{\bar{\mathrm{H}}}$ and the other 8$\dot{\bar{\mathrm{H}}}$. It is isomorphous also with pharmacolite if the prism *I* (142° 26′) be regarded as corresponding to *i*-2 of the latter, the angle of which is 141° 8′.

519. METABRUSHITE. *A. A. Julien*, Am. J. Sci., II. xl. 371, 1865. Zeugite *Julien*, ib., p. 373. Ornithite *Julien*, ib., p. 377.

Monoclinic, with pearly clinodiagonal cleavage, as in brushite. Occurring planes, the clinodiagonal *i-ì*, with the two orthodiagonal *i-i* and −1-*i*, giving the section in the annexed figure. Crystals usually having *i-i* broad and even, but not shining, and the other planes deeply furrowed and rounding into one another, as in fig. 462; sometimes thin and flattened parallel to *i-ì*. Angle *i-i* ∧ −1-*i* varying, 38°—46°, mostly 38°—42°; and 38° in the best crystals (Dana). Cleavage: clinodiagonal perfect.

H. = 2·5—3. G. = 2·288, 2·356, 2·362. Lustre feeble, except on the cleavage-face, which is pearly, somewhat resinous in fracture. Color pale yellow, buff, to nearly white; streak uncolored. Translucent to transparent. Brittle.

461



462

Comp.—$(\frac{2}{3}\dot{\mathrm{Ca}}+\frac{1}{3}\dot{\mathrm{H}})^3\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\mathrm{P}}}+3\dot{\mathrm{H}}$=Phosphoric acid 41·90, lime 35·42, water 20·68=100; or same as brushite, excepting one less of water. Analyses: 1, Julien (l. c.):

	$\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\mathrm{P}}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Mg}}$	$\overset{\cdots}{\bar{\mathrm{Al}}}$, $\overset{\cdots}{\bar{\mathrm{Fe}}}$	$\dot{\mathrm{H}}$	$\dddot{\mathrm{S}}$
1. (¼)	42·72	32·98	0·52	0·79	21·83	0·05, hygrosc. 1·50=100·39 Julien.

The water included some organic matter.

Pyr., etc.—Same as for brushite.

Obs.—From Sombrero, coating cavities in guano and the coral rock altered by filtrations from the overlying guano. Crystals sometimes 1 inch long and ¼ inch broad.

This compound, as Julien states, has been recognized as an artificial salt by Raewsky and Berzelius.

Alt.—The crystals of metabrushite from Sombrero are often hollow from the removal of the interior, and otherwise altered. Julien describes the following varieties:

1. H.=3·25. G.=2·971. The crust of the hollow crystals thin, and surfaces within and without often coated by minute rhombs of calcite; the *zeugite* of Julien. 2. Crust rather thicker, without a glittering surface of calcite rhombs. 3. G.=2·988—3·030; in narrow blades sometimes an inch long; the crust thick, the crystals being nearly or quite solid.

4. *Ornithite* of Julien, from Sombrero (l. c., p. 377), appears also to be altered metabrushite, its crystals presenting the same forms and habit, but usually quite small and very thin parallel to the orthodiagonal; also sometimes thin parallel to the clinodiagonal, and acute rhombic in section; angle *i-i* ∧ −1-*i*=about 38°; H.=2·5. The analysis given was made on only one-tenth of a gram and the results are hence unavoidably doubtful.

Analyses of 1, 3, 4, afforded Julien (the water including some organic matter):

	$\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\mathrm{P}}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{H}}$	$\dot{\mathrm{Mg}}$	$\overset{\cdots}{\bar{\mathrm{Fe}}}$, $\overset{\cdots}{\bar{\mathrm{Al}}}$	$\dddot{\mathrm{S}}$	$\ddot{\mathrm{C}}$	F	Na Cl
Var. 1. *Zeugite* (⅔)	46·55	44·21	3·02	3·59	0·66	0·19	0·24	*tr.*	1·08=99·54 Julien.
Var. 3. "	43·24	48·87	3·98	0·36	1·02	0·18	1·74	*tr.*	? =99·59 Julien.
Var. 4. *Ornithite*	40·14	45·77	9·45	—	4·62	—	—	—	—=99·98 Julien.

In 1, O. ratio for $\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\mathrm{P}}}$, $\dot{\mathrm{Ca}}$ (impurities excluded)=2·95 : 1·56; ornithite corresponds nearly to the formula $\dot{\mathrm{Ca}}^3\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\mathrm{P}}}+2$ aq.

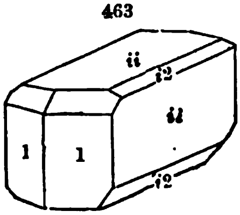
There occur also hemispherical stellated groups of white crystals, as altered ornithite, which Mr. Julien has not analyzed, but supposed to be the same compound *minus* the water. One crystal of the so-called ornithite examined by the author had on its edges and surface microscopic tufts of acicular crystals.

Epiglaubite and crystallized *Glaubapatite* of Shepard (Am. J. Sci., II. xxii. 96, 1856). One or the other of these may be metabrushite or brushite. Glaubapatite has already been remarked upon on page 535. It may be added that there is further proof that no such guano compound exists (combination of sulphate of soda and phosphate of lime) in that A. A. Julien has found no evidence of it in his investigations. His results suggest that Shepard's soda may have come from common salt present, and his sulphuric acid from sulphate of lime.

Epiglaubite is described as occurring in "small aggregates or interlaced masses of minute semi-transparent crystals of a shining vitreous lustre, which are always implanted on druses of glaubapatite, with H.=about 2·5," and as being "a largely hydrate phosphate, chiefly of lime, and may also contain magnesia and soda." It is not impossible that the mineral is metabrushite, although some characters are inconsistent with such a conclusion. If so, the name *epiglaubite* (meaning occurring implanted on glaubapatite) is inapplicable, and should be rejected.

520. PHARMACOLITE. Arseniksaurer Kalk (von Wittichen) *Selb*, Scherer's J., iv. 537, 1800. Pharmakolit *Karsten*, Tab., 75, 1800. Arsenikblüthe *Wern.*, pt. Arseniate of Lime. Chaux arseniatée *Fr.* Picropharmacolit *Stromeyer*, Gilb. Ann., lxi. 185, 1819. Arsenicite *Beud.*, Min., ii. 593, 1832.

463



Monoclinic. *I* ∧ *I*=111° 6′, *i*-2 ∧ *ì*-2=141° 8′, *i-ì* ∧ *ì*-2=109° 26′, *i-i* ∧ *i-ì*=90°, 1 ∧ 1=117° 24′, *i-ì* ∧ 1=121° 28′, *i-i* ∧ 1=95° 46′, *i-i*, on edge 1/1,=83° 14′. Cleavage: *i-ì* eminent. One of the faces 1 often obliterated by the extension of the other. Surfaces *i-i* and *i*-2 usually striated parallel to their mutual intersection. Rarely in crystals; commonly in delicate silky fibres or acicular crystallizations, in stellated groups. Also botryoidal and stalactitic and sometimes massive.

H.=2—2·5. G.=2·64—2·73. Lustre vitreous; on i-$\bar{i}$ inclining to pearly. Color white or grayish; frequently tinged red by arsenate of cobalt. Streak white. Translucent—opaque. Fracture uneven. Thin laminæ flexible.

Comp.—$(\frac{2}{3}\,\dot{\mathrm{C}}\mathrm{a}+\frac{1}{3}\,\dot{\mathrm{H}})^3\,\ddot{\bar{\mathrm{A}}}\mathrm{s}+5\,\dot{\mathrm{H}}$=Arsenic acid 51·1, lime 24·9, water 24·0=100. Analyses: 1, Klaproth (Beitr., iii. 277); 2, John (Ch. Unters., ii. 221); 3, Rammelsberg (Pogg., lxii. 150):

	$\ddot{\bar{\mathrm{A}}}\mathrm{s}$	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\mathrm{H}}$
1. Wittichen	50·54	25·00	24·46=100 Klaproth.
2. Andreasberg	45·68	27·28	23·86=96·82 John.
3. Glücksbrunn	51·58	23·59	23·40, $\dot{\mathrm{C}}\mathrm{o}$, $\ddot{\bar{\mathrm{F}}}\mathrm{e}$ 1·43=100 Ramm.

The cobalt in the last is attributed to a mixture with cobalt bloom. Turner obtained for a specimen of unknown locality (Brewst. J., iii. 306) Arsenate of lime 79·01, water 20·99=100. The name *arsenicite* is applied by Beudant to the mineral analyzed by John on the ground of the analysis alone.

Pyr., etc.—In the closed tube yields water and becomes opaque. B.B. in O.F. fuses with intumescence to a white enamel, and colors the flame light blue (arsenic). On charcoal in R.F. gives arsenical fumes, and fuses to a semi-transparent globule, sometimes tinged blue from traces of cobalt. The ignited mineral reacts alkaline to test paper. Insoluble in water, but readily soluble in acids.

Obs.—Found with arsenical ores of cobalt and silver. Has been found at Wittichen, Baden, in crystals; at St. Marie aux Mines in the Vosges, in botryoidal or globular groups; at Andreasberg in the Harz, and at Riechelsdorf and Bieber in Hessia; at Glücksbrunn in Thuringia; at Joachimsthal in Bohemia.

This species was named, in allusion to its containing arsenic, from φάρμακον, *poison*.

Viewing the form as above, it is remotely homœomorphous with cobalt bloom and vivianite.

520A. *Picropharmacolite* of Stromeyer, from Riechelsdorf (l. c.), contains Arsenic acid 46·97, lime 24·65, magnesia 3·22, oxyd of cobalt 1·00, water 23·98=99·82, affording the formula $(\dot{\mathrm{C}}\mathrm{a},\ \dot{\mathrm{M}}\mathrm{g})^5\,\ddot{\bar{\mathrm{A}}}\mathrm{s}^2+12\,\dot{\mathrm{H}}$, Ramm; but it is probably impure pharmacolite. The prefix *picro*, from πικρος, *bitter*, alludes to the magnesia present.

521. CHURCHITE.

A new British mineral containing cerium *A. H. Church*, Ch. News, xii. 121, 1865. Churchite *C. G. Williams*, ib. 183. Hydrated Cerous Phosphate *Church*, J. Ch. Soc., II. iii. 259, 1865.

Monoclinic? In fan-like aggregations of minute crystals. Cleavage perfect in one direction (the clinodiagonal?); also radiated columnar.

H.=3. G.=3·14? Lustre vitreous; pearly on cleavage plane; color pale smoke-gray, tinged with flesh-red. Streak white. Transparent to translucent. Fracture conchoidal. Doubly refracting.

Comp.—O. ratio for $\dot{\mathrm{R}}$, $\ddot{\bar{\mathrm{P}}}$, $\dot{\mathrm{H}}$=3 : 5 : 4; $(\frac{5}{6}\,\dot{\mathrm{C}}\mathrm{e}+\frac{1}{6}\,\dot{\mathrm{C}}\mathrm{a})^3\,\ddot{\bar{\mathrm{P}}}+4\,\dot{\mathrm{H}}$=Phosphoric acid 27·73, ceria 52·73, lime 5·47, water 14·07=100. Analysis: Church (J. Ch. Soc., II. iii. 262):

$\ddot{\bar{\mathrm{P}}}$	$\dot{\mathrm{C}}\mathrm{e}$	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\mathrm{H}}$
28·48	51·87	5·42	14·93=100·70 Church.

Pyr., etc.—B.B. in tube yields acid water, becoming opaque. In outer flame becomes reddish, and difficultly soluble. With borax in outer flame gives a bead which is orange-yellow and opaline while hot, and colorless or slightly amethystine when cold.

Obs.—Occurs at Cornwall, in a copper lode, as a coating $\frac{1}{10}$ of an inch thick on quartz and argillaceous schist. C. G. Williams (l. c.) has proved churchite to contain didymium. Church obtained a trace of fluorine. Cleavage takes place parallel to a rhombic plane, which Maskelyne calls the *basal* plane.

Named after Prof. A. H. Church, of Cirencester, Eng.

522. **HŒRNESITE.** Hörnesit *Haid.*, Verh. G. Reichs., 41, 1860, Ber. Ak. Wien, xl. 18 1860.

Monoclinic. Cleavage eminent in one direction, like talc. Also columnar; stellar-foliated.

H.=0·5−1. G.=2·474. Cleavage pearly. Color snow-white. Folia transparent, flexible.

Comp.—$\dot{M}g^3\ddot{\bar{A}}s+8\dot{\bar{H}}$=Arsenic acid 46·6, magnesia 24·3, water 29·1=100, analogous to vivianite. Analysis: v. Hauer (l. c.):

$\ddot{\bar{A}}s$ 46·33 $\dot{M}g$ 24·54 $\dot{\bar{H}}$ 29·07=99·94.

Pyr., etc.—In a glass tube gives much water. B.B. fuses easily, and on charcoal affords the odor of arsenic. Insoluble in water and easily soluble in acids.

Obs.—First distinguished by Kenngott in minerals from the Bannat (vicinity either of Cziklowa or Orawitza) in the Imperial Mineral Cabinet at Vienna. Occurs in a coarsely granular calcite, containing also some garnets.

Named after Dr. Hörnes.

523. **RŒSSLERITE.** *R. Blum*, Jahresb. Wett. Ges. Hanau, 32, 1861.

In thin crystalline plates, with columnar or fibrous structure. Cleavage apparent in one direction. Also in vermiform efflorescences.

H.=2−3. G.= ? Lustre vitreous to dull. Colorless or white. Transparent to translucent. Becomes opaque and dull on exposure.

Comp.—$(\frac{2}{3}\dot{M}g+\frac{1}{3}\dot{\bar{H}})^3\ddot{\bar{A}}s+12\dot{\bar{H}}$=Arsenic acid 39·65, magnesia 13·80, water 46·55. Analysis by Delffs (l. c.):

$\ddot{\bar{A}}s$ 40·16 $\dot{M}g$ 14·22 $\dot{C}e$ *tr.* $\dot{\bar{H}}$ 45·62

Pyr., etc.—B.B. fuses to a white enamel, and in a closed tube gives water. On charcoal gives arsenical fumes. Soluble in muriatic acid.

Obs.—Occurs in the Kupferschiefer, at Bieber, with pharmacolite and erythrite.

Named after Dr. C. Rössler of Hanau.

A mineral in monoclinic crystals occurs at Joachimsthal and Kremnitz, which, according to Tschermak (Anzeig. Ak. Wien, 1867, 218), has the composition $(\frac{2}{3}\dot{M}g+\frac{1}{3}\dot{\bar{H}})^3\ddot{\bar{A}}s+8\dot{\bar{H}}$, and which is probably rœsslerite.

624. **VIVIANITE.** Bloa Järnjord, Naturligit Berlinerblätt, Calx Martis phlogisto juncta, etc., *Cronst.*, 182, 1758. Cæruleum Berolinense nativum *Born.*, Lithoph., i. 136, 1772. Ocre martiale bleue, Bleu de Prusse natif, *de Lisle* iii. 295, 1783. Naturliche Berlinerblau, Phosphorsaurer Eisen, *Klapr.*, Crell's Ann., i. 390. 1784. Eisenblau, Blaueisenerde, *Germ.* Vivianit (fr. Cornwall) *Wern.*, Leztes Min.-Syst., 1817, 41. Breith., Hoffm. Min., iv. b, 146, 1817. Phosphate of Iron, Blue Iron Earth. Fer phosphaté, Fer azuré, *Fr.* Eisenglimmer *Mohs*, Min., 212, 1824. Eisen-Phyllit *Breith.*, Char., 26, 1823. Glaukosiderit *Glocker*, Handb., 857, 1831. Mullicite *Thoms.*, Min., i. 452, 1836. Anglarite *Berthier*, Ann. d. M., III. xii. 308, 1837.

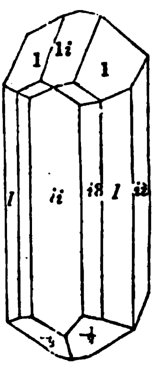
Monoclinic. C=71° 25′, $I\wedge I$=111° 12′, $O\wedge 1\text{-}\grave{i}$=145° 33′, $a:b:c$=1·002 : 1 : 1·3843. Observed planes: O; vertical, *i-i*, *I*, *i-ì*, *i-3*; clinodomes, ½-*ì*, 1-*ì*; hemidomes, ½-*i*, 1-*i*, 2-*i*, −1-*i*; hemioctahedral, ½, 1, −½, −1.

i-i ∧ 1-*i*=125° 47′
i-i ∧ −1-*i*=144 20
i-i ∧ *I*=145 36
i-i ∧ *i-3*=167 7

1 ∧ 1, front,=119° 10′
1 ∧ 1-*i*=149 35
1 ∧ *i-ì*=120 25
1-*ì* ∧ 1-*ì*, top,=111 6

i-ì ∧ 1-*i*=90° 0′
i-3 ∧ *i-3*=154 14
½ ∧ ½, front,=140 52
O ∧ *i-i*=108 35

464



Surface *i-ī* smooth, others striated. Cleavage: *i-ī*, highly perfect; *i-i* and $\frac{1}{2}$-*i* in traces. Often reniform and globular. Structure divergent, fibrous, or earthy; also incrusting.

H.=1·5–2. G.=2·58–2·68. Lustre, *i-ī* pearly or metallic pearly; other faces vitreous. Color white or colorless, or nearly so, when unaltered; often blue to green, deepening on exposure; usually green when seen perpendicularly to the cleavage-face, and blue transversely; the two colors mingled, producing the ordinary dirty blue color. Streak colorless to bluish-white, soon changing to indigo-blue; color of the dry powder often liver-brown. Transparent—translucent; becoming opaque on exposure. Fracture not observable. Thin laminæ flexible. Sectile.

Comp.—$\dot{\mathrm{F}}\mathrm{e}^3\overset{.....}{\bar{\mathrm{P}}}+8\dot{\bar{\mathrm{H}}}$=Phosphoric acid 28·3, protoxyd of iron 43·0, water 28·7=100, when colorless, being isomorphous with erythrite; but changes readily, owing to oxydation of the iron; analysis afforded Rammelsberg $6(\dot{\mathrm{F}}\mathrm{e}^3\overset{.....}{\bar{\mathrm{P}}}+8\dot{\bar{\mathrm{H}}})+\overset{...}{\bar{\mathrm{F}}}\mathrm{e}^3\overset{.....}{\bar{\mathrm{P}}}{}^2+8\dot{\bar{\mathrm{H}}})$.

Analyses: 1, Vogel (Gilb. Ann., lix. 174); 2, Rammelsberg (Pogg., lxiv. 411); 3, Stromeyer (Unters., 274); 4, 5, Rammelsberg (Pogg., lxiv. 411); 6, Brandes (Schw. J., xxxi. 77); 7, Thomson (Min., i. 452); 8, W. Fisher (Am. J. Sci., II. ix. 84); 9, Rammelsberg (J. pr. Ch., lxxxvi. 344):

	$\overset{.....}{\bar{\mathrm{P}}}$	$\overset{...}{\bar{\mathrm{F}}}\mathrm{e}$	$\dot{\mathrm{F}}\mathrm{e}$	$\dot{\bar{\mathrm{H}}}$
1. Bodenmais	26·4	——	41·0	31·0=98·4 Vogel.
2. "	29·01	11·60	35·65	*und.* Rammelsberg.
3. St. Agnes, Cornwall	31·18	——	41·23	27·48=99·89 Stromeyer.
4. N. Jersey, *Mullicite*	28·40	12·06	33·91	*und.* } Rammelsberg. G.=2·58.
5. " "	——	12·06	33·98	27·49 }
6. Hillentrup	30·32	——	43·78	25·00, $\overset{...}{\bar{\mathrm{A}}}\mathrm{l}$ 0·7, $\dddot{\mathrm{S}}\mathrm{i}$ 0·02=99·82 Brandes.
. *Mullicite*	26·06	——	46·31	27·14=99·51 Thomson.
8. Delaware	27·17	——	44·10	27·95, Silica 0·10=99·82 Fisher.
9. Allentown, N. J.	28·81	4·26	38·26	28·67=100 Rammelsberg. G.=2·68.

Other analyses, probably of this species more or less impure or altered, have afforded: 10, Berthier (Ann. d. M., xii. 303); 11, Segeth (J. pr. Ch., xx. 256); 12, Klaproth (Beitr., iv. 120); 13, Berthier (l. c.); 14, 15, Struve (Bull. phys.-math. Ac. St. Petersb., xiv. 171, 1856); 16, C. A. Kurlbaum (Am. J. Sci, II. xxiii. 422):

	$\overset{.....}{\bar{\mathrm{P}}}$	$\overset{...}{\bar{\mathrm{F}}}\mathrm{e}$	$\dot{\mathrm{F}}\mathrm{e}$	$\dot{\bar{\mathrm{H}}}$
10. Alleyras, *Blue Iron Earth*	23·1	——	43·0	32·4, $\overset{...}{\bar{\mathrm{A}}}\mathrm{l}$ 0·6, $\overset{...}{\bar{\mathrm{M}}}\mathrm{n}$ 0·3=99·4 Berthier.
11. Kertsch, " "	24·95	——	48·79	26·26=100 Segeth.
12. Eckartsberg, " "	32·0	——	47·5	20·0=99·5 Klaproth.
13. Anglar, *Anglarite*	27·3	——	56·0	16·5=99·8 Berthier.
14. Kertsch	29·17	21·34	21·54	27·50=99·55 Struve. G.=2·72.
15. Barguis, *earthy, blue*	19·79	33·11	13·75	26·10, $\dot{\mathrm{M}}\mathrm{g}$ 7·37=100·12 Struve.
16. Allentown, N. J., "	29·65	18·45	27·62	25·60, $\dot{\mathrm{M}}\mathrm{g}$ 0·03=101·35 Kurlbaum.

The anglarite corresponds to the formula $\dot{\mathrm{F}}\mathrm{e}^4\overset{.....}{\bar{\mathrm{P}}}+4\dot{\bar{\mathrm{H}}}$; it is probably massive vivianite.

A vivianite from New Zealand afforded R. Pattison (Phil. Mag., III. xxv. 495):

Phos. iron 62·8, water 28·4, organic matter 2·8, silica 5·2=99·2.

Pyr., etc.—In the closed tube yields neutral water, whitens, and exfoliates. B.B. fuses at 1·5, coloring the flame bluish-green, to a grayish-black magnetic globule. With the fluxes reacts for iron. Soluble in muriatic acid.

Obs.—Occurs associated with pyrrhotite and pyrite in copper and tin veins; sometimes in narrow veins with gold, traversing gray-wacke; both friable and crystallized in beds of clay, and sometimes associated with limonite, or bog iron ore; often in cavities of fossils or buried bones.

At St. Agnes in Cornwall transparent indigo crystals have been found, 1 in. in diameter and 2 long, on pyrrhotite; at Wheal Falmouth, and near St. Just; in Devonshire, near Tavistock; at Bodenmais, and the gold mines of Vöröspatak in Transylvania, in crystals; on the promontory of Kerts in the Black Sea, in large indistinct crystals in the interior of shells. The earthy variety, som times called *blue iron earth* or *native Prussian blue* (*Fer azuré*), occurs in Greenland, Syria, Cari thia, Cornwall, etc. The friable varieties in bog iron ore in several peat swamps in the Shetlan Isles, at Ballagh in the Isle of Man, accompanying sometimes the horns of the elk and deer, an near an old slaughter-house in Edinburgh. At Cransac, France, in crystals formed after th burning of a coal mine.

In N. America, it occurs in *N. York*, at Harlem, in crystals accompanying stilbite and feldspar i fissures in gneiss. In *New Jersey*, at Imleytown, in dark blue crystals; at Allentown, Monmou Co., in considerable abundance, both crystallized, in nodules, and earthy, imbedded in bog iron or and associated with clays; at Mullica Hill, Gloucester Co (*Mullicite*), in cylindrical masses, co sisting of divergent fibres or acicular crystals; at Franklin, occasionally; it often fills the interi of belemnites and other fossils in the Ferruginous sand formation. Also in *Delaware* (see anal. above), 4 m. W. of Cantwell's Bridge, and near Middletown, in Green sand, in fine large cryst which are colorless when first obtained, evidently, as Fisher observed, containing only protox of iron; near Cape Henlopen, in Sussex Co. In *Maryland*, in the north part of Somerset an Worcester Cos. In *Virginia*, with bog ore in Stafford Co., and 8 or 10 m. from Falmouth, wit gold and galenite. In *Canada*, with limonite at Vandreuil, abundant.

Named by Werner after J. G. Vivian, an English mineralogist who discovered the specimens i Cornwall. Werner was not aware of their identity with the *Blaueisenerde* when he gave th name.

Alt.—Becomes altered, as above stated, through the oxydation of the iron, which the analyses given illustrate. Tschermak obtained (Ber. Ak. Wien, xlix. 342) for an altered vivianite in crystals from a cabinet in Vienna, $\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{P}}$ 30·5, $\overset{\cdot\cdot\cdot}{\bar{\mathrm{F}}}\mathrm{e}$ 55·0, $\dot{\mathrm{N}}\mathrm{a}$ 1·5, $\dot{\mathrm{H}}$ 14·0=101. G.=2·95; lustre metallic-pearly; color on face of cleavage pinchbeck-brown, elsewhere blackish-brown; streak ochre-yellow.

Beraunite Breithaupt (Handb., 156, 1841, B. H. Ztg., 1853, 402) is of similar origin and character. It occurs in small foliated and columnar aggregations, with one perfect metallic-pearly cleavage, having H.=2; G.=2·878; color hyacinth-red to reddish-brown; streak dirty yellow. Plattner found it to be a hydrous phosphate of sesquioxyd of iron. From St. Benigua, near Beraun, in Bohemia; and reported also from Wheal Jane, near Truro, England, by Greg, associated with pure and altered vivianite.

525. SYMPLESITE. Symplesit *Breith.*, J. pr. Ch., x. 501, 1837.

Monoclinic. In form resembling erythrite. Cleavage perfect parallel with the clinodiagonal face. In minute prismatic crystals; also aggregated.

H.=2·5, nearly. G.=2·957. Lustre of cleavage-face pearly; elsewhere vitreous. Color pale indigo, inclined to celandine-green; sometimes between leek- and mountain-green. Streak bluish-white. Subtransparent to translucent.

Comp.—Supposed to be an arsenate of the protoxyd of iron.

Pyr., etc.—In the closed tube yields much water; at a high temperature some arsenous acid sublimes, imparting an acid reaction to the water, and giving a black magnetic residue. B.B. in the forceps infusible, but colors the outer flame light blue (arsenic), and becomes black and magnetic. On charcoal gives a strong arsenical odor. With the fluxes reacts for iron, and gives also traces of manganese and sulphuric acid (Plattner).

According to Breithaupt, when heated in a glass tube, it turns brown, and loses 26¼ p. c. of water. Plattner found 24¾ p. c.

Obs.—Occurs at Lobenstein in Voigtland, with spathic iron.

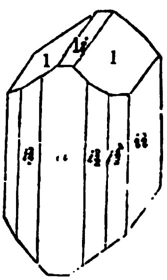
526. ERYTHRITE. Kobold-Blüthe *Brückmann*, Magnalia, 161, etc., 1727. Kobolt Blomma, Flos Cobalti [the cryst.], Koboltbeslag [impure earthy], Cobalti minera colore rubro, etc., *Wall.*, Min., 234, 1747. Koboltblüte, Koboltbeschlag, Ochra Cobalti rubra, *Cronstedt*, 212, 1758. Kobaltblüthe *Germ.* Cobalt Bloom, Red Cobalt, Cobalt Ochre. Cobaltum acido arsenico mineralisatum *Bergmann*, Sciagr., 134, 1782, Opusc., ii. 446, 1780 (first anal.). Arseniate of Cobalt. Cobalt arseniaté *Fr.* Erythrine *Beud.*, Min., ii. 596, 1832. Rhodoise *Huot*, i. 318, 1841.

Monoclinic. $C=70°\ 54'$, $I \wedge I=111°\ 16'$, $O \wedge 1\text{-}\grave{\imath}=146°\ 19'$; $a:b:c$

=0·9747 : 1 : 1·3818. Observed planes as in the annexed figure, together with 3-*i* and $\frac{3}{2}$-*i* between *i-i* and 1-*i*.

i-i ∧ *i-ĭ*=90° 0′ *i-ĭ* ∧ *i*-$\frac{3}{2}$=155° 5′ *i*-$\frac{4}{3}$ ∧ *i*-$\frac{4}{3}$=94° 12′
i-i ∧ 1-*i*=124 51′ *i-i* ∧ *i*-$\frac{4}{3}$=137 6 *i-ĭ* ∧ 1=120 48
1-*i* ∧ 1=149 12 *i*-$\frac{3}{2}$ ∧ *i*-$\frac{3}{2}$=130 10 1 ∧ 1=118 24

465



Schneeberg.

Surfaces *i-i* and 1-*i* vertically striated. Cleavage: *i-ĭ* highly perfect, *i-i* and 1-*i* indistinct. Also in globular and reniform shapes, having a drusy surface and a columnar structure; sometimes stellate. Also pulverulent and earthy, incrusting.

H.=1·5—2·5; the lowest on *i-ĭ*. G.=2·948. Lustre of *i-ĭ* pearly; other faces adamantine, inclining to vitreous; also dull and earthy. Color crimson and peach-red, sometimes pearl or greenish-gray; red tints incline to blue, perpendicular to cleavage-face. Streak a little paler than the color; the dry powder deep lavender-blue. Transparent—subtranslucent. Fracture not observable. Thin laminæ flexible in one direction. Sectile.

Var.—1. Crystallized and foliated. 2. Earthy. The latter is the *earthy cobalt bloom* (Kobaltbeschlag *Germ.*, Rhodoise *Huot*).

Comp.—$\dot{C}o^3\,\dddot{A}s+8\dot{H}$=Arsenic acid 38·43, oxyd of cobalt 37·55, water 24·02; $\dot{C}o$ often partly replaced by $\dot{F}e$, $\dot{C}a$, or $\dot{N}i$. Analyses: 1, Bucholz (Gehlen's J., II. ix. 308); 2, Laugier (Mem. d. Mus. d'hist., ix. 233); 3, 4, 5, Kersten (Pogg., lx. 251); 6, Lindaker (Vogl's Joach.):

	$\dddot{A}s$	$\dot{C}o$	$\dot{N}i$	$\dot{F}e$	$\dot{C}a$	$\dot{H}$
1. Riechelsdorf	37	39	—	—	—	22=98 Bucholz.
2. Allemont	40·0	20·5	9·2	5·5	—	24·5=99·7 Laugier.
3. Schneeberg	38·43	36·52	—	1·01	—	24·10=100·06 Kersten.
4. "	38·30	33·42	—	4·01	—	24·08=99·81 Kersten.
5. "	38·10	29·19	—	—	8·00	23·90=99·19 Kersten.
6. Joachimsthal	36·42	23·75	11·26	3·51	0·42	23·52, $\dddot{S}$ 0·86=99·74 Lindaker.

Pyr., etc.—In the closed tube yields water at a gentle heat and turns bluish; at a higher heat gives off arsenous acid, which condenses in crystals on the cool glass, and the residue has a dark gray or black color. B.B. in the forceps fuses at 2 to a gray bead, and colors the flame light blue (arsenic). B.B. on charcoal gives an arsenical odor, and fuses to a dark gray arsenid, which with borax gives the deep blue color characteristic of cobalt. Soluble in muriatic acid, giving a rose-red solution.

The *earthy cobalt bloom*, of a peach-blossom color (kobaltbeschlag), is shown by Kersten to be cobalt bloom, with some free arsenous acid. He obtained:

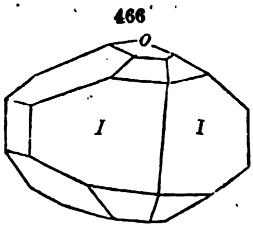
	$\ddot{A}s$	$\dddot{A}s$	$\dot{C}o$	$\dot{F}e$	$\dot{H}$
1. Schneeberg	51·00	19·10	16·60	2·10	11·90=100·70.
2. Annaberg	48·10	20·00	18·30	—	12·13=98·53,

with a trace of nickel, lime, and sulphuric acid (Pogg., lx. 262).

Obs.—Occurs at Schneeberg in Saxony, in micaceous scales, stellularly aggregated; in brilliant specimens, consisting of minute aggregated crystals, at Saalfeld in Thuringia; also at Riechelsdorf in Hessia; Wolfach and Wittichen in Baden; Modum in Norway. The earthy peach-blossom varieties have been observed at Allemont in Dauphiny; in Cornwall, at the Botallack mine, St. Just, etc.; near Alston in Cumberland; near Killarney in Ireland. A perfectly green variety occurs at Platten in Bohemia, and sometimes red and green tinges have been observed on the same crystals.

Erythrite, when abundant, is valuable for the manufacture of smalt. Named from ἐρυθρός, red.

466



526A. **Roselite.** The *roselite* of Levy (Ann. Phil., II. viii. 439, 1824, and Ed. J. Sci., ii. 177) is probably a variety of cobalt bloom; and Kersten suggests that it may be identical with the variety in the third of his analyses above, which contains lime an element detected by Children in roselite. The form here given is from Levy. Haidinger makes it a twin with composition parallel to i-$\bar{i}$.

Orthorhombic. $I \wedge I = 132° 48'$. $O \wedge 1$-$\bar{i} = 158° 2'$. Cleavage distinct and brilliant, parallel to i-$\bar{i}$. It is deep rose-red, with the lustre vitreous, and H.=3.

Its only known locality is at Schneeberg in Saxony, where it has been found in small quantities on quartz. Named after G. Rose, of Berlin.

526B. **Lavendulan** (Breithaupt, J. pr. Ch., x. 505, 1837). Amorphous, with a greasy lustre inclining to vitreous. H.=2·5–3. G.=3·014, Breithaupt. Color lavender-blue. Streak pale blue. Translucent. Fracture conchoidal.

Contains, according to Plattner, arsenic, and the oxyds of cobalt, nickel, and copper, with water. J. Lindaker (Jahrb. G. Reichs., iv. 555) found oxyd of copper as a prominent ingredient with the others mentioned. Fuses easily before the blowpipe, coloring the flame deep blue, and yielding a globule which becomes crystalline on cooling. On charcoal yields an arsenical odor. With the fluxes gives the reaction of cobalt. Occurs at Annaberg in Saxony, with cobalt and other ores, and is a result of their alteration.

527. ANNABERGITE.

Ochra Niccoli, Niccolum calciforme, *Cronst.*, Min., 218, 1758. Nickelocker. Nickelblüthe. Nickel Ochre; Nickel Green; Arseniate of Nickel. Nickel Arseniate. Annabergite *B. & M.*, 503, 1852.

Monoclinic. In capillary crystals; also massive and disseminated.

Soft. Color fine apple-green. Streak greenish-white. Fracture uneven, or earthy.

Comp.—$\dot{\mathrm{N}}\mathrm{i}^3\,\ddot{\bar{\mathrm{A}}}\mathrm{s}+8\,\dot{\bar{\mathrm{H}}}$=Arsenic acid 38·6, oxyd of nickel 37·2, water 24·2=100. Analyses: 1, Berthier (Ann. Ch. Phys., xiii. 52); 2, Stromeyer (Schw. J., xxv. 220); 3–5, Kersten (Pogg., lx. 251):

	$\ddot{\bar{\mathrm{A}}}\mathrm{s}$	$\dot{\mathrm{N}}\mathrm{i}$	$\dot{\mathrm{C}}\mathrm{o}$	$\dot{\bar{\mathrm{H}}}$
1. Allemont	36·8	36·2	2·5	25·5=100 Berthier.
2. Riechelsdorf	36·97	37·35	——	24·32, $\ddot{\bar{\mathrm{F}}}\mathrm{e}$ 1·13, $\dddot{\mathrm{S}}$ 0·23=100 Strom.; some $\dot{\mathrm{C}}\mathrm{o}$ with $\dot{\mathrm{N}}\mathrm{i}$.
3. Schneeberg	38·30	36·20	1·53	23·91, $\dot{\mathrm{F}}\mathrm{e}$ *tr.*=99·94 Kersten.
4. "	38·90	35·00	——	24·02, " 2·21=100·13 Kersten.
5. "	37·21	36·10	*tr.*	23 92, " 1·10, $\ddot{\bar{\mathrm{A}}}\mathrm{s}$ 0·52=98·85 Kersten.

Pyr., etc.—In the closed tube gives off water and darkens in color. B.B. fuses easily, and on charcoal gives an arsenical odor and yields a metallic button, which with borax glass gives at first a cobalt-blue glass, and later the violet to reddish-brown color characteristic of nickel; in R.F. it becomes gray from reduced nickel. Soluble in acids.

This species is probably isomorphous with erythrite.

Obs.—Occurs on smaltite at Allemont in Dauphiny, and is supposed to result from the decomposition of this ore; also at Kamsdorf, near Saalfeld; at Annaberg; at Riechelsdorf and other mines of nickel ores. It has been occasionally observed associated with copper nickel in the cobalt mine at Chatham, Connecticut.

528. *Hydrous Bibasic Arseniate of Nickel and Cobalt.* Under this name D. Forbes describes (Phil. Mag., IV. xxv. 103) a mineral occurring in the desert of Atacama in veins in a decomposed dioryte. A few yards below the surface it passes into chloanthite, from which mineral it appears to have been derived. H.=2·5. G.=3·086. Structure fibro-crystalline. Lustre dull to silky or resinous Color grayish-white. Analysis afforded $\ddot{\bar{\mathrm{A}}}\mathrm{s}$ 44·05, $\dot{\mathrm{N}}\mathrm{i}$ 19·71, $\dot{\mathrm{C}}\mathrm{o}$ 9·24, $\dot{\bar{\mathrm{H}}}$ 26·98=99·98; from which Forbes deduces the formula $(\dot{\mathrm{N}}\mathrm{i}, \dot{\mathrm{C}}\mathrm{o})^2\,\ddot{\bar{\mathrm{A}}}\mathrm{s}+8\,\dot{\bar{\mathrm{H}}}$, which requires $\ddot{\bar{\mathrm{A}}}\mathrm{s}$ 43·89, $\dot{\mathrm{C}}\mathrm{o}$, $\dot{\mathrm{N}}\mathrm{i}$ 28·63, $\dot{\bar{\mathrm{H}}}$ 27·48 =100, making it allied to pharmacolite. B.B. in the closed tube yields water, becoming darker; on charcoal fuses imperfectly, evolves arsenic fumes, leaving metallic globules of an arsenid of nickel and cobalt. With fluxes gives reactions for nickel and cobalt.

By regarding a portion of the water basic, the mineral becomes a tribasic arsenate, and then approaches annabergite. Kenngott names it *Forbesite* (Ueb., 1862–'65, 46, 1868)

529. CABRERITE. Wasserhaltige Nickeloxyd-Magnesia *J. H. Ferber*, B. H. Ztg., xxii. 306, 1863. Cabrerite *Dana.*

Monoclinic. Like erythrite in habit. Cleavage: clinodiagonal perfect. Also fibrous, concentric. Reniform and granular.

H.=2. G.=2·96. Lustre pearly on face of cleavage; silky when fibrous. Color apple-green. Translucent to transparent.

Comp.—O. ratio for $\dot{R}$, $\ddot{\bar{A}}s$, $\dot{H}$=3 : 5 : 8. $\dot{R}^3\ddot{\bar{A}}s+8\dot{H}$, in which $\dot{R}$ corresponds to $\dot{N}i$, $\dot{C}o$, $\dot{M}g$ n the ratio 5 : 1 : 4½. Analysis: Ferber (l. c.), having only a small quantity at his disposal:

$\ddot{\bar{A}}s$ 42·37 $\dot{N}i$ 20·01 $\dot{C}o$ 4·06 $\dot{M}g$ 9·29 $\dot{H}$ 25·80=101·53.

Pyr., etc.—In the closed tube yields water and becomes grayish-yellow. B.B. in R.F. infusble: on charcoal gives arsenical fumes.

Obs.—From the Sierra Cabrera, Spain, in a gangue of brown spar, which is connected with he mountain limestone and argillaceous schist. Results from the alteration of arsenids of nickel nd cobalt.

30. KÖTTIGITE. Zinkarseniat *Otto Köttig*, J. pr. Ch., xlviii. 183, 1849; *Naumann*, ib., 256. Köttigite *Dana*, Min., 487, 1850.

Monoclinic, and isomorphous with erythrite, Naumann. Massive, or in rusts, with crystalline surface and fibrous structure. Cleavage: clinodiagonal perfect.

H.=2·5—3. G.=3·1. Lustre of surface of fracture silky. Color light armine- and peach-blossom-red, of different shades. Streak reddish-white. ranslucent to subtranslucent.

Comp.—$(\dot{Z}n, \dot{C}o, \dot{N}i)^3\ddot{\bar{A}}s+8\dot{H}$, or analogous to erythrite. Analysis by Köttig (l. c.):

$\ddot{\bar{A}}s$ [37·17] $\dot{Z}n$ 30·52 $\dot{C}o$ 6·91 $\dot{N}i$ 2·00 $\dot{C}a$ *tr.* $\dot{H}$ 23·40=100.

Pyr., etc.—In the closed tube gives much water, and at a higher temperature a faint crystale sublimate of arsenous acid. B.B. fuses easily, coloring the flame blue; on charcoal in R.F. ves copious fumes of arsenic and coats the coal with oxyd of zinc; with soda the coating is uch more marked, and is yellow while hot and white on cooling; this moistened with cobalt lution and heated in O F. assumes a green color. With borax and salt of phosphorus gives a balt-blue glass.

Obs.—Occurs with smaltite at the cobalt mine Daniel, near Schneeberg. The color is owing rtly to the arsenate of cobalt in the mineral.

1. HUREAULITE. *Alluaud*, Vauquelin, Ann. Ch. Phys., xxx. 302, 1825; *Alluaud*, Ann. d. Sci. Nat., viii. 349, 1826. *Dufrénoy*, Ann. Ch. Phys., xli. 338, 1829; *Descloizeaux* and *Damour*, bid., III. liii. 293.

Monoclinic $I \wedge I$ (planes unobs.)=99° 21′; i-2 $\wedge$ i-2=61°; $O \wedge I$=90° ′, $O \wedge i$-i (=C)=90° 33′, $O \wedge$ 1-i=138° 22′, $O \wedge$ 3-i=122° 53′, $O \wedge \frac{1}{2}$-i 174° 2′. In small crystals, isolated or grouped, the groups sometimes mmillary, or fascicled as in stilbite. Cleavage not observed. Also to a ited extent massive, compact, scaly, or imperfectly fibrous.

H.=5. G.=3·185, yellow, and 3·198, reddish, Damour. Lustre vitre, somewhat greasy, bright. Color brownish-orange, rose-violet, and e rose, nearly colorless. Streak similar. Transparent—translucent. tically biaxial; axes very divergent, the plane orthodiagonal; bisectrix itive.

Var.—The (*a*) brownish-orange or yellowish, (*b*) the rose-violet, and (*c*) the pale rose, are thre varieties, differing somewhat in their crystalline planes. The orange is the most common. Th crystals approach in habit those of crocoisite, though of very different angles.

Comp.—O. ratio for $\dot{R}$, $\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{P}}$, $\dot{\bar{H}}$=1 : 2 : 1; whence $(\dot{Mn}, \dot{Fe})^6 \overset{\cdot\cdot\cdot\cdot\cdot}{\bar{P}}{}^2 + 5\ \dot{\bar{H}}$, with $\dot{Mn} : \dot{Fe}$=5 : 1, o better $(\dot{Mn}, \dot{Fe}, \dot{\bar{H}})^3\ \overset{\cdot\cdot\cdot\cdot\cdot}{\bar{P}} + 2\ \dot{\bar{H}}$=Phosphoric acid 39·1, protoxyd of manganese 40·2, protoxyd of iro 8·3, water 12·4=100. Analyses: 1, Dufrénoy (l. c.); 2, 3, 4, Damour (l. c.):

	$\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{P}}$	$\dot{Mn}$	$\dot{Fe}$	$\dot{\bar{H}}$
1. Limoges	38·00	32·85	11·10	18·00=99·95 Dufrénoy.
2. " *yellow*	37·96	41·15	8·10	12·35, quartz 0·35=99·91 Damour.
3. " "	38·20	42·04	6·75	12·00 " 0·50=99·49 Damour.
4. " *reddish*	37·83	41·80	8·73	11·60 " 0·30=100·26 Damour.

Pyr., etc.—In the closed tube gives water. B.B. fuses to a reddish-yellow crystalline pearl brown in the outer flame, then becomes black, and the flame is colored green. Reactions of manganese and iron. Easily soluble in acids.

Obs.—Found in cavities of triphyline or its altered form heterosite, in granite, at Limoges, commune of Huréaux, France.

The crystals were first examined by Dufrénoy (l. c.), and afterward more completely by De cloizeaux (l. c.).

532. CHONDRARSENITE. Kondroarsenit *Igelström*, Œfv. Ak. Stockh., xxii. 3, 1865.

In small grains.

H.=3. Color yellow to reddish-yellow. Translucent. Brittle. Fracture conchoidal.

Comp.—An arsenate of manganese. O. ratio for $\dot{R}$, $\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{As}}$, $\dot{\bar{H}}$=2 : 2 : 1; whence $\dot{Mn}^5\ \overset{\cdot\cdot\cdot\cdot\cdot}{\bar{As}} + 2\frac{1}{2}$
Analysis: Igelström (l. c.):

$\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{As}}$	$\dot{Mn}$	$\dot{Mg}$	$\dot{Ca}$	$\dot{\bar{H}}$	
33·50	51·59	2·05	4·86	7·00,	$\ddot{C}$ *tr.*=99·00 Igelström.

Pyr., etc.—B.B. in tube decrepitates, blackens, and gives neutral water. On charcoal easi fusible to a black bead, not magnetic; in the inner flame gives arsenical fumes. With bor gives manganese reaction. Easily and completely soluble in dilute muriatic and nitric acids.

Obs.—Occurs in the Paisberg mines, Wermland, in veins of barite intersecting hausmannite.

Named from its similarity in occurrence, color, and transparency to chondrodite, while differi from it in being an arsenate.

---

533. TRICHALCITE. Trichalcit *Herm.*, J. pr. Ch., lxxiii. 212, 1858.

In radiated groups, columnar; also in dendritic forms.

H.=2·5. Lustre silky. Color verdigris-green.

Comp.—$\dot{Cu}^3\ \overset{\cdot\cdot\cdot\cdot\cdot}{\bar{As}} + 5\ \dot{\bar{H}}$. Analysis by Hermann (l. c.):

$\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{As}}$	$\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{P}}$	$\dot{Cu}$	$\dot{\bar{H}}$
38·73	0·67	44·19	16·41=100.

Pyr., etc.—Heated decrepitates, yields much water, and becomes dark brown. B.B. on charcoal fuses in the outer flame to a pearl, and in the inner yields a bead of copper. Dissolv easily in cold muriatic acid.

Obs.—From the Turjinsk copper mine, or Beresovsk, on tetrahedrite. Resembles tyrolite.

534. THROMBOLITE. Thrombolith *Breith.*, J. pr. Ch., xv. 321, 1838.

Amorphous.

H.=3—4. G.=3·38—3·40. Lustre vitreous. Color emerald-, leek-, or dark green. Streak emerald-green. Opaque. Fracture conchoidal.

Comp.—According to an imperfect analysis by Plattner (l. c.) it contains:

$\overset{\cdot\cdot}{\bar{\mathrm{P}}}$ 41·0 $\dot{\mathrm{C}}\mathrm{u}$ 39·2 $\dot{\mathrm{H}}$ 16·8, besides a small amount of silica and alumina.

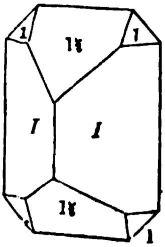
Pyr., etc.—In the closed tube gives much water and turns black. B.B. fuses easily and first colors the flame blue, like chlorid of copper, and later gives a dark emerald-green. On charcoal fuses to a black globule, which, after long blowing, yields globules of copper. With the fluxes reacts for copper. With boric acid and iron gives a fusible phosphid (Plattner).

Obs.—Found with malachite in a fine-grained limestone at Retzbanya, Hungary.

535. **LIBETHENITE.** Olivenerz pt. Phosphorkupfererz pt. Phosphate of Copper pt. Cuivre phosphaté pt. Octaedrisches Phosphorkupfer *Leonh.*, Leonh. u. Selb's Min. Stud., 1812. Blättricher Pseudomalachite pt. *Hausm.*, Handb., 1036, 1813. Libethenit *Breith.*, Char., 267, 1823. Aphérèse *Beud.*, ii. 569, 1832. Pseudo-libethenit *Ramm.*, Min. Ch., 344, 1860.

Orthorhombic. $I \wedge I=92°\ 20'$, $O \wedge 1\text{-}\bar{\imath}=143°\ 50'$; $a:b:c=0{\cdot}7311:1:1{\cdot}0416$. Observed planes as in the annexed figure, with also the prismatic planes $i\text{-}2$. $1\text{-}\breve{\imath} \wedge 1\text{-}\breve{\imath}$, top, $=109°\ 52'$, $1 \wedge 1$, ov. $1\text{-}\bar{\imath}$, $=118°\ 12'$, adj., $=120°\ 56'$, ov. I, $=90°\ 46'$, $I \wedge 1=135°\ 23'$. Cleavage: diagonal, $i\text{-}\bar{\imath}$, $i\text{-}\breve{\imath}$, very indistinct. Also globular or reniform, and compact.

467



H.=4. G.=3·6—3·8. Lustre resinous. Color olive-green, generally dark. Streak olive-green. Translucent to subtranslucent. Fracture subconchoidal—uneven. Brittle.

Comp.—$\dot{\mathrm{C}}\mathrm{u}^4\overset{\cdot\cdot}{\bar{\mathrm{P}}}+\dot{\mathrm{H}}$, or $\dot{\mathrm{C}}\mathrm{u}^3\overset{\cdot\cdot}{\bar{\mathrm{P}}}+\dot{\mathrm{C}}\mathrm{u}\,\dot{\mathrm{H}}$ (Ramm.)=Phosphoric acid 29·7, oxyd of copper 66·5, water 3·8=100. Analyses; 1, Kühn (Ann. Ch. Pharm., li. 154); 2, Bergemann (Pogg., civ. 190); , Hermann (J. pr. Ch., xxxvii. 175); 4, Chydenius (Acta Soc. Sc. Fenn., v. 340); 5, F. Field Chem. Gaz., June, 1859); 6, H. Müller (Qu. J. Ch. Soc., xi. 202); 7, Berthier (Ann. d. M., viii. 34); 8, Rhodius (Ann. Ch. Pharm., lxii. 371):

	$\overset{\cdot\cdot}{\bar{\mathrm{P}}}$	$\dot{\mathrm{C}}\mathrm{u}$	$\dot{\mathrm{H}}$
1. **Libethen**, *cryst.*	29·44	66·94	4·05=100·43 Kühn.
2. "	26·46	66·29	4·04, $\overset{\cdot\cdot}{\bar{\mathrm{A}}}\mathrm{s}$ 2·80=99·09 Bergemann.
3. **N. Tagilsk**	28·61	65·89	5·50=100 Hermann.
4. "	29·48	64·47	3·68, $\overset{\cdot\cdot}{\bar{\mathrm{A}}}\mathrm{s}$ *tr.*, $\overset{\cdot\cdot}{\bar{\mathrm{F}}}\mathrm{e}$ 1·77, $\ddot{\mathrm{C}}$ 0·82=100·22 Chydenius.
5. **Coquimbo**	29·31	66·42	3·74=99·47 Field
6. **Congo, Africa**	(?) 28·89	66·98	[4·13]=100 Müller.
7. **Libethen**	28·7	63·9	7·4=100 Berthier.
8. **Ehl**	28·9	63·1	7·3=99·8 Rhodius.

G. of anal. 3=3·6—3·8; 8, 4·27.

The analysis by Berthier is identical with Rhodius's analysis of ehlite=$\dot{\mathrm{C}}\mathrm{u}^4\overset{\cdot\cdot}{\bar{\mathrm{P}}}+2\dot{\mathrm{H}}$, and the ineral is called *Pseudo-libethenite* by Rammelsberg, who writes the formula $\dot{\mathrm{C}}\mathrm{u}^3\overset{\cdot\cdot}{\bar{\mathrm{P}}}+\dot{\mathrm{C}}\mathrm{u}\,\dot{\mathrm{H}}+\dot{\mathrm{H}}$. udant cites the same analysis in connection with his name Aphérèse.

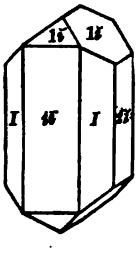
Pyr., etc.—In the closed tube yields water and turns black. B.B. fuses at 2 and colors the me emerald-green. On charcoal with soda gives metallic copper, sometimes also an arsenical or. Fused with metallic lead on charcoal is reduced to metallic copper, with the formation of osphate of lead, which treated in R.F. gives a crystalline polyhedral bead on cooling. With fluxes reacts for copper. Soluble in nitric acid.

Obs.—Occurs in cavities in quartz, associated with chalcopyrite, at Libethen, near Neusohl, in ngary; at Rheinbreitenbach and Ehl on the Rhine; at Nischne Tagilsk in the Ural; in Bolivia, A., with malachite; at the Mercedes mine, near Coquimbo, Chili, with tagilite and limonite o in small quantities near Gunnis Lake in Cornwall, and near Redruth; in the Ural.

536. OLIVENITE. Arseniksaures Kupfererz (fr. Cornwall) *Klapr.*, Schrft. Ges. Nat. Fr. Be vii. 160, 1786; Olivenerz (fr. Cornwall) *Wern.*, Bergm. J., 382, 395, 1789. Olive Copper Or *Kirwan*, ii. 151, 1796. Olive-green Copper Ore *Rashleigh*, Brit. Min., i. pl. 11, f. 2, 1797, ii. pl. 6 1802. Cuivre arseniaté en octaèdre aigus *Bourn.*, Phil. Tr., 177, 1801. Pharmakochalzit pt *Hausm.*, iii. 1042, 1813; Olivenkupfer, id., 1045; Pharmacolzit *id.*, 1025, 1847. Olivenite pt *Jameson*, Syst., ii. 335, 1820; *Leonh.*, Orykt, 283, 1821.

Orthorhombic. $I \wedge I = 92° \; 30'$, $O \wedge 1\text{-}\bar{i} = 144° \; 14'$; $a : b : c = 0{\cdot}72 : 1$: 1·0446. Observed planes as in the figure. $1\text{-}\breve{i} \wedge 1\text{-}\breve{i}$, top, $= 110° \; 50'$ (110° 47′, Descl.), $i\text{-}\breve{i} \wedge 1\text{-}\bar{i} = 124° \; 35'$, $i\text{-}\bar{i} \wedge I =$ 136° 15′. Cleavage: I and $1\text{-}\breve{i}$ in traces. Sometimes acicular. Also globular and reniform, indistinctly fibrous fibres straight and divergent, rarely promiscuous; also curved lamellar and granular.

468



H.=3. G.=4·1—4·4. Lustre adamantine—vitreous of some fibrous varieties pearly. Color various shades of olive-green, passing into leek-, siskin-, pistachio-, and blackish-green; also liver- and wood-brown; sometimes straw yellow and grayish-white. Streak olive-green—brown Subtransparent—opaque. Fracture, when observable, conchoidal—uneven. Brittle. Optically like libethenite, Descl.

Var.—1. *Ordinary.* (*a*) *Crystallized*; G.=4·378, Cornwall, Damour; 4·135, ib., Hermann.

(*b*) *Fibrous*; finely and divergently fibrous, of green, yellow, brown, and gray, to white colors with the surface sometimes velvety or acicular; G.=3·913, Hermann; found investing the common variety or passing into it; called *wood-copper* or *wood-arseniate* (*Holzkupfererz*).

(*c*) *Earthy*; nodular or massive; sometimes soft enough to soil the fingers.

Comp.—$\dot{C}u^4(\dddot{A}s, \dddot{P}) + \dot{H}$, or $\dot{C}u^3(\dddot{A}s, \dddot{P}) + \dot{C}u\dot{H} =$, the arsenic being to the phosphoric acid a 6 : 1, Arsenic acid 35·7, phosphoric acid 3·7, oxyd of copper 57·4, water 3·2=100, and isomorphous with libethenite. Analyses: 1, v. Kobell (Pogg., xviii. 249); 2, 3, Richardson (Thom. Min i. 614); 4, Hermann (J. pr. Ch., xxxiii. 291); 5, Damour (Ann. Ch. Phys., III. xiii. 404); 6, Thomson (Min., i. 615); 7, Hermann (l. c.):

		$\dddot{A}s$	$\dddot{P}$	$\dot{C}u$	$\dot{H}$
1.	Cornwall, *cryst.*	36·71	3·36	56·43	3·50=100 Kobell.
2.	" "	39·9	—	56·2	3·9=100 Richardson.
3.	" "	39·80	—	56·65	3·55=100 Richardson.
4.	" "	33·50	5·96	56·38	4·16=100 Hermann.
5.	" "	34·87	3·43	56·86	3·72=98·88 Damour.
6.	" *fibrous*	40·61	—	54·98	4·41=100 Thomson.
7.	" "	40·50	1·00	51·03	3·83, $\dot{F}e$ 3·64=100 Hermann.

Pyr., etc.—In the closed tube gives water. B.B. fuses at 2, coloring the flame bluish-gree and on cooling the fused mass appears crystalline. B.B. on charcoal fuses with deflagration, give off arsenical fumes, and yields a metallic arsenid, which with soda yields a globule of coppe With the fluxes reacts for copper. Soluble in nitric acid.

Obs.—The crystallized varieties occur disposed on, or coating, cavities of quartz in Cornwal at Wheal Gorland, Ting Tang, Wheal Unity, and other mines near St. Day; also near Redruth near Tavistock, in Devonshire; also in inferior specimens at Alston Moor, in Cumberland; a Camsdorf and Saalfeld in Thuringia; the Tyrol; the Bannat; Siberia; Chili; and other places.

The name olivenite alludes to the olive-green color.

None of the mineral phosphates or arsenates were distinctively recognized in ancient mineralogy. The species containing copper, if observed, were left to pass under the general names o *chrysocolla* and *malachites*. In 1747, Wallerius has, besides *Koppar-Lazur* or azurite, the tw species Copper Green (malachite) and Copper Blue (chrysocolla and azurite in part), but witho well-defined limits. Cronstedt, in 1758, describes the Mountain Blue as sometimes impure (ter calcarea mixta), and hence effervescing with aqua-fortis. Fontana, in 1778, announced the gree *carbonate* after an analysis; and Bergmann in his Sciagraphia, 1782, recognizes only carbon of copper, and calls wrongly the *green mica* of Werner (1780, and later *torbernite*) a chlorid.

1786 Klaproth analyzed an *arsenate*, and Werner soon after gave it the name of *Olivenerz;* and in Werner's system of 1789 (Bergm. J., 382, 1789), Azurite, Malachite, Copper green of compact texture not effervescing with acids (chrysocolla), and Olivenerz, together with a so-called *Eisenschüssig Kupfergrün* (mostly earthy green carbonate), were the only species. Karsten's Tabellen of 1800 contains no addition to the list. But in 1801 Bournon announced, from an analysis by Chenevix, a second arsenate, afterward called *Liroconite;* Vauquelin a third, afterward named *Chalcophyllite*; Klaproth a fourth, the *Strahliges Olivenerz*, or *Clinoclase*. Klaproth also published at the same time an analysis of the first *phosphate*, now called *Pseudomalachite*; besides one of the oxychlorid *Atacamite*, which mineral had been brought from Chili as *copper sand* between 1780 and 1790, and was pronounced an oxyd by Vauquelin, and a chlorid by Karsten in his Tabellen of 1800.

537. **ADAMITE.** Adamine *C. Friedel*, C. R., lxii. 692, 1866.

Orthorhombic. $I \wedge I = 91° \ 33'$, $O \wedge 1\text{-}\bar{\imath} = 143° \ 40'$; $a : b : c = 0{\cdot}73547 : 1 : 1{\cdot}0271$; isomorphous with olivenite. $I \wedge i\text{-}\breve{3} = 161° \ 43\tfrac{1}{2}'$, $I \wedge i\text{-}\breve{3} = 161° \ 25'$, $1\text{-}\bar{\imath} \wedge 1\text{-}\bar{\imath} = 107° \ 20'$, $I \wedge 1 = 135° \ 45'$, $1 \wedge 1$, over $1\text{-}\bar{\imath}$, $= 120° \ 4'$. Cleavage: $1\text{-}\bar{\imath}$ very distinct.

H.=3·5. G.=4·338. Lustre vitreous, strong. Color honey-yellow, violet, the latter often external only. Streak white. Transparent. Plane of optical axes parallel to the base, and normal to $i\text{-}\breve{\imath}$; angle in oil for a plate of violet variety, normal to the obtuse bisectrix, 115° 50′ for the red rays; Descl.

Comp.—O. ratio for $\dot{R}$, $\ddot{\bar{A}}s$, $\dot{H} = 4 : 5 : 1$; $\dot{Z}n^3 \ddot{\bar{A}}s + \dot{Z}n \dot{H}$ = Arsenic acid 40·2, oxyd of zinc 56·7, water 3·1=100. But the analysis gives $1\tfrac{1}{2}$ $\dot{H}$ instead of 1 $\dot{H}$. Analysis: Friedel (l. c.):

$\ddot{\bar{A}}s$ 39·95 $\dot{Z}n$ 54·32 $\dot{F}e$ 1·48 $\dot{M}n$ *tr.* $\dot{H}$ 4·55=100·30.

It is a zinc olivenite.

Pyr., etc.—Heated in a closed tube decrepitates feebly, and yields a little water, becoming white and porcelanous. On charcoal fuses, producing a coating of oxyd of zinc, and a feeble odor of arsenic. In a closed tube with soda and charcoal gives a ring of arsenic. With borax in O. F. pearl-yellow while hot, colorless on cooling. Easily soluble in dilute muriatic acid.

Obs.—From Chañarcillo, Chili, with limonite and native silver. Named after Mr. Adam of Paris.

538. **CONICHALCITE.** Konichalcit *Breith.* & Fritzsche, Pogg., lxxvii. 139, 1849.

Reniform and massive, resembling malachite.

H.=4·5. G.=4·123. Color pistachio-green, inclining to emerald-green; treak the same. Subtranslucent. Brittle. Fracture splintery.

Comp.—$(\dot{C}u, \dot{C}a)^3 (\ddot{\bar{A}}s, \ddot{\bar{P}}) + \dot{C}u \dot{H} + \tfrac{1}{2} \dot{H}$, with some vanadic acid replacing (?) part of the phos-horic, the copper and lime in equal proportions, the arsenic to the other acids as 2 : 1. Closely llied to olivenite and volborthite. Analysis by Fritzsche (l. c.):

$\ddot{\bar{A}}s$ 30·68 $\ddot{\bar{P}}$ 8·81 $\ddot{V}$ 1·78 $\dot{C}u$ 31·76 $\dot{C}a$ 21·36 $\dot{H}$ 5·61.

Pyr., etc.—In the closed tube decrepitates, gives water, and turns black. In the forceps fuses, nd colors the flame at first emerald-green, but after a time light blue adjacent to the assay. On harcoal fuses with deflagration to a red slag-like mass, which gives an alkaline reaction to test aper, and with soda gives a globule of copper. On charcoal, with salt of phosphorus and etallic lead, yields a glass which is dark yellow while hot and chrome-green on cooling (vanaium).

Obs.—From Hinajosa de Cordova, in Andalusia, Spain. Named from κονία, *lime*, and χαλκός.

539. **BAYLDONITE.** *A. H. Church*, J. Ch. Soc., II. iii. 265, 1865.

In minute mammillary concretions, with a drusy surface. Structure ften somewhat reticulated.

H.=4·5. G.=5·35. Lustre strong resinous. Color grass-green to blackish-green. Streak siskin- to apple-green. Subtranslucent. Fracture subconchoidal, uneven.

Comp.—O. ratio for $\dot{R}$, $\ddot{\bar{A}}s$, $\dot{H}$=4 : 5 : 2 nearly; whence $(\dot{P}b, \dot{C}u)^4\ddot{\bar{A}}s+2\dot{H}$, with $\dot{P}b : \dot{C}u$= 1 : 3; or $(\dot{P}b, \dot{C}u)^3\ddot{\bar{A}}s+\dot{C}u\dot{H}+\dot{H}$, Church,=Arsenic acid 31·6, oxyd of copper 32·8, oxyd of lead 30·7, water 4·9=100. Analysis: Church (l. c.):

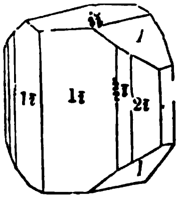
$\ddot{\bar{A}}s$	$\dot{C}u$	$\dot{P}b$	$\dot{H}$
(½) 31·76	30·88	30·13	4·58, $\ddot{\bar{F}}e$, $\dot{C}a$, and loss 2·65=100 Church.

Pyr., etc.—B.B. gives off water and becomes black, which latter reaction Church regards as indicating that part of the copper exists in the mineral as hydrate. On charcoal fuses to a black bead, deflagrates, giving off arsenical fumes, and leaves a white metallic bead of lead and copper. With borax in outer flame gives a blue bead. Difficultly soluble in nitric acid.

Obs.—Occurs in Cornwall. Named after Dr. John Bayldon.

540. EUCHROITE. Euchroit *Breith.*, Char., 172, 266, 1823.

469



Orthorhombic. $I \wedge I=92^\circ\ 8'$, $O \wedge 1\text{-}\bar{i}=148^\circ\ 40'$; $a : b : c=0·6088 : 1 : 1·038$. Observed planes as in the annexed figure. $1\text{-}\bar{i} \wedge 1\text{-}\bar{i}=117^\circ\ 20'$, $i\text{-}\bar{i} \wedge 1\text{-}\bar{i}=121^\circ\ 20'$, $i\text{-}\bar{i} \wedge \frac{3}{2}\text{-}\bar{i}=132^\circ\ 24'$, $i\text{-}\bar{i} \wedge 2\text{-}\bar{i}=140^\circ\ 36\frac{1}{2}'$, $2\text{-}\bar{i} \wedge 2\text{-}\bar{i}$, ov. $i\text{-}\bar{i}$, =101° 13′. Cleavage: I and $1\text{-}\bar{i}$. Faces $1\text{-}\bar{i}$ vertically striated.

H.=3·5—4. G.=3·389. Lustre vitreous. Color bright emerald- or leek-green. Transparent—translucent. Fracture small conchoidal—uneven. Rather brittle.

Comp.—$\dot{C}u^4\ddot{\bar{A}}s+7\dot{H}$, or $\dot{C}u^3\ddot{\bar{A}}s+\dot{C}u\dot{H}+6\dot{H}$ (Ramm.)=Arsenic acid 34·1, oxyd of copper 47·2, water 18·7=100. Analyses: 1, Turner (Edinb. Phil. J., iv. 301); 2, 3, Kühn (Ann. Ch. Pharm., li. 128); 4, Wöhler (ib., 285):

	$\ddot{\bar{A}}s$	$\dot{C}u$	$\dot{H}$
1. Libethen	33·02	47·85	18·80=99·67 Turner.
2. "	34·42	46·97	19·31=100·70 Kühn.
3. "	32·42	46·99	19·31, $\dot{C}a$ 1·12=99·84 Kühn.
4. "	33·22	48·09	18·39=99·70 Wöhler.

Pyr., etc.—In the closed tube gives more water, but has otherwise the same reactions as olivenite.

Obs.—Occurs in quartzose mica slate at Libethen in Hungary, in crystals of considerable size, having much resemblance to dioptase.

Named from εὐχροα, *beautiful color.*

If the prism $2\text{-}\bar{i}$ were made the fundamental vertical prism in euchroite, then $I \wedge I$ would equal 101° 13′, and $1\text{-}\bar{i} \wedge 1\text{-}\bar{i}$, top,=87° 52′, nearly as in wolfram and hopeite. The cleavage is not in accordance with this view.

Alt.—Tschermak suggests that olivenite may be euchroite altered by the loss of water, he finding crystals of olivenite projecting from the holes of cavernous euchroite (Ber. Ak. Wien, li. 129).

541. TAGILITE. Tagilith (fr. N. Tagilsk) *Hermann*, J. pr. Ch., xxxvii. 184, 1846; (fr. Ullersreuth) *Breith.*, B. H. Ztg., xxiv. 309.

Monoclinic, but like liroconite in habit of crystals, Breith. Cleavage: brachydiagonal, distinct. Also in reniform or spheroidal concretions. Structure fibrous; also earthy.

H.=3—4. G.=about 3·5, Hermann; 4·076, Breith. Lustre vitreous

Color verdigris- to emerald-green. Streak verdigris-green. Subtranslucent. Brittle.

Comp.—O. ratio for $\dot{R}$, $\overline{\ddddot{P}}$, $\dot{H}$=4 : 5 : 3; whence $\dot{C}u^4 \overline{\ddddot{P}} + 3 \dot{H}$; or, $\dot{C}u^3 \overline{\ddddot{P}} + \dot{C}u \dot{H} + 2 \dot{H}$ (Ramm.)=Phosphoric acid 27·7, oxyd of copper 61·8, water 10·5=100. Analyses: 1, 2, Hermann (l. c.); 3, Field (Ch. Gaz., June 15, 1859):

	$\overline{\ddddot{P}}$	$\dot{C}u$	$\dot{H}$
1. Ural	26·44	61·29	10·77, $\overline{\dddot{F}}e$ 1·50=100 Hermann.
2. "	26·91	62·58	10·71=100 Hermann.
3. Coquimbo	27·42	61·70	10·25=99·37 Field.

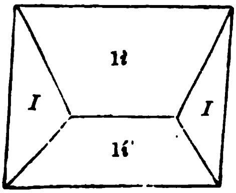
Pyr., etc.—No blowpipe characters are given by Hermann.

Obs.—Occurs at Nischne Tagilsk on limonite; at the Arme Hilfe mine, Ullersreuth, in minute crystals and reniform groups or masses, on limonite, with quartz; in S. America, at the Mercedes mine, Coquimbo, fibrous, on limonite.

Hermann's *tagilite* was in reniform concretions, with H.=3, G.=3·5, and color emerald- to mountain-green; and had the composition mentioned. The other characters in the above description (excepting the anal. by Field) are from Breithaupt, in an account of the Ullersreuth ore, which he refers to tagilite, but which has not been analyzed, and may or may not be that species.

542. LIROCONITE. Octahedral Arseniate of Copper (fr. Cornwall) *Bourn.*, Phil. Trans., 1801 174, Rashleigh's Brit. Min., ii., pl. 2, 5, 11, 1802. Linsenerz *Wern.*, 1803, Ludwig's Min., ii. 215, 1804; *Karsten*, Tab., 64, 1808. Linsenkupfer *Hausm.*, Handb., 1051, 1813. Lirokon malachit pt. *Mohs*, Grundr., 180, 1822. Chalcophacit *Glocker*, Handb., 859, 1831.

470



Monoclinic, Breith., Descl. *I* ∧ *I*=74° 21′, Descl.; 72° 22′, B. & M.; 71° 59′, Breith. 1-*ì* ∧ 1-*ì*=61° 31′, Descl.; 60° 40′, B. & M. *C*=88° 33′. Observed planes as in the annexed figure. Cleavage lateral, but obtained with difficulty. Rarely granular.

H.=2—2·5. G.=2·882, Bournon; 2·926, Haid.; 2·985, Hermann; 2·964, Damour. Lustre vitreous, inclining to resinous. Color and streak sky-blue—verdigris-green. Fracture imperfectly conchoidal, uneven. Imperfectly sectile.

Comp.—O. ratio fr. anal. 1, 3, 4, for $\dot{R}$, $\overline{\dddot{A}}l$, ($\overline{\ddddot{A}}s$, $\overline{\ddddot{P}}$), $\dot{H}$=4 : 2 : 5 : 12; whence $\dot{C}u^3 (\overline{\ddddot{A}}s, \overline{\ddddot{P}}) + (\frac{1}{4} \dot{C}u^3 + \frac{3}{4} \overline{\dddot{A}}l) \dot{H}^3 + 9 \dot{H}$, if the alumina and a fourth of the copper may be in the state of hydrate. It is closely parallel with that of pseudomalachite, the second member corresponding in oxygen to $\dot{C}u^3 \dot{H}^3$, or $3 \dot{C}u \dot{H}$. As the O. ratio for bases and acid is 6 : 5, the formula might be written $(\frac{1}{2} \dot{C}u^3 + \frac{1}{2} \overline{\dddot{A}}l)^2 (\overline{\ddddot{A}}s, \overline{\ddddot{P}}) + 12 \dot{H}$. Analyses: 1, T. Wachtmeister (Ak. H. Stockh., 80, 1832); 2, Hermann (J. pr. Ch., xxxiii. 296); 3, 4, Damour (Ann. Ch. Phys., III. xiii. 404):

	$\overline{\ddddot{A}}s$	$\overline{\ddddot{P}}$	$\overline{\dddot{A}}l$	$\dot{C}u$	$\dot{H}$
1. Cornwall	20·79	3·61	8·03	35·19	22·24, $\overline{\dddot{F}}e$ 3·41, $\dddot{S}i$ 4·04, gangue 2·95=100·26 W.
2. "	23·05	3·78	10·85	36·38	25·01, $\overline{\dddot{F}}e$ 0·98=100 Hermann.
3. "	22·22	3·49	9·68	37·18	25·49=98·06 Damour.
4. "	23·40	3·24	10·09	37·40	25·44=98·47 Damour.

Pyr., etc.—In the closed tube gives much water and turns olive-green. B.B. cracks open, but does not decrepitate; fuses less readily than olivenite to a dark gray slag; on charcoal cracks open, deflagrates, and gives reactions like olivenite. Soluble in nitric acid.

Obs.—Crystals occasionally an inch in diameter; usually quite small. With various ores of copper, pyrite, and quartz, at Wheal Gorland, Wheal Muttrell, and Wheal Unity, in Cornwall; also in minute crystals at Herrengrund in Hungary; and in Voigtland.

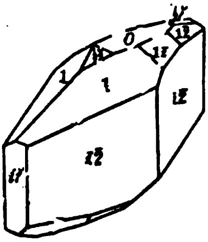
The prism *i*-2 (which may be taken as *I*) has the front angle 111° 17′, if calculated from *I* ∧ *I* =72° 22′, and this is near the angle *I* ∧ *I* of pseudomalachite. Moreover, the formulas of the two are similar, as shown above.

Named from λειρός, *pale*, and κονία, *powder*.

543. PSEUDOMALACHITE. Phosphorsaures Kupfer pt. *Karst.*, *Klapr.*, N. Schrift. Berl Ges. Nat. Fr. iii. 304, 1801. Phosphorkupfer *id.*, Tab., 64, 97, 1808. Phosphorkupfererz *Wern.* Cuivre phosphaté *H.*, Tabl., 92, 1809. Phosphate of Copper. Pseudomalachit *Hausm.*, Handb., 1035, 1813. Phosphorochalcit *Glocker*, Handb., 847, 1831. Ypoléime *Beud.*, Tr., ii. 570, 1832. Ehlit, Prasin-chalzit, *Breith.* Char., 45, 49, 1832. Lunnit *Bernhardi.* Kupferdiaspore *Kühn*, J Ch. Pharm., li. 125, 1844. Dihydrit *Herm.*, J. pr. Ch., xxxvii. 178, 1846.

Orthorhombic, hemihedral (monoclinic?). $I \wedge I = 109°\ 28'$, $O \wedge 1\text{-}\bar{\imath} = 146°\ 18\tfrac{1}{2}'$; $a : b : c = \sqrt{2} : 1 : 0{\cdot}6667$. Observed planes as in the annexed figure. $i\text{-}2 \wedge i\text{-}2 = 141°\ 4'$ and $38°\ 56'$, $1 \wedge 1 = 117°\ 49'$, $O \wedge \tfrac{1}{2}\text{-}\bar{\imath} = 166°\ 34'$, $1\text{-}\bar{\imath} \wedge 1\text{-}2 = 168°\ 46'$. Cleavage: $i\text{-}\bar{\imath}$ imperfect. Also reniform or massive; indistinctly fibrous, and having a drusy surface.

471



H.=4·5–5. G.=4–4·4. Lustre adamantine, inclining to vitreous. Color dark emerald-, verdigris-, or blackish-green, often darker at the surface. Streak green, a little paler than the color. Translucent—subtranslucent. Fracture small conchoidal—uneven. Brittle.

Var., Comp.—The analyses vary much, and have been regarded by Hermann and others as indicating that two or three species are here included; but the differences may be only a consequence of mixture. The supposed species distinguished are as follows:

A. *Ehlite* (and Prasin) of Breithaupt. Formula $\dot{C}u^6\dddot{\bar{P}}+3\dot{\bar{H}}$, or $\dot{C}u^3\dddot{\bar{P}}+2\dot{C}u\dot{\bar{H}}+\dot{\bar{H}}$ (Ramm),=Phosphoric acid 23·9, oxyd of copper 67·0, water 9·1=100. Occurs crystallized; also reniform and botryoidal, with a radiating fibrous structure; also massive. G.=3·8–4·4. Includes analyses 1—7, and perhaps others.

The name *Prasin* is used by Breithaupt for pseudomalachite in general; he cites Berthier's analysis (No. 8) of a Libethen ore, and one by Lunn (p. 569) of a Rheinbreitenbach specimen, and mentions other localities in Bavaria, Voigtland, and Siberia. For his *ehlite* he gives Bergemann's analysis of an Ehl specimen (No. 5) which does not differ essentially from Berthier's. According to a recent analysis of the Ehl mineral by Bergemann (No. 6), it contains 7 p. c. of *vanadic* acid replacing part of the phosphoric.

B. *Dihydrite.* Formula $\dot{C}u^6\dddot{\bar{P}}+2\dot{\bar{H}}$, or $\dot{C}u^3\dddot{\bar{P}}+2\dot{C}u\dot{\bar{H}}$ (Ramm),=Phosphoric acid 24·7, oxyd of copper 69·0, water 6·3=100. Includes the analyses having 6 to 6·5 p. c. of water.

C. *Pseudomalachite.* Formula $\dot{C}u^6\dddot{\bar{P}}+3\dot{\bar{H}}$, or $\dot{C}u^3\dddot{\bar{P}}+3\dot{C}u\dot{\bar{H}}$ (Ramm),=Phosphoric acid 21·1, oxyd of copper 70·9, water 8·0=100. Includes analyses 16–19.

Nordenskiöld unites *Dihydrite* and *Ehlite.*

Analyses: 1, Hermann (J. pr. Ch., xxxvii); 2, Kühn (Ann. Ch. Pharm., xxxiv. 218); 3, Berthier (Ann. d. M., viii.); 4, Nordenskiöld (l. c.); 5, Bergemann (Schw. J., liv. 305); 6, Bergemann (Jahrb. Min. 1858, 195); 7, Heddle (Phil. Mag., IV. x. 39); 8, 9, Hermann (l. c.); 10–13, Nordenskiöld (l. c.); 14, Arfvedson (Jahresb., iv. 143); 15, Kühn (l. c., lv. 124); 16, 17, Kühn (l. c.); 18, Rhodius (Pogg., lxii. 369); 19, Church (Ch. News, x. 217); 20, Bergemann (Pogg., civ. 190):

				$\dddot{\bar{P}}$	$\dot{C}u$	$\dot{\bar{H}}$
1.	Libethen		G.=4·4	24·55	67·25	8·20=100 Hermann.
2.	"	*massive*		23·14	66·86	10·00=100 Kühn.
3.	"			24·7	66·3	9·0=100 Berthier.
4.	Ehl		G.=4·198	22·51	66·55	9·03, $\dddot{\bar{F}}e$ 2·11, $\ddot{C}$ *tr.*=100 Nordensk.
5.	"			24·93	65·99	9·06=99·98 Bergemann.
6.	"			17·89	64·09	8·90, $\dddot{\bar{V}}$ 7·34=99·22 Bergemann.
7.	Cornwall		G.=4·25	22·73	68·13	8·51, quartz 0·48=99·85 Heddle.
8.	N. Tagilsk		G.=4·25	23·75	68·75	7·50=100 Hermann.
9.	"	*Dihydrite*	G.=4·4	25·30	68·21	6·49=100 Hermann.
10.	"	*fibrous*	G.=4·131	23·00	65·22	7·50, malachite 4·34 Nord.
11.	"	*mass.*	G.=4·07	23·15	64·63	6·84, " 5·24 Nord.
12.	"	"		22·72	64·46	6·82, " 5·76 Nord.
13.	"		G.=4·24	22·39	64·72	6·59, " 6·52 Nord.

		$\ddot{\bar{P}}$	$\dot{C}u$	$\dot{H}$
14.	Rheinbreitenbach	24·70	68·20	5·97=98·87 Arfvedson.
15.	Hirschberg, *Kupferdiaspore*	24·13	69·61	[6·26]=100 Kühn.
16.	Hirschberg	20·87	71·73	7·40=100 Kühn.
17.	Rheinbreitenbach	21·52	68·74	8·64=98·90 Kühn.
18.	Libethen	20·4	70·8	8·4=99·6 Rhodius.
19.	"	19·63	71·16	8·82=99·61 Church.
20.	Linz	19·89	69·97	8·21, $\ddot{\bar{A}}s$ 1·78=99·85 Bergemann.

Rev. F. Lunn obtained for an ore from Rheinbreitenbach (Ed. Phil. J., v. 211, 1821) $\ddot{\bar{P}}$ 21·687, $\dot{C}u$ 62·847, $\dot{H}$ 15·454=99·988, giving the formula $\dot{C}u^6\ddot{\bar{P}}^2+5\dot{H}$. But no later analyst has found as much water. Beudant cites this analysis under his *ypoleime.*

Pyr., etc.—Like libethenite; some varieties decrepitate remarkably and yield a black powder in the closed tube.

Obs.—Occurs in veins traversing slate at Virneberg, near Rheinbreitenbach, and at Ehl, near Linz, on the Rhine, along with other copper ores; at Hirschberg in Voigtland; Libethen in Hungary; Nischne Tagilsk in Siberia. A single specimen has been found in Cornwall, consisting of minute globular concretions. Also met with in the Perkiomen mine, Pa.; in Cabarras Co., N. C.

The phosphates of copper were included in the olivenerz and malachite of the mineralogists of last century.

Pseudomalachite of Hausmann is the earliest of the names of this species, and is as short and as good as the later *Phosphorochalcite* of Glocker. *Lunnite* was substituted by Bernhardi, and has been used in some recent works. But Lunn's one analysis was not made until 1821, and gives a different composition from that since obtained. It will certainly be soon enough to use his name in mineralogy when a mineral having the composition he arrived at, and thus befitting it, has been identified.

544. ERINITE. *Haid.*, Ann. Phil., II. iv. 154, 1828.

In mammillated crystalline groups, concentric in structure and fibrous, nd rough from the terminations of very minute crystals; the concentric ayers compact, and often easily separable. Traces of cleavage in one irection.

H.=4·5—5. G.=4·043. Lustre almost dull, slightly resinous. Color ne emerald-green, slightly inclining to grass-green. Streak green, paler han the color. Subtranslucent—nearly opaque. Brittle.

Comp.—$\dot{C}u^6\ddot{\bar{A}}s+2\dot{H}$, or $\dot{C}u^3\ddot{\bar{A}}s+2\dot{C}u\dot{H}$ (Ramm.),=Arsenic acid 34·7, oxyd of copper 59·9, ater 5·4=100. Analysis (approximative) by Turner (l. c.):

$\ddot{\bar{A}}s$ 33·78 $\dot{C}u$ 59·44 $\dot{H}$ 5·01 $\bar{\bar{A}}l$ 1·77=100.

Pyr., etc.—In the closed tube decrepitates and yields water. B.B. on charcoal emits arsenical mes and fuses, giving an arsenid, which in O.F. yields a globule of copper. Soluble in nitric id.

Obs.—Stated by Haidinger to come from the County of Limerick, Ireland; but shown by urch to be a Cornish species.

545. CORNWALLITE. Cornwallit *Zippe*, Abh. d. Böhm. Ges. Prag, 1846.

Amorphous.

H.=4·5. G.=4·160. Color emerald-green to dark verdigris-green. acture conchoidal.

Comp.—$\dot{C}u^6\ddot{\bar{A}}s+5\dot{H}$, or $\dot{C}u^3\ddot{\bar{A}}s+2\dot{C}u\dot{H}+3\dot{H}$ (Ramm.). According to Lerch, who obtained, a mean of two analyses (l. c., Ramm. Min. Ch., 377):

$\ddot{\bar{A}}s$ 30·22 $\ddot{\bar{P}}$ 2·15 $\dot{C}u$ 54·55 $\dot{H}$ 13·02=99·94.

Pyr., etc.—In the matrass yields water. B.B. on charcoal gives arsenical fumes, and a bead opper enveloped in a brittle crust.

Obs.—From Cornwall, occurring in small botryoidal or disseminated individuals on olivenit Resembles malachite, but differs from it in not effervescing with acids.

546. TYROLITE. Kupferschaum *Wern.*, Hoffm. Min., iii. 180, 1816, Letzt. Min. Syst., 19, 5 1817. Kupaphrite *Shep.*, Min., i. 294, 1835. Tirolit *Haid.*, Handb., 509, 1845.

Orthorhombic. Observed planes: *O*, *i-ī*, *I*. Cleavage: *O*, perfect. Usu ally reniform, massive; structure radiate foliaceous, surface drusy.

H.=1—2. G.=3·02—3·098. Lustre: *O* pearly; other faces vitreou Color pale apple-green and verdigris-green, inclining to sky-blue, Strea a little paler. Translucent—subtranslucent. Fracture not observabl Very sectile. Thin laminæ flexible.

Comp.—$\dot{C}u^5\,\ddot{\bar{A}}s+9\,\dot{H}$, or $\dot{C}u^5\,\ddot{\bar{A}}s+2\,\dot{C}u\,\dot{H}+7\,\dot{H}$ (Ramm.),=Arsenic acid 29·2, oxyd of copp 50·3, water 20·5=100, with carbonate of lime as impurity. Analysis: v. Kobell (Pogg., xvi 253):

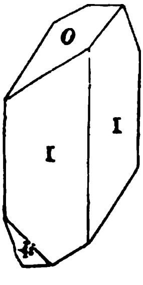
Falkenstein, Tyrol $\ddot{\bar{A}}s$ 25·01 $\dot{C}u$ 43·88 $\dot{H}$ 17·46 $\dot{C}a\,\ddot{C}$ 13·65=100.

Pyr., etc.—In the closed tube decrepitates and yields much water. B.B. in the forceps fus to a steel-gray globule. On charcoal gives off arsenical fumes, and fuses quietly without deflag tion to a slaggy mass, which in R.F. yields globules of copper. Soluble in nitric acid with eff vescence. Soluble in ammonia, yielding a blue solution and a white residue of carbonate of lim

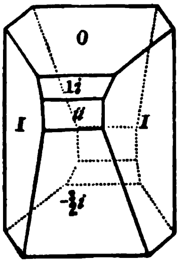
Obs.—Usually occurs in the cavities of calamine, calcite, or quartz, accompanied by other or of copper, appearing in small aggregated and diverging fibrous groups of a pale green color, a possessing a delicate silky lustre. Has been observed in the Bannat; at Posing and Libethen Hungary; Nertschinsk in Siberia; Falkenstein and Schwatz in the Tyrol; Saalfeld in Thuringi Riechelsdorf in Hessia; Schneeberg in the Erzgebirge; in zechstein-dolomite near Bieber.

547. CLINOCLASITE. Strahliges Olivenerz *Karst.*, Klapr., N Schrift. Berl Ges Fr., iii. 29 1801. Cupreous Arsenate of Iron *Bourn.*, Phil. Trans., 1801 (with anal. by Chenevix). Stra leuerz *Karsten*, Tab., 64, 97, 1808. Cuivre arseniaté férrifère *H.*, Tabl., 91, 1809. Strahlenkupf *Hausm.*, Handb., 1050, 1813. Strahlerz *Wern.* Klinoklas *Breith.*, Uib., 1830. Siderochal *Glocker*, Grundr., 840, 1831. Aphanèse *Beud.*, Tr., ii. 602, 1832. Aphanesite *Shep.*, Min., 183 Abichit *Bernhardi*, Glocker's Grundr., 579, 1839.

472



473



Monoclinic. $C=80°\ 30'$, $I \wedge$ front,=56°, side, 124°. Observe planes as in the annexed figure $O \wedge -\frac{1}{2}\text{-}i=99°\ 30'$, $O \wedge 1\text{-}i=123°\ 4$ Cleavage: basal, highly perfec Also massive, hemispherical, or ren form; structure radiated fibrous.

H.=2·5—3. G.=4·19—4·3 Lustre: *O* pearly; elsewhere vitr ous to resinous. Color internall dark verdigris-green; externall blackish-blue green. Streak bluis green. Subtranslucent. Not very brittle.

Comp.—$\dot{C}u^6\,\ddot{\bar{A}}s+3\,\dot{H}$, or $\dot{C}u^3\,\ddot{\bar{A}}s+3\,\dot{C}u\,\dot{H}$ (Ramm.),=Arsenic acid 30·2, oxyd of copper 62· water 7·1=100. Analyses: 1, Rammelsberg (2d Suppl., 78); 2, Damour (Ann. Ch. Phys., II xiii.):

			$\ddot{\bar{A}}s$	$\ddot{\bar{P}}$	$\dot{C}u$	$\dot{H}$	$\ddot{\bar{F}}e$
1.	Cornwall	G.=4·258—4·359	29·71	0·64	60·00	7·64	0·39, $\dot{C}a$ 0·50, $\ddot{S}i$ 1·12=100 Ram
2.	"	G.=4·312	27·09	1·50	62·80	7·57	0·49=99·44 Damour.

Pyr., etc.—Same as for olivenite.

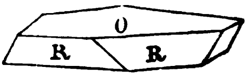
Obs.—Occurs in Cornwall, with other ores of copper, at Ting Tang mine, Wheal Unity, and Wheal Gorland, and at Bedford United Mines, near Tavistock. The crystals usually present a very dark blue color and brilliant lustre, but are rarely recognizable, being aggregated in diverging groups, or disposed in extremely minute individuals, in cavites of quartz; whence the name *aphanesite*, from 'αφανής, *unmanifest*. Also found in the Erzgebirge.

Named *Clinoclasite* in allusion to the basal cleavage being oblique to the sides of the prism.

548. CHALCOPHYLLITE. Cuivre arseniaté lamelliforme *H.*, Tr., 1801; *Vauquelin* J. d. M., x. 562, 1801. Blättriges Olivenerz, Kupferglimmer, *Karst.*, Hoff's Mag., i. 543, 1801; Ludwig's Werner, 180, 1803. Copper Mica *Jameson*, Min., 1820. Kupferphyllit *Breith.*, Char., 42, 1832. Chalkophyllit *Breith.*, Handb., 149, 1847. Tamarite *B. & M.*, Min., 1852.

Rhombohedral. $R \wedge R = 69° \ 48'$, $O \wedge R = 108° \ 44'$; $a = 2{\cdot}5536$. Observed planes: R, 2, O, $-\frac{1}{2}$, I. $\frac{1}{2} \wedge \frac{1}{2} = 88° \ 46'$, $O \wedge \frac{1}{2} = 124° \ 9'$. Usually in six-sided tabular crystals; plane O sometimes triangularly striated. Cleavage: O highly perfect. Also foliated massive, and in druses.

474



H.=2. G.=2·4—2·66; 2·435, Cornwall, Hermann; 2·659, ib., Damour. Lustre: of O pearly; of other faces vitreous or subadamantine. Color emerald- or grass-green to verdigris-green. Streak somewhat paler than the color. Transparent—translucent. Fracture scarcely observable.

Comp.—$Cu^6\,\overset{\cdot\cdot}{\dddot{A}}s+12\,\dot{H}$, or $\dot{C}u^3\,\overset{\cdot\cdot}{\dddot{A}}s+5\,\dot{C}u\,\dot{H}+7\,\dot{H}$, from Chenevix's analysis, = Arsenic acid 21·3, oxyd of copper 58·7, water 20·0=100. From Hermann's analysis, $\dot{C}u^8\,\overset{\cdot\cdot}{\dddot{A}}s+23\,\dot{H}$=Arsenic acid 18·0, oxyd of copper 49·6, water 32·4=100. Analyses: 1, Chenevix (Phil. Trans., 1801); 2, Hermann (J. pr. Ch., xxxiii. 294); 3, 4, Damour (Ann. Ch., Phys., III. xiii. 404):

			$\overset{\cdot\cdot}{\dddot{A}}s$	$\dot{C}u$	$\dot{H}$
1.	Cornwall		21	58	21=100 Chenevix.
2.	"	G.=2·435	17·51	44·45	31·19, $\dot{F}e$ 2·92, $\dddot{A}l$ and $\overset{\cdot\cdot}{\dddot{P}}$ 3·93=100 Hermann.
3.	"	G.=2·659	19·35	52·92	23·94, $\dddot{A}l$ 1·80, $\overset{\cdot\cdot}{\dddot{P}}$ 1 29=99·30 Damour.
4.	"	"	21·27	52·30	22·58, $\dddot{A}l$ 2·13, $\overset{\cdot\cdot}{\dddot{P}}$ 1·56=99·84 Damour.

Pyr., etc.—In the closed tube decrepitates, yields much water, and gives a residue of olive-green scales. In other respects like olivenite. Soluble in nitric acid, and in ammonia.

Obs.—The copper mines of Tingtang, Wheal Gorland, and Wheal Unity, near Redruth, are its principal localities in Cornwall. Occurs also crystallized in iron ore at Sayda in Saxony; in minute crystals at Herrengrund in Hungary; Moldawa in the Bannat.

Taking $\frac{1}{2}R$ as the fundamental rhombohedron, then $R \wedge R = 88° \ 46'$, and $a = 1{\cdot}7768$.

Alt.—Found altered to chrysocolla.

---

549. BERLINITE. Berlinit *C. W. Blomstrand*, Priv. contrib., dated Lund, Dec. 9, 1867.

Compact massive, without a trace of cleavage.

H.=6. G.=2·64. Lustre vitreous. Colorless to grayish or pale rose-red. Streak uncolored. Translucent. Fracture uneven.

Comp.—$\dddot{A}l\,\overset{\cdot\cdot}{\dddot{P}}+\frac{1}{2}\,\dot{H}$, Blomstrand, = Phosphoric acid 55·9, alumina 40·5, water 3·6=100. **nalysis**: C. W. Blomstrand (l. c.):

$\overset{\cdot\cdot}{\dddot{P}}$ ($\frac{3}{3}$) 54·84 $\dddot{A}l$ 40·27 $\dddot{F}e$ 0·26 $\dot{H}$ 4·14=99·51.

Pyr., etc.—B.B. whitens without fusing. A deep blue color with cobalt. Hardly attacked by ids. Easily decomposed on fusion with alkalies, and the resulting mass soluble in water with olution of much heat.

Obs.—Resembles quartz. From the iron mine of Westana in Scania, Sweden, where it occur sparingly in quartz, from which it is ordinarily separated by a thin layer of lazulite.
Named after Prof. N. H. Berlin, of the University of Lund.

550. CALLAINITE. ? Callaina *Plin.*, xxxvii. 33. Turquois pt. Callais *Damour*, C. R., lix 936, 1864. Callainite *Dana*.

Massive. Texture wax-like.

H.=3·5—4. G.=2·50—2·52. Color apple-green to emerald-green, spotted or lined with whitish and bluish. Translucent.

Comp.—$\dddot{\bar{\mathrm{A}}}\mathrm{l}\,\ddot{\bar{\mathrm{P}}}+5\,\dot{\mathrm{H}}$=Phosphoric acid 42·39, alumina 30·75, water 26·36=100. **Analysis:** A Damour (l. c.):

$\ddot{\bar{\mathrm{P}}}$	$\dddot{\bar{\mathrm{A}}}\mathrm{l}$	$\dddot{\bar{\mathrm{F}}}\mathrm{e}$	$\dot{\mathrm{M}}\mathrm{n}$	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\mathrm{H}}$	Sand
42·58	29·57	1·82	*tr.*	0·70	23·62	2·10=100·39.

Pyr., etc.—When heated yields water, and becomes opaque, chocolate-brown, and friable B.B. infusible.

Obs.—From a Celtic grave, near Mané-er H'roek in Lockmariaquer, in rounded pieces from the size of a flax-seed to that of a pigeon's egg, and found in the collections of the Polymathic Society of Morbihan, in western France.

Damour makes this mineral the *callais* of Pliny, and especially in view of its *green* color. But the callais was blue, and the green stone really related to it was probably the *callaina* (see p. 581). Yet, as this identity is not established, the name *callainite* is better than Pliny's name unmodified.

551. LAZULITE. Himmelblau Fossil von Steiermark [Styria] *Widenmann*, Bergm. J., 348, Ap. 1791; Smalteblaue F. von Vorau, Schrift. Ges. N. Berlin, ix. 352, 1791; Naturliche Smalt; Berlinerblau, Eisenblau [=Vivianite]; Bergblau [=Chrysocolla]; Unächter Lasurstein [=False Lapis-Lazuli], *Stütz*, Einricht. Nat. Wien, 49, 1793; Lazulit=Kieselerde+Thonerde+Eisenerde, *Klapr.*, Schrift. Ges. N. Berl., x. 90, 1792, Beitr., i. 197, 1795. Dichter blauer Feldspath (fr. Krieglach, Styria) *Klapr.*, Beitr., i. 14, 1795; Lazulith *Klapr.*, Beitr., iv. 279, 1807. Blue Spar, Blue Feldspar. Wahrscheinlich n. Foss. aus d. Salzburgischen, Siderit, *v. Moll*, Jahrb. B. H., iv. 71, 1799 (with bad anal. by Heim); Mollit *Haberle*, Handb., 1804; =Lazulith *Mohs*, Null Kab., i. 427, 1804. Blauspath *Wern.* Voraulite *Delameth.*, Min., 1812. Azurite *Jameson*, Min., i. 341, 1816. Phosphorsäure Thonerde, etc., *Fuchs*, Schw. J., xxiv. 373, 1818. Klaprothite *Beud.* Tr., 464, 1824; Klaprothine *id.*, ii. 576, 1832.

Monoclinic. $C=88°\ 15'$, $I \wedge I=91°\ 30'$, $O \wedge 1\text{-}\grave{\imath}=139°\ 45'$, Prüfer; $a : b : c=0{\cdot}86904 : 1 : 1{\cdot}0260$. Observed planes as in the annexed figures.

$O \wedge -2=111°\ 37'$
$O \wedge 2\text{-}\grave{\imath}=120\ 42\frac{1}{2}$
$1 \wedge 1$, front, $=115\ 30$
$O \wedge 2\text{-}i=121\ 15$

$O \wedge \frac{2}{3}\text{-}i=150°\ 15'$
$O \wedge \frac{2}{3}=140\ 20$
$O \wedge 1=129\ 10$
$O \wedge I=90\ 23$

$O \wedge -\frac{2}{3}=141°\ 3'$
$2 \wedge 2$, front, $=100\ 20$
$-2 \wedge -2$, " $=99\ 40$
$2\text{-}i \wedge \frac{2}{3}=141\ 38$

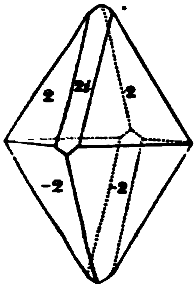
Twins: composition-face *i-i*; also *O*, as in f. 481. Cleavage: lateral, indistinct. Also massive.

H.=5—6. G.=3·057, Fuchs; 3·067—3·121, Prüfer; 3·122, Smith & Brush. Lustre vitreous. Color azure-blue; commonly a fine deep blue viewed along one axis, and a pale greenish-blue along another. Streak white. Subtranslucent—opaque. Fracture uneven. Brittle. Plane of optical axes clinodiagonal; bisectrix negative and inclined 50° 39′ to a normal to the edge $-2 / -2$, and 70° to a normal to $2\text{-}\grave{\imath}$; angle large, for the red ray in oil 77° 16′; Descl.

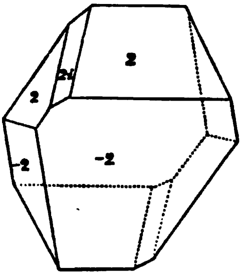
Comp.—O. ratio for $\dot{R}$, $\bar{\text{Al}}$, $\overset{\cdot\cdot}{\bar{\text{P}}}$, $\dot{\text{H}}$=1 : 3 : 5 : 1; whence $\bar{\text{Al}}\,\overset{\cdot\cdot}{\bar{\text{P}}}+\dot{\text{Mg}}\,\dot{\text{H}}$; or $\bar{\text{Al}}\,\overset{\cdot\cdot}{\bar{\text{P}}}+(\dot{\text{Mg}}, \dot{\text{Fe}})\,\dot{\text{H}}$, Dana,=Phosphoric acid 46·8, alumina 34·0. magnesia 13·2, water 6·0=100.

Analyses: 1, Fuchs (Schweig. J., xxiv. 373); 2, R. Brandes (ib., xxx. 385); 3–8, Rammelsberg (Pogg., lxiv. 260); 9, 10, Smith & Brush (Am. J. Sci., II. xvi. 370): 11, Igelström (J. pr. Ch., lxiv. 252, fr. Œfv. Ak. Stockh., 1854); 12, C. W. Blomstrand (priv. contrib., Dec. 9, 1867):

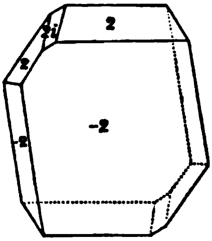
476



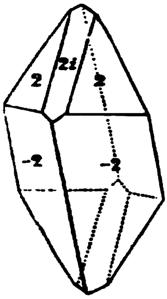
477



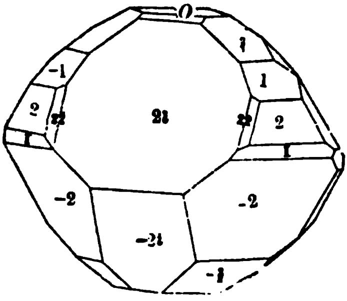
478



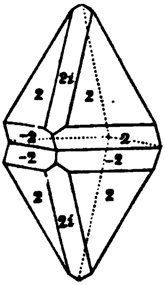
479



480



481



	$\overset{\cdot\cdot}{\bar{\text{P}}}$	$\bar{\text{Al}}$	$\dot{\text{Fe}}$	$\dot{\text{Mg}}$	$\dot{\text{Ca}}$	$\dot{\text{H}}$
1. **Rädelgraben**	41·81	35·73	2·64	9·34	—	6·06, $\ddot{\text{Si}}$ 2·1=87·68 Fuchs.
2. **Krieglach**	43·32	34·50	0·80	13·56	0·42	0·50, $\ddot{\text{Si}}$ 6·5=99·6 Brandes.
3. **Gratz.** G.=3·11	42·41	29·58	10·60	10·67	1·12	5·62=100 Rammelsberg.
4. " "	43·84	33·09	6·69	9·00	1·44	5·94=100 Rammelsberg.
5. " "	46·99	27·62	6·47	11·19	2·12	5·61=100 Rammelsberg.
6. **Krieglach.** G.=2·02	40·95	36·22	1·64	12·85	1·42	6·92=100 Rammelsberg.
7. " "	47·36	30·05	1·89	12·20	1·65	6·85=100 Rammelsberg.
8. " "	47·73	27·48	1·91	12·16	4·32	6·40=100 Rammelsberg.
9. **North Carolina**	43·38	31·22	8·29	10·06	—	5·68, $\ddot{\text{Si}}$ 1·07=99·70 Smith & Br.
10. "	44·15	32·17	8·05	10·02	—	5·50, $\ddot{\text{Si}}$ 1·07=100·96 Smith & Br.
11. **Wermland**	47·52	32·36	10·55	8·58	*tr.*	5·30, $\dot{\text{Mn}}$ *tr.*=99·81 Igelström.
12. **Westana**	43·83	32·52	7·82	9·05	0·84	5·92, $\dot{\text{Mn}}$ 0·18, $\dot{\text{Cu}}$ 0·1=100·36 Bl.

Rammelsberg found some silica, as impurity, in his analyses, which is excluded in the results above given.

Pyr., etc.—In the closed tube whitens and yields water. B.B. with cobalt solution the blue color of the mineral is restored. In the forceps whitens, cracks open, swells up, and without fusion falls to pieces, coloring the flame bluish-green. The green color is made more intense by moistening the assay with sulphuric acid. With the fluxes gives an iron glass; with soda on charcoal an infusible mass. Unacted upon by acids, retaining perfectly its blue color.

Obs.—Occurs both massive and crystallized in narrow veins, traversing clay slate, in the torrent beds of Schladming and Rädelgraben, near Werfen in Salzburg, with spathic iron; in Gratz, near Vorau; in Krieglach, in Styria; at Hochthäligrat, at the Gorner glacier, Rympfischwang, Upper Valais, in Switzerland, H.=about 4; also in veins or pockets in quartzite, in Horrsjöberg, Wermland, massive and granular, sometimes in 8-sided crystals 6 inches long and 2 inches in diameter; in the iron mine of Westana, in Scania, Sweden, massive, of a dark azure color, also at Tijuco in Minas Geraes, Brazil. Abundant at Crowder's Mt., Lincoln Co., N. C.; and in fine sky-blue crystals, often 1—1¼ inch long and broad, on Graves Mt., Lincoln Co., Ga., 50 m. above Augusta, with cyanite, rutile, pyrophyllite, etc.

The name lazulite is derived from an Arabic word, *azul*, meaning *heaven*, and alludes to the color of the mineral.

On cryst., Prüfer, Nat. Abhandl. Wien, i. 169; Dana, Am. J. Sci., II. xxvii. 38.

552. BARRANDITE. Barrandit *v. Zepharovich*, Ber. Ak. Wien, lvi. 1867.

In spheroidal concretions, indistinctly radiated fibrous, with the surface crystalline angular; concentric in structure.

H.=4·5. G.=2·576. Lustre between vitreous and greasy. Color pale bluish, reddish, greenish or yellowish-gray. Streak yellowish to bluish white. Translucent to opaque.

Comp.—O. ratio for $\overset{\cdots}{\overline{R}}$, $\overset{\cdot\cdot\cdot\cdot\cdot}{P}$, $\dot{H}$=3 : 5 : 4, with $\overset{\cdots}{\overline{R}}=\frac{4}{7}\,\overset{\cdots}{\overline{Fe}}+\frac{3}{7}\,\overset{\cdots}{\overline{Al}}$; whence $(\frac{4}{7}\,\overset{\cdots}{\overline{Fe}}+\frac{3}{7}\,\overset{\cdots}{\overline{Al}})\overset{\cdot\cdot\cdot\cdot\cdot}{P}+4\,\dot{H}$= Phosphoric acid 40·63, alumina 12·61, sesquioxyd of iron 26·16, water 20·60=100. Analysis: K. Boricky (l. c.):

$\overset{\cdot\cdot\cdot\cdot\cdot}{P}$	$\overset{\cdots}{\overline{Al}}$	$\overset{\cdots}{\overline{Fe}}$	$\dot{H}$
39·68	12·74	26·58	21·00=100.

Pyr., etc.—Yields water with an acid reaction. B.B. splits open and becomes darker in color; moistened with sulphuric acid colors the flame bluish-green. Soluble in hot muriatic acid.

Obs.—Occurs at Cerhovic, N.N.W. of Przibram, in Bohemia, in clefts in a Lower Silurian sandstone, with cacoxene and stilpnosiderite; the translucent globules ½ to 1½ mm. in diameter, and having within some resemblance to opal; the opaque variety without lustre; sometimes a grain of limonite at centre, and particles of the same as impurity.

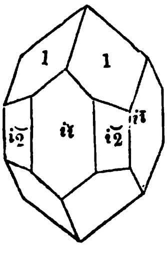
Alt.—Stated to give origin by alteration to dufrenite, similar globules and fibrous crusts at the locality having the composition of the latter mineral.

---

553. SCORODITE. Cupreous Arseniate of Iron. Cupro-martial Arsenate *Bourn.*, Phil. Trans., 1801, 191. Martial Arseniate of Copper. Cuivre arseniaté ferrifère *H.*, Tabl., 91, 1809. Skorodit *Breith.*, Hoffm. Handb., iv. 2, 182, 1817. Scorodite and Néoctèse *Beud.*, ii. 605, 607, 1832; Descl., Ann. Ch. Phys., III. x. 403. Arseniksinter, Eisen-sinter, *Hermann*, Bull. Soc. Imp. Nat. Moscou, i. 254, 1845. Kobalt-scorodit *Lippmann*, v. Hornberg, Zool. Min. Ver. Regensb., xi. 172.

Orthorhombic. $I \wedge I$=98° 2′, $O \wedge 1\text{-}\bar{i}$=132° 20′; $a : b : c$=1·0977 : 1 : 1·1511. Observed planes as in the annexed figure, with also I, $2\text{-}\bar{i}$, $\frac{1}{2}$, $2\text{-}\breve{2}$.

482



$i\text{-}\breve{2} \wedge i\text{-}\breve{2}$=120° 10′

$i\text{-}\breve{i} \wedge i\text{-}\breve{2}$=150 5

$1 \wedge 1$, pyr.,=114 34 and 103 5

$1 \wedge 1$, bas.,=110° 58′

$\frac{1}{2} \wedge \frac{1}{2}$, pyr.,=134 38, 127 18

$\frac{1}{2} \wedge \frac{1}{2}$, bas.,= 72 2

Cleavage: $i\text{-}\breve{2}$ imperfect, $i\text{-}\breve{i}$ and $i\text{-}\bar{i}$ in traces.

H.=3·5—4. G.=3·1—3·3. Lustre vitreous—subadamantine and subresinous. Color pale leek-green or liver-brown. Streak white. Subtransparent — translucent. Fracture uneven.

Comp.—$\overset{\cdots}{\overline{Fe}}\,\overset{\cdot\cdot\cdot\cdot\cdot}{As}+4\,\dot{H}$=Arsenic acid 49·8, sesquioxyd of iron 34·7, water 15·5=100. Analyses: 1, Berzelius (Ak. H. Stockh., 350, 1824, Jahresb., v. 205); 2, Boussingault (Ann. Ch. Phys., xli 837); 3—6, Damour (Ann. Ch. Phys., III. x. 412):

	$\overset{\cdot\cdot\cdot\cdot\cdot}{\text{As}}$	$\overset{\cdot\cdot\cdot}{\overline{\text{Fe}}}$	$\dot{\text{H}}$	$\overset{\cdot\cdot\cdot\cdot\cdot}{\text{P}}$
1. Brazil, *Neoctese*	50·78	34·85	15·55	0·67, $\dot{\text{Cu}}$ *tr.*=101·85 Berzelius.
2. Popayan	49·6	34·3	16·9	——, $\dot{\text{Pb}}$ 0·4=101·2 Boussingault.
3. Vaulry, *gn. cryst.*	50·95	31·89	15·64	——=98·48 Damour. G.=3·11.
4. Cornwall, *blue cryst.*	51·06	32·74	15·68	——=99·48 Damour.
5. Saxony, *bluish*	52·16	33·00	15·58	——=100·74 Damour.
6. Brazil, *Neoctese*	50·96	33·20	15·70	——=98·86 Damour. G.=3·18.

An *Iron-sinter* (Eisensinter, Arsenik-sinter), from Nertschinsk, analyzed by Hermann, is an amorphous scorodite. Hermann obtained (J. pr. Ch., xxxiii. 95) $\overset{\cdot\cdot\cdot\cdot\cdot}{\text{As}}$ 48·05, $\overset{\cdot\cdot\cdot}{\overline{\text{Fe}}}$ 36·41, $\dot{\text{H}}$ 15·54=100.

Pyr., etc.—In the closed tube yields neutral water and turns yellow. B.B. fuses easily, coloring the flame blue. B.B. on charcoal gives arsenical fumes, and with soda a black magnetic scoria. With the fluxes reacts for iron. Soluble in muriatic acid.

Obs.—Found of brown color in the granitic mountains of Schwarzenberg in Saxony, associated with arsenopyrite; at Löling, near Huttenberg in Carinthia, with leucopyrite; at Chanteloube, near Limoges; at Nertschinsk, Siberia, in fine crystals; also as an amorphous crust or *iron-sinter* on beryl, topaz, and quartz; leek-green, in the Cornish mines, coating cavities of ferruginous quartz; at the Minas Goraes, in Brazil; in Popayan; at the gold mines of Victoria in Australia, in quartz with arsenopyrite and gold.

Occurs in minute crystals and druses of leek-green and greenish-white colors, near Edenville, N. Y., with arsenopyrite, iron-sinter, etc., in white limestone; in Cabarras Co., N. C., on G. Luderick's farm, in aggregations of greenish-white, brownish- and leek-green crystals; coating cavities of quartz and limonite with copper ores and pyrite.

The cobalt-scorodite of Lippmann (l. c.) occurs in bluish crystals with quartz and hypochlorite, at Schneeberg; it has not been analyzed.

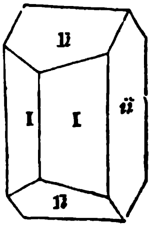
Named from σκόροδον, *garlic*, alluding to the odor before the blowpipe.

Alt.—Scorodite occurs altered to limonite.

554. WAVELLITE. Wavellite *Babbington*, Davy's Mem. in Phil. Tr., 162, 1805. Hydrargillite *Davy*, ib., 155, 162. Devonite *Thomson*. Strahliger Hydrargillit (=columnar var. of Diaspore) *Hausm.*, Handb., 443, 1813. Lasionit *Fuchs*, Schw. J., xviii. 288, 1816, xxiv. 121. Striegisan *Breith.*, Schw. J., lxii. 379, 1831. Thonerdephosphat *Germ.* Alumine phosphatée *Fr.* Subphosphate of Alumine.

Orthorhombic. $I \wedge I$=126° 25′, $O \wedge 1\text{-}\bar{i}$=143° 23′; $a : b : c$=0·7431 : 1 : 1·4943. Observed planes as in the annexed figure, with also 1, $2\text{-}\breve{2}$, and $i\text{-}\breve{\tfrac{4}{3}}$.

488



$1 \wedge I$=129° 47′
$1 \wedge 1$, mac.,=146 28
$1 \wedge 1$, brach.,=110 20
$1 \wedge 1$, bas.,=79 34
$2\text{-}\breve{2} \wedge 2\text{-}\breve{2}$, mac.,=117° 23′
$2\text{-}\breve{2} \wedge 2\text{-}\breve{2}$, brach.,=118 33
$2\text{-}\breve{2} \wedge 2\text{-}\breve{2}$, bas.,=93 7
$i\text{-}\breve{i} \wedge i\text{-}\breve{\tfrac{4}{3}}$=123 57

Cleavage: *I* rather perfect; also brachydiagonal. Usually in hemispherical or globular concretions, having a radiated structure.

H.=3·25—4. G.=2·337, Barnstaple, Haidinger; 2·316, Irish variety, Richardson. Lustre vitreous, inclining to pearly and resinous. Color white, passing into yellow, green, gray, brown, and black. Streak white. Translucent. Index of refraction 1·52.

Comp.—O. ratio for $\overset{\cdot\cdot\cdot}{\overline{\text{Al}}}$, $\overset{\cdot\cdot\cdot\cdot\cdot}{\text{P}}$, $\dot{\text{H}}$=9 : 10 : 12; whence $\overset{\cdot\cdot\cdot}{\overline{\text{Al}}}{}^3\overset{\cdot\cdot\cdot\cdot\cdot}{\text{P}}{}^2+12\dot{\text{H}}$, or perhaps $\overset{\cdot\cdot\cdot}{\overline{\text{Al}}}\,\overset{\cdot\cdot\cdot\cdot\cdot}{\text{P}}+\tfrac{1}{2}\overset{\cdot\cdot\cdot}{\overline{\text{Al}}}\,\dot{\text{H}}^3+5\dot{\text{H}}$=Phosphoric acid 34·4, alumina 37·3, water 28·3=100; or the same with $4\tfrac{1}{2}\dot{\text{H}}$=Phosphoric acid 35·1, alumina 38·1, water 26·8=100.

Analyses: 1, 2. Fuchs (Schw. J., xxiv. 121); 3, Berzelius (Schw. J., xxvii. 63); 4–7, Erdmann (Schw. J., lxix. 154); 8, Hermann (J. pr. Ch., xxxiii. 288); 9, Sonnenschein (J. pr. Ch., liii. 344); 10, Genth (Am. J. Sci., II. xxiii. 423).

	$\overset{\cdot\cdot\cdot\cdot\cdot}{\overline{\rm P}}$	$\dddot{\overline{\rm Al}}$	$\dddot{\overline{\rm Fe}}$	$\dot{\rm H}$	F
1. Devonshire	35·12	37·20	——	28·00	——=100·32 Fuchs.
2. "	84·84	37·16	——	28·00	——=100 Fuchs.
3. "	33·40	35·35	1·25*	26·80	2·06, $\dot{\rm Ca}$ 0·50=99·39 Berzelius.
4. Striegis, *blue*	34·08	36·60	1·00	27·40	*tr.*=99·06 Erdmann.
5. " *green, yellow*	33·28	86·39	2·69	27·10	*tr.*=99·46 Erdmann.
6. " *brown*	31·55	34·90	2·21	24·01	*tr*, $\dddot{\rm Si}$ 7·30=99·97 Erdmann.
7. " *black*	32·46	35·39	1·5	24·00	*tr.*, $\dddot{\rm Si}$ 6·65=100 Erdmann.
8. Zbirow	34·29	36·39	1·20	26·34	1·69=98·91 Hermann.
9. Allendorff	82·16	35·76	——	28·32	*tr.*, $\dot{\rm Ca}$ 0·86, $\dddot{\rm Si}$ 2·70=98 80 Sonn.
10. Chester Co., Pa.	34·68	36·67	——	28·29	*tr.*, limonite 0·22=99·86 Genth.

* With peroxyd of manganese.

Hermann obtained much less fluorine than Berzelius, and gives a different formula. But Berzelius remarks that this ingredient may easily fall short.

The cement of a conglomerate near Loughhill, Co. of Limerick, Ireland, consisting of emerald-green, with some white, crystals, approaches wavellite in composition, affording A. Gages (J. G. Soc. Dubl., viii. 73) $\overset{\cdot\cdot\cdot\cdot\cdot}{\overline{\rm P}}$ 30·88, $\dddot{\overline{\rm Al}}$ 36·16, $\dddot{\overline{\rm Fe}}$ 1·81, $\dot{\rm Ni}$ 0·33, $\dot{\rm H}$ 23·56, F *tr.*, $\dddot{\rm Si}$ 3·61, apatite 1·58, quartz 1·00=98·94. A wavellite containing oxyd of lead occurs at Rosières in stalactites, as detected by Berthier.

Pyr., etc.—In the closed tube gives off much water, the last portions of which react acid and color Brazil-wood paper yellow (fluorine), and also etch the tube. B.B. in the forceps swells up and splits frequently into fine acicular particles, which are infusible, but color the flame pale green; moistened with sulphuric acid the green becomes more intense. Gives a blue with cobalt solution. Some varieties react for iron and manganese with the fluxes. Heated with sulphuric acid gives off fumes of fluohydric acid, which etch glass. Soluble in muriatic acid, and also in caustic potash.

Obs.—Wavellite was first discovered in a tender clay slate near Barnstaple, in Devonshire, by Dr. Wavel. It has since been found at Clonmel and Cork, Ireland; in the Shaint Isles of Scotland; at Zbirow in Bohemia; Zajecov in Bohemia: at Frankenberg and Langenstriegis, Saxony; Diensberg near Giessen, Hesse Darmstadt; on brown iron ore in the Jura limestone at Amberg in Bavaria (the *lasionite* of Fuchs); in a manganese mine at Weinbach near Weilburg in Nassau (Genth); at Villa Rica, Minas Geraes, Brazil.

In the United States reported as found near Saxton's River, Bellows Falls, N. H.: also at the slate quarries of York Co., Pa., near the Susquehanna; at Washington mine, Davidson Co., N. C., with actinolite, pyrite, and native silver; at Steamboat, Chester Co., Pa., in a bed of limonite, abundant in stalactitic forms, part looking like gibbsite, part drusy with rhombic crystals, and often coated with a pearly scaly mineral yet undetermined.

Named after Dr. Wavel, the discoverer. The species was considered a variety of diaspore by D'Aubuisson, Bournon, Hausmann, and some other early mineralogists, and placed next to diaspore by Werner in 1817; while Jameson arranged it in 1816 among the zeolites.

Calculating from the angle $I \wedge I$=126° 25′, the prism i-$\breve{2}$ has the angle, over i-$\breve{\imath}$,=90° 34′, very near the angle $I \wedge I$ of lazulite.

554A. **Kapnicite** *Kenng.*, Ueb., 1855, and 1856–57. Probably wavellite. Occurs in fibrous radiated rounded concretions, the fibres rhombic prisms pyramidally terminated, with vitreous lustre; H.=3·5—4; G.=2·356 (Städeler). Städeler obtained (Ann. Ch. Pharm., cix. 305) $\overset{\cdot\cdot\cdot\cdot\cdot}{\overline{\rm P}}$ 35·49, $\dddot{\overline{\rm Al}}$ 39·59, with water 24·92 (from the loss)=100, and remarks on the close approximation to wavellite. From Kapnik in Hungary.

554B. **Planerite.** Under this name Hermann has described (Bull. Soc. Nat. Mosc., xxxv. 240, 1862) a mineral from the copper mines of Gumeschefsk, in the Ural. It occurs in thin subcrystalline, botryoidal layers in the cavities of a quartz rock. H.=5; G.=2·65. Color on fresh surface verdigris-green, passing to olive-green on exposure to the air. Lustre dull. Translucent on the edges. Analysis afforded:

$$\overset{\cdot\cdot\cdot\cdot\cdot}{\overline{\rm P}}\ 33{\cdot}94 \qquad \dddot{\overline{\rm Al}}\ 37{\cdot}48 \qquad \dot{\rm Cu}\ 3{\cdot}72 \qquad \dot{\rm Fe}\ 3{\cdot}52 \qquad \dot{\rm H}\ 20{\cdot}93=99{\cdot}59.$$

From which Hermann deduces the formula $(\dddot{\overline{\rm Al}}{}^3\overset{\cdot\cdot\cdot\cdot\cdot}{\overline{\rm P}}{}^2+9\,\dot{\rm H})+\frac{1}{2}(\dot{\rm Cu}, \dot{\rm Fe})\dot{\rm H}$. He regards the hydrated oxyds of iron and copper as unessential, and as occurring in many other aluminous phosphates as turquois, peganite, and fischerite.

B.B. in tube decrepitates, yielding much neutral water. Easily soluble in borax, giving copper reaction. Only slightly attacked by acids, but easily decomposed by boiling with caustic soda Named after Planer, director of the mines. Possibly impure wavellite.

555. TROLLEITE. Trolleit *C. W. Blomstrand*, Priv. contrib., dated Dec. 9, 1867.

Compact, with indistinct cleavage.

H. a little below 6. G.=3·10. Lustre more or less vitreous. Colo
ale green. Fracture even, to conchoidal.

Comp.—$\dddot{\bar{\mathrm{Al}}}\,\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\mathrm{P}}}+\frac{1}{3}\,\dddot{\bar{\mathrm{Al}}}\,\dot{\mathrm{H}}^3$=Phosphoric acid 47·8, alumina 46·2, water 6·0=100. Analysis: C. W
lomstrand (l. c.):

$\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\mathrm{P}}}$	$\dddot{\bar{\mathrm{Al}}}$	$\dddot{\bar{\mathrm{Fe}}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{H}}$
(⅓) 46·72	43·26	2·75	0·97	6·23=99·93.

Pyr., etc.—B.B. same as for berlinite. Scarcely attacked by acids.

Obs.—Constitutes small detached masses and veins in other phosphates, at the iron mine of
estana, in Scania, Sweden.

Named after the chemist H. G. Trolle Wachtmeister.

56. PLUMBOGUMMITE. Plomb rouge en stalactites—tantot en globules, *de Lisle*, Demeste Lettres Min., ii. 399, 1779; Crist., iii. 399, 1783. Sel acide-phosphorique-martial *G. de Laumont*, J. de Phys., xxviii. 385, 1786. Plomb-gomme *de Laumont*. Aluminiate de Plomb avec eau de combinaison *Berz.*, in his Nouv. Min., 283, 1819. Bleigummi, Blei-aluminat, etc., *Berz.*, Schw. J., xxvii 65, 1819 (trl. fr. Nouv. Min). Native Aluminiate of Lead *Smithson*, Ann. Phil., xiv. 31, 1819 (citing Berz., and also a letter by de Laumont, in which S. Tennant (who died in 1815) is said to have first analyzed plombgomme and made it a combination of oxyd of lead, alumina, and water). Plomb hydro-alumineux *H.*, Tr., iii. 410, 1822. Gummispath *Breith.*, Char., 56, 1832. Plomgomme *Beud.*, Tr., ii. 1832. Plumbo-gummite *Shep.*, Min., ii. 113, 1835. Plumbo-resinite *Dana*, Min., 230, 1837. Gummibleispath, Bleihydroaluminat, *Germ.* Hitchcockite *Shep.*, Rep. Canton Mine, Ga., 1856, Min., 401, 1857.

Reniform, globular, botryoidal, with sometimes a concentric structure;
thin crusts; compact massive.

H.=4—5. G.=4—6·4; 6·421, Breith.; 4·88, fr. Nuissière, Dufrénoy;
)14, hitchcockite, Genth. Lustre resinous or gum-like. Color yel-
wish-gray, reddish-brown, greenish; also yellowish-white; sometimes
ayish-white, bluish. Streak uncolored. Translucent; subtransparent.
agile.

omp.—Analyses: 1, Berzelius (Schw. J., xxvii. 65); 2, Dufrénoy (Ann. Ch. Phys., lix. 440);
, Damour (Ann. d. M., III. xvii. 191); 6, Genth (Am. J. Sci., II. xxiii. 424):

	$\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\mathrm{P}}}$	$\dddot{\mathrm{S}}$	$\dddot{\bar{\mathrm{Al}}}$	$\dot{\mathrm{Pb}}$	$\dot{\mathrm{H}}$	$\dddot{\bar{\mathrm{Fe}}}$	$\dot{\mathrm{Ca}}$	$\ddot{\mathrm{Si}}$	
Huelgoet	——	0·20	37·00	40·14	18·80	1·80[a]		0·60=98·54 Berzelius.	
uissière	——	——	34·28	37·51	16·13	——	——	2 11,	$\dot{\mathrm{Pb}}^3\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\mathrm{P}}}$ 7·79=97·77 Dufrénoy.
uelgoet	8·06	0·30	34·32	35·10	18·70	0·20	0·80	——,	Pb Cl 2·27=99·75 Damour.
"	12·05	0·25	11·05	62·15	6·18	——	——	——	" 8·24=99·92 Damour.
"	15·18	0·40	2·88	70·85	1·24	——	——	——	" 9·18=99·73 Damour.
itchcockite	18·74	——	25·54	29·04	20·86	0·90	1·44	——,	$\ddot{\mathrm{C}}$ 1·98, Cl 0·04, insol. 0·48=99·02 G

[a] With some $\mathrm{Mn}^2\mathrm{O}^3$.

erzelius made the mineral a hydrous aluminate of lead, $\dot{\mathrm{Pb}}\,\dddot{\bar{\mathrm{Al}}}^2+6\,\dot{\mathrm{H}}$. Damour concluded
his results that in Berzelius's investigation the phosphoric acid was precipitated with the
ina and oxyd of lead, and so lost sight of. He observes that his own analyses, though so
ly different, agree in affording 1 : 1 for the O. ratio of water and alumina, and regards the
ina as present in the state of a hydrate. He writes for the formula of anal. 3, $\dot{\mathrm{Pb}}^3\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\mathrm{P}}}+6\,\dddot{\bar{\mathrm{Al}}}$
Dufrénoy inclines to adopt Damour's view (Min., iii. 294, 1856).

Genth's analysis of hitchcockite, the O. ratio for the water and alumina is 3 : 2; for the whole
$\dddot{\bar{\mathrm{Al}}}$, $\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\mathrm{P}}}$, $\dot{\mathrm{H}}$, 2·1 : 12·2 : 10·5 : 18·5, which corresponds to $2\,\dddot{\bar{\mathrm{Al}}}\,\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\mathrm{P}}}+\dot{\mathrm{Pb}}^3\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\mathrm{P}}}+4\,\dddot{\bar{\mathrm{Al}}}\,\dot{\mathrm{H}}^3+10\,\dot{\mathrm{H}}$.

earthy mineral from Rosières afforded Berthier (Ann. d. M., III. xix. 669) $\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\mathrm{P}}}$ (with *tr.* of $\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\mathrm{As}}}$),
$\dddot{\bar{\mathrm{Al}}}$ 23·0, $\dot{\mathrm{Pb}}$ 10·0, $\dot{\mathrm{Cu}}$ 8·0, $\dot{\mathrm{H}}$ and organic matters 38 0=99·5.

Pyr., etc.—In the closed tube decrepitates and yields water. B.B. in the forceps swells u like a zeolite, colors the flame azure-blue, but is imperfectly fused. On charcoal gives in additic a faint white coating of chlorid of lead (Plattner). With soda gives metallic lead. With cob solution gives a blue color. With the sodium test yields a phosphid. Soluble in nitric acid.

Obs.—Occurs in clay slate at Huelgoet in Brittany, associated with galenite, blende, pyrit and pyromorphite; also in a lead mine at Nuissière, near Beaujeu; at Roughten Gill, Cumberlanc at Mine La Motte, Missouri; at Canton mine, Ga., with galenite, etc. (*hitchcockite*).

Named from the Latin *plumbum*, *lead*, and *gummi*, *gum*. The identity of de Lisle's miner (which was carnelian-like in color) with plombgomme, though questioned by de Laumont in h early paper, is admitted in his letter cited in Ann. Phil., xiv. 31, 1819.

The mineral looks usually like drops or coatings of gum, also at times somewhat like chalcedo or allophane. It differs from globular pyromorphite or blende in not being fibrous within. T *hitchcockite* occurs in botryoidal crusts and thin coatings, white, bluish, yellowish, or greenis allophane-like, sometimes concentric in structure; Shepard gives H.=2·75—3, and says that loses 29 p. c. on ignition.

557. CALCIOFERRITE. Calcoferrit *J. R. Blum*, Jahrb. Min. 1858, 287.

Monoclinic? Foliated massive. Cleavage: very perfect, or foliated, in one direction; traces another at right angles to the perfect one; also in another oblique to the same. In nodules.

H.=2·5. G.=2·523—2·529, Reissig. Lustre of cleavage-face pearly. Color sulphur-yello greenish-yellow to siskin-green, yellowish, white. Streak sulphur-yellow. Thin laminæ transl cent. Brittle.

Analysis by Reissig (l. c.), giving nearly $4\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{P}}$, $3\overset{\cdots}{\bar{\mathrm{R}}}$, $6\dot{\mathrm{R}}$, $19\dot{\mathrm{H}}$; $2\dot{\mathrm{R}}^3\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{P}}+2\overset{\cdots}{\bar{\mathrm{R}}}\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{P}}+\overset{\cdots}{\bar{\mathrm{R}}}\dot{\mathrm{H}}^3+16\dot{\mathrm{H}}$:

$\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{P}}$ 34·01 $\overset{\cdots}{\bar{\mathrm{F}}}\mathrm{e}$ 24·34 $\overset{\cdots}{\bar{\mathrm{A}}}\mathrm{l}$ 2·90 $\dot{\mathrm{M}}\mathrm{g}$ 2·65 $\dot{\mathrm{C}}\mathrm{a}$ 14·81 $\dot{\mathrm{H}}$ 20·56=99·27.

B.B. fuses easily to a shining black magnetic globule. Easily decomposed by muriatic acid.

In nodules in a bed of clay at Battenberg in Rhenish Bavaria. The exterior of the nodules yellowish- or reddish-brown impure calcioferrite.

558. PHARMACOSIDERITE. ?Fer minéralisé par l'acide arsenique *Proust*, Ann. Che i. 195, 1790; Arsenicated Iron Ore *Kirwan*, ii. 189, 1796. Olivenerz, Arseniksaures Eisen Würfeln kryst. (fr. Carharrack) *Klapr.*, Schrift. Ges. nat. Fr. Berl., 1, 161, 1786, Beitr.. iii. 1 1802; Würfelerz, var of Olivenerz, *Lenz*, ii. 18, 151, 1794. Würfelerz *Karsten*, Tab., 66, 18 Cube Ore. Pharmakosiderit *Hausm.*, Handb., 1065, 1813.

Isometric; tetrahedral. Observed planes: *O*, 1, 2, *I*; f. 1, 29, et Crystals modified cubes and tetrahedrons. Cleavage: cubic; imperfe *O* sometimes striated parallel to its edge of intersection with plane 1 (f. 2 planes often curved. Rarely granular.

H.=2·5. G.=2·9—3. Lustre adamantine to greasy, not very distin Color olive-green, passing into yellowish-brown, bordering sometimes up hyacinth-red and blackish-brown; also passing into grass-green, emeral green, and honey-yellow. Streak green—brown, yellow, pale. Subtra parent—subtranslucent. Rather sectile. Pyroelectric.

Comp.—O. ratio for $\overset{\cdots}{\bar{\mathrm{R}}}$, $\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{A}}\mathrm{s}$, $\dot{\mathrm{H}}$=4 : 5 : 5; whence $3\overset{\cdots}{\bar{\mathrm{F}}}\mathrm{e}\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{A}}\mathrm{s}+\overset{\cdots}{\bar{\mathrm{F}}}\mathrm{e}\dot{\mathrm{H}}^3+12\dot{\mathrm{H}}$, with one-eleve of the $\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{A}}\mathrm{s}$ replaced by $\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{P}}$=Arsenic acid 39·8, phosphoric acid 2·5, sesquioxyd of iron 40·6, wa 17·1=100. Analysis: Berzelius (Ak. H. Stockh., 354, 1824):

$\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{A}}\mathrm{s}$	$\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{P}}$	$\overset{\cdots}{\bar{\mathrm{F}}}\mathrm{e}$	$\dot{\mathrm{C}}\mathrm{u}$	$\dot{\mathrm{H}}$
40·20	2·53	39·20	0·65	18·61, gangue 1·76=102·95.

Pyr., etc.—Same as for scorodite.

Obs.—Formerly obtained at the mines of Wheal Gorland, Wheal Unity, and Carharrack, Cornwall, coating cavities in quartz, with ores of copper; now found in quartz at Burdle Gill Cumberland, in small brilliant crystals; in minute tetrahedral crystals at Wheal Jane; also Australia; at St. Leonard in France; and at Schneeberg and Schwarzenberg in Saxony.

Named from φάρμακον, *poison* (in allusion to the arsenic present), and σίδηρος, *iron*. *Würfel* of the Germans means *cube-ore*.

Proust first announced the existence of an arsenate of iron, from greenish-white concretionary specimens found in Spain; but from his meagre description its identity with this species cannot be made certain.

Alt.—Has been observed altered to psilomelane, limonite ($\bar{\mathrm{F}}\mathrm{e}^2\dot{\mathrm{H}}^3$), red iron ore ($\bar{\mathrm{F}}\mathrm{e}$).

559. CIRROLITE. Kirrolith *C. W. Blomstrand*, Priv. contrib., dated Dec. 9, 1867.

Compact, without a trace of cleavage.
H.=5—6. G.=3·08. Color pale yellow.

Comp.—O. ratio for $\dot{\mathrm{R}}$, $\bar{\mathrm{R}}$, $\dddot{\mathrm{P}}$, $\dot{\mathrm{H}}$=2 : 2 : 5 : 1. Formula, $\bar{\mathrm{A}}\mathrm{l}^2\dddot{\mathrm{P}}+2\,\dot{\mathrm{C}}\mathrm{a}^3\dddot{\mathrm{P}}+3\,\dot{\mathrm{H}}$, Blomstrand,= Phosphoric acid 41·7, alumina 20·1, lime 32·9, water 5·3=100. Analysis: Blomstrand (l. c.):

$\dddot{\mathrm{P}}$	$\bar{\mathrm{A}}\mathrm{l}$	$\dot{\mathrm{F}}\mathrm{e}$	$\dot{\mathrm{M}}\mathrm{n}$	$\dot{\mathrm{P}}\mathrm{b}$	$\dot{\mathrm{M}}\mathrm{g}$	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\mathrm{H}}$
(½) 41·17	20·54	0·91	2·24	0·11	0·21	29 37	5·06=99·61,

after removal of 4·60 not dissolved in the acid solution, of which 3·17 was silica.

Pyr., etc.—B.B. fuses very easily to a white enamel. With soda a manganese reaction. Decomposed on digestion in fine powder in muriatic acid.

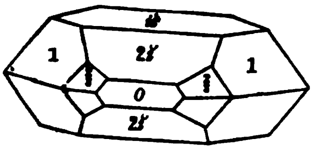
Obs.—Occurs at the iron mine of Westana, in Scania, Sweden.

Named from *κιῤῥός*, *pale yellow*.

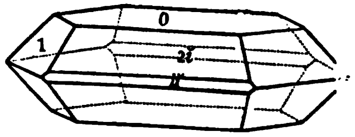
560. CHILDRENITE. *Levy*, Brande's J., xvi. 274, 1823.

Orthorhombic. $I\wedge I$=111° 54′, $O\wedge 1\text{-}\bar{i}$=136° 26′; $a:b:c$=0·9512 : : 1·4798. Observed planes as in the annexed figures, with also $\frac{3}{2}\text{-}\breve{i}$. ∧ 2-$\breve{i}$=127° 53′, $O\wedge 1$=131° 4′, $O\wedge\frac{2}{3}$=142° 35′, $O\wedge i\text{-}\breve{i}$=90°, 1 ∧ 1, nac., 130° 4′, brach., or over 2-$\breve{i}$, 102° 41′, bas., 97° 52′, 2-$\breve{i}$ ∧ 2-$\breve{i}$, ov. O,= 5° 46′, B. & M. Plane O sometimes wanting, and the form a double six-ided pyramid, made up of the planes 1, 2-$\breve{i}$, with $i\text{-}\breve{i}$ small. Cleavage: $i\text{-}\breve{i}$, mperfect.

484



485



H.=4·5—5. G.=3·18—3·24; 3·184, Kenngott. Lustre vitreous, clining to resinous. Color yellowish-white and pale yellowish-brown, so brownish-black. Streak white, yellowish. Translucent. Fracture even.

Comp.—O. ratio for $\dot{\mathrm{R}}$, $\bar{\mathrm{R}}$, $\dddot{\mathrm{P}}$, $\dot{\mathrm{H}}$=4 : 3 : 7 : 7; or less nearly 4 : 3 : 7½ : 7½, Rammelsberg, o writes the formula $2\,\dot{\mathrm{R}}^4\dddot{\mathrm{P}}+\bar{\mathrm{A}}\mathrm{l}^2\dddot{\mathrm{P}}+15\,\dot{\mathrm{H}}$=Phosphoric acid 28·9, alumina 14·0, protoxyd of n 29·3, protoxyd of manganese 9·5, water 18·3=100. Perhaps $(\frac{4}{7}\,\dot{\mathrm{R}}^3+\frac{3}{7}\,\bar{\mathrm{A}}\mathrm{l})^5\dddot{\mathrm{P}}^3+15\,\dot{\mathrm{H}}$. But ew analysis is needed. Analysis: Rammelsberg (Pogg., lxxxv. 435):

$\dddot{\mathrm{P}}$ 28·92 $\bar{\mathrm{A}}\mathrm{l}$ 14·44 $\dot{\mathrm{F}}\mathrm{e}$ 30·68 $\dot{\mathrm{M}}\mathrm{n}$ 9·07 $\dot{\mathrm{M}}\mathrm{g}$ 0·14 $\dot{\mathrm{H}}$ 16·98=100·23 Ramm.

Pyr., etc.—In the closed tube gives off neutral water. B.B. swells up into ramifications, and es on the edges to a black mass, coloring the flame pale green. Heated on charcoal turns ck and becomes magnetic. With soda gives a reaction for manganese. With borax and salt phosphorus reacts for iron and manganese. Soluble in muriatic acid.

Obs.—Occurs in crystals and crystalline coats, on spathic iron, pyrite, or quartz, and sometimes th apatite, near Tavistock, and at the George and Charlotte mine, and also at Wheal Crebor, in

Devonshire; on slate at Crinnis mine in Cornwall. Crystals 1 in. long have been observed. They look a little like siderite, but are more lustrous and of greater hardness.

In U. States, at Hebron, Me., in minute hair-brown prismatic crystals, with amblygonite (f. 485 by Cooke, and an octahedral form, Am. J. Sci., II. xxxvi. 258).

If the dome 2-ĭ be made the fundamental vertical prism, then $I \wedge I = 104° 14'$, $1\text{-}\bar{i} \wedge 1\text{-}\bar{i}$, top, $= 73°$, $1\text{-}\breve{i} \wedge 1\text{-}\breve{i}$, ib., $= 87° 14'$; the cleavage macrodiagonal; $a : b : c = 1{\cdot}3514 : 1 : 1{\cdot}2853$.

Named after Mr. Children.

561. ATTACOLITE. Attakolith *C. W. Blomstrand*, Priv. contrib., dated Dec. 9, 1867.

Massive, indistinctly crystalline.
H.=5. G.=3·09. Color pale red.

COMP.—O. ratio for $\dot{R}$, $\overset{\cdots}{\bar{R}}$, $\overset{\cdot\cdot\cdot\cdot\cdot}{P}$, $\dot{H}$, after separating 8·60 $\ddot{Si}$ as free silica=6 : 15 : 20 : 6. The uncertainty as to whether the silica is free or combined renders the composition and formula doubtful. Analysis: C. W. Blomstrand (l. c.):

	$\overset{\cdot\cdot\cdot\cdot\cdot}{P}$	$\overset{\cdots}{\bar{A}l}$	$\overset{\cdots}{\bar{F}e}$	$\dot{M}n$	$\dot{M}g$	$\dot{C}a$	$\dot{N}a$	$\dot{H}$
(⅔)	36·06	29·75	3·98	8·02	0·33	13·19	0·45	6·90=98·68.
					$\ddot{\mathrm{V}}$			

PYR., ETC.—B.B. fuses easily, and, when more heated, with intumescence, to a brownish-yellow glass. With soda a strong manganese reaction. Very incompletely decomposed by acids.

OBS.—From the iron mine of Westana, in Scania, Sweden.

Named from ἀτταγεύς, *salmon*, alluding to the color.

562. AUGELITE. Augelith *C. W. Blomstrand*, Priv. contrib., dated Dec. 9, 1867.

Massive. Cleavage: distinct in three directions, and generally easily obtained.

G.=2·77. Lustre of cleavage surface strongly pearly. Colorless, but generally pale red.

Comp.—$\overset{\cdots}{\bar{A}l}{}^2 \overset{\cdot\cdot\cdot\cdot\cdot}{P} + 3\dot{H}$=Phosphoric acid 35·3, alumina 51·3, water 13·4=100. Analysis: C. W. Blomstrand (l. c.):

	$\overset{\cdot\cdot\cdot\cdot\cdot}{P}$	$\overset{\cdots}{\bar{A}l}$	$\overset{\cdots}{\bar{F}e}$	$\overset{\cdots}{\bar{M}n}$	$\dot{C}a$	$\dot{H}$
(⅔)	35·61	48·80	0·75	0·31	1·09	13·04=99·60.

The mineral is often intimately mixed with silica, and not easily separated from it.

Pyr., etc.—Yields much water in the glass tube. B.B. infusible. Scarcely affected by acids

Obs.—Occurs imbedded in other phosphates at the iron mine of Westana, in Scania, Sweden

Named from αὐγή, *lustre*.

563. TURQUOIS. ? Callais, ? Callaina, *Plin.*, xxxvii. 56, 33. Firuzegi *Pers.* Turques, Turquois pt., of the 16th century and later (Turques, Fabyan's Chronicle). Türkis pt *Germ*, Turchesa *Ital.*, Turquoise *Fr.* Turquoise *J. B. Tavernier*, Voy. en Turquie, en Persie, etc., Paris, 167 Turchine *Bocconi*, Museo di Fisica, etc., 278, 1697. Orientalischer Türkis *Demetrius Agaph N. Nord.* Beytr., v. 261, *Pallas*, ib., 265. Turquois orientale, Calaite, Agaphite, Johnite. G *Fischer*, Mém. Soc. Imp. N. Moscou, i. 1806; also his Onomasticon Min. Mus. Imp. Mosco 1811, and Essai sur la Turquoise, Moscou, 1816, of which Abstr. in Ann. Phil., xiv. 406, 181 *John*, Mem. Soc. Imp. N. Moscou, i. 1806, Schw J., iii. 93, 1807 (with analyses and assertio that it is no *Odontolite*). Hydrargillite pt. *Hausm.*, Handb., 444, 1813. Turquoise de vieill roche (in distinction from Odontolite, or T. de nouvelle roche, called also Occidental Turquois) Kallait, Kalait, *Germ.*

Reniform, stalactitic or incrusting. Cleavage none.

H.=6. G.=2·6–2·83; 2·621, Hermann. Lustre somewhat waxy feeble. Color sky-blue, bluish-green to apple-green. Streak white or greenish. Feebly subtranslucent—opaque. Fracture small conchoidal.

Comp.—O. ratio fr. anal. 1 and 3, for $\dddot{\bar{A}}l$, $\ddot{\bar{P}}$, $\dot{H}=6:5:5$; whence $\dddot{\bar{A}}l^2\ddot{\bar{P}}+5\dot{H}$=Phosphoric acid 32·6, alumina 46·9, water 20·5=100. Analyses: 1, John (Ann. d. M., II. iii. 231); 2, Zellner (Isis, 1834, 637); 3, Hermann (J. pr. Ch., xxxiii. 282); 4, Church (Ch. News, x. 290):

	$\ddot{\bar{P}}$	$\dddot{\bar{A}}l$	$\dot{H}$	$\dot{C}u$	
1. Silesia	30·90	44·50	19·00	3·75	$\dot{F}e$ 1·80=99·95 John.
2. "	38·90	54·50	1·00	1·50	$\dddot{\bar{F}}e$ 2·8=98·70 Zellner.
3. *Blue Oriental*	27·34	47·45	18·18	2·02	" 1·10, $\dddot{\bar{M}}n$ 0·50, $\dot{C}a^3\ddot{\bar{P}}$ 3·41=100 H.
4. Nichabour, Persia	32·86	40·19	19·34	5·27	$\dot{F}e$ 2·21, $\dot{M}n$ 0·36=100·23* C.; G.=2·75.

* After subtracting 0·74 SiO^2 and 0·49 hygroscopic water.

The green oriental turquois afforded Hermann only 5·64 p. c. of phosphoric acid, and is evidently mechanical mixture, containing but little turquois. Specific gravity of the last 2·621. John in is early analysis did not detect the phosphoric acid; he obtained $\dddot{\bar{A}}l$ 73·0, $\dot{C}u$ 4·5, $\dddot{\bar{F}}e$ 4·0, $\dot{H}$ (or ss) 18=99·5.

Pyr., etc.—In the closed tube decrepitates, yields water, and turns brown or black. B.B. in he forceps becomes brown and assumes a glassy appearance, but does not fuse; colors the flame reen; moistened with muriatic acid the color is at first blue (chlorid of copper). With the sodim test gives phosphuretted hydrogen. With borax and salt of phosphorus gives beads in O.F. hich are yellowish-green while hot and pure green on cooling. With salt of phosphorus and n on charcoal gives an opaque red bead (copper). Soluble in muriatic acid.

Obs.—Occurs in clay slate, in a mountainous district in Persia, not far from Nichabour. According to Agaphi, the only naturalist who has visited the locality, turquois occurs only in veins, hich traverse the mountain in all directions. Fischer, in 1816, named the different varieties alaite, Agaphite (or conchoidal T.), and Johnite (or quartzy T.). Pieces of the size of a hazelut are considered very large. An impure variety is found in Silesia, and at Oelsnitz in Saxony; ar the well of Nasaiph between Suez and Sinai. W. P. Blake refers here a hard, yellowish-bluish-green stone (which he identifies with the *chalchihuitl* of the *Mexicans*) from the mountains s Cerillas, 20 m. S.E. of Santa Fé; H.=6; G.=2·426–2·651 (Am. J. Sci., II. xxv. 227). A le green turquois occurs in the Columbus district, Nevada.

Turquois receives a good polish, and is highly esteemed as a gem. The Persian king is said to tain for his own use all the larger and finely tinted specimens.

The *Callais* of Pliny is generally regarded as turquois, and probably rightly so. But all he says it is, "Callais sapphirum imitatur, candidior et litoroso mari similis," resembling sapphire (that *lapis-lazuli*) in color, but paler, and like the sea toward the shore; indicating a greenish-blue t and degree of opacity corresponding well enough with much turquois.

The *Callaina* also of Pliny (to which he devotes a long chapter) is referred to this species, and th even better reason. It was a stone of a pale green color, and was obtained, according to a, amid inaccessible rocks in the countries that lie at the back of India, near Mt. Caucasus, etc. also states that it was remarkable for its size, and was full of holes and foreign substances, ich it is difficult to reconcile with the true turquois. But he speaks in the next sentence of a d from Carmania (a district of Persia) as of better quality and clearer, and this may have been l turquois. He says that no stones were more easily imitated, which is very true of turquois. also remarks that the beauty of the Callaina is greatly heightened by a setting of gold, the trast peculiarly befitting it.

liny also speaks of another stone called *Callaica* (xxxvii. 56), and says of it: "Callaicam vocant rbido callaino; ferunt pluris conjunctis semper inveniri;" it is so called because it is a turbid aina, and they are found together. He also remarks that the stone called "*Augetis* (xxxvii. 54) tis non alia videtur quam callaina," by many is thought to be nothing but callaina. (See her **Callainite**, p. 572).

he *Persian smaragdus*, or emerald, alluded to by Pliny (xxxvii. 18, citing from Democritus), as ithout transparency, agreeable and uniform in color, satisfying the vision without allowing it enetrate it," may have been turquois; yet, as with most of Pliny's descriptions (owing to his ing different things of similar aspect), when all the other characters given are weighed they e doubt.

; is probable that the turquois—oriental and occidental—was as commonly used in Persia as em in ancient times as now. The name *turquois* is French in form, and means *Turkish*, a *kish gem*, the gem having come into Europe through Turkey.

ost of the turquois (not artificial) used in jewelry in former centuries, as well as the present, that described in the early works on minerals, was *bone-turquois* (called also *odontolite*, from , *tooth*), which is fossil-bone, or tooth, colored by a phosphate of iron. Its organic origin mes manifest under a microscope. Moreover, true turquois, when decomposed by muriatic , gives a fine blue color with ammonia, which is not true of the odontolite.

564. PEGANITE. Peganit *Breith.*, Schw. J, lx. 308, 1830.

Orthorhombic. In rhombic prisms, with the acute lateral edge truncated; angle of the prism about 127° and 53°. Cleavage: basal, and brachydiagonal, imperfect.

H.=3—3·5. G.=2·492—2·501. Lustre greasy to vitreous. Color deep green, greenish-gray, greenish-white. Streak white.

Comp.—$\bar{A}l^2\dddot{P}+6\dot{H}$, Hermann, =Phosphoric acid 31·1, alumina 45·2, water 23·7=100. Analysi by Hermann (J. pr. Ch., xxxiii. 287):

$\dddot{P}$ 30·49 $\bar{A}l$ 44·49 $\dot{H}$ 22·82 $\dot{C}u$, $\bar{F}e$, gangue 2·20=100 Hermann.

Pyr., etc.—In the closed tube yields water, and assumes a violet or rose color. B.B. crack open, becomes violet, but does not fuse. Gives but a faint copper reaction, but in other respect like turquois. The powdered mineral gives a fine blue with cobalt solution.

Obs.—Occurs in crusts, consisting of small prismatic crystals, at Striegis, near Freiberg Saxony.

Erdmann analyzed a Striegis mineral (*Striegisan* of Breithaupt) with a very different result, a seen from the analyses under WAVELLITE, to which species the specimens evidently pertain *Peganite* has till recently been placed under wavellite.

Named from πήγανον, *an herb*, in allusion to the color.

565. FISCHERITE. *Schtschurovski, Hermann*, J. pr. Ch., xxxiii. 285, 1844.

Orthorhombic, Kokscharof. $I \wedge I$=118° 32′; $a : b : c = x : 1 : 1·189$ $I \wedge i\text{-}\breve{2}$, bevelling plane, =160° 48′, $i\text{-}\breve{2} \wedge i\text{-}\breve{2}$=99° 52½′ and 80° 7½′, $i\text{-}\breve{2} \wedge i$ =139° 56′. Mostly in small six-sided prisms. Also crystalline, massive.

H.=5. G.=2·46. Lustre vitreous. Color grass-green to olive-green and verdigris-green. Translucent.

Comp.—$\bar{A}l^2\dddot{P}+8\dot{H}$=Alumina 41·8, phosphoric acid 28·9, water 29·3=100. Analysis Hermann (l. c.):

$\dddot{P}$ 29·03 $\bar{A}l$ 38·47 $\bar{F}e$ and $\bar{M}n$ 1·20 $\dot{C}u$ 0·80 $\dot{H}$ 27·50=100.

Pyr., etc.—B.B. becomes white, and clouded; yields much water, but no fluorine. Solubl in sulphuric acid.

Obs.—From Nischne Tagilsk, where it occurs in veins in a ferruginous sandstone and cla slate.

565A. VARISCITE *Breith.* (J. pr. Ch., x. 506, 1837). Contains the same ingredients as the abov but is not yet accurately analyzed. Reniform; apple-green; with white shining streak wes greasy lustre, and translucent. Yields water in a matrass. B.B. in the forceps infusible, b becomes white; in the outer flame, colors the flame deep bluish-green; with borax and salt c phosphorus forms a pale yellowish-green glass; with soda fuses with effervescence, but impe fectly; with cobalt solution becomes blue. Occurs in quartz and siliceous slate at Messbach i Saxon Voigtland. Named from Variscia (Voigtland).

566. TAVISTOCKITE. Hydrated Calcium-aluminic Phosphate (?) *A. H. Church*, J. Ch. So II. iii. 263, 1865. Tavistockite *Dana*.

In microscopic acicular crystals, sometimes aggregated in irregular ste late groups, constituting a white pearly powder.

Lustre pearly. Color white. Transparent to translucent. Fragile.

Comp.—O. ratio for $\dot{R}+\bar{R}$, $\dddot{P}$, $\dot{H}$=6 : 5 : 8; whence $(\frac{1}{2}\dot{C}a^3+\frac{1}{2}\bar{A}l)^2\dddot{P}+3\dot{H}$=Phosphoric ac 30·41, alumina 22·06, lime 35·97, water 11·56=100. Analyses: Church (l. c.):

$\ddot{\text{P}}$	$\bar{\ddot{\text{Al}}}$	$\dot{\text{Ca}}$	$\dot{\text{H}}$
30·36	22·40	36·27	12·00=101·03 Church.

Pyr., etc.—B.B. "incandesces" and becomes opaque. With nitrate of cobalt gives a blue color. Colorless bead with borax. Difficultly soluble in acids.

Obs.—Occurs at Tavistock, Devonshire, in cavities in quartz crystals, with pyrite, chalcopyrite, and childrenite.

567. CHENEVIXITE. Chenevixite *Adam*, *F Pisani*, C. R., lxii. 690, 1866.

Massive—compact.

H.=4·5. G.=3·93? Lustre vitreous. Color dark green Streak yellowish-green.

Comp.—O. ratio for $\dot{\text{R}}+\bar{\ddot{\text{R}}}$, $\ddot{\text{As}}$, $\dot{\text{H}}$=6 : 5 : 3 nearly, with O. ratio of $\bar{\ddot{\text{Fe}}}$, $\dot{\text{Cu}}$=7½ : 6½. Formula $(\bar{\ddot{\text{Fe}}}, \dot{\text{Cu}}^3)^2 \ddot{\text{As}} + 3\dot{\text{H}}$; or perhaps $\bar{\ddot{\text{Fe}}}\ddot{\text{As}} + 3\dot{\text{Cu}}\dot{\text{H}}$; $\ddot{\text{As}} : \ddot{\text{P}}$=9 : 1. Analyses: 1, Chenevix (l. c.); 2, Pisani (l. c.):

	$\ddot{\text{As}}$	$\ddot{\text{P}}$	$\bar{\ddot{\text{Fe}}}$	$\dot{\text{Cu}}$	$\dot{\text{Ca}}$	$\dot{\text{H}}$
1. Cornwall	33·5	—	27·5	22·5	—	12, sand 3=98·5 Chenevix.
2. "	32·20	2·30	25·10	31·70	0·34	8·66=100·30 Pisani.

Pisani refers here the analysis by Chenevix. 10·3 p. c. of sand are removed from anal. 2.

Pyr., etc.—In the closed tube decrepitates and yields water; becomes brown after calcination. B.B on charcoal fuses easily, giving out arsenical fumes, and leaving a black magnetic scoria with grains of copper. Easily soluble in the acids.

Obs.—From Cornwall, involved in a quartz rock in small compact masses, from which gangue it is difficult to separate it entirely.

568. DUFRENITE. Strahlstein (var.) *Jordan*, Min., etc., Reisebem., 243, 1803. Grüneisenstein (strahlichter) *Ullmann*, Syst. Tab. Uebers., 152, 319, 1814. Chalkosiderit *Ullmann*, ib., 323. Fasriche Grün-Eisenerde *W.* Dufrenite *Brongn.*, Tabl., 20, 1833. Green Iron Ore. Kraurit *Breith.*, Handb., 152, 1841.

Delvauxene *Dumont*, L'Institut, 121, 1839, *Delvaux*, Bull. Ac. Brux., 147, 1838. Delvauxit *Haid.*, Handb., 512, 1845.

Orthorhombic. *I* ∧ *I* about 123°. Cleavage: brachydiagonal. Also massive, in nodules; radiated fibrous, with a drusy surface.

H.=3·5—4. G.=3·2—3·4; 3·227, Dufr. Lustre silky, weak. Color dull leek-green, olive, or blackish-green; alters on exposure to yellow and brown. Streak siskin-green. Subtranslucent.

Comp., Var.—$\bar{\ddot{\text{Fe}}}^2\ddot{\text{P}} + 3\dot{\text{H}}$=Phosphoric acid 27·5, sesquioxyd of iron 62·0, water 10·5=100. $(\bar{\ddot{\text{Fe}}}, \bar{\ddot{\text{Al}}})^2 \ddot{\text{P}} + 3\frac{1}{2}\dot{\text{H}}$, Pisani. Schnabel's analysis makes part of the iron protoxyd.

Analyses: 1, Vauquelin (Ann. Ch. Pharm., xxx. 202); 2, Karsten (Arch. f. Bergb. u. Hütt., xv. 243); 3, Schnabel (Ramm. Min. Ch., 329); 4, Pisani (C. R., liii. 1020); 5, Kurlbaum (Am. J. Sci., II. xxiii. 423); 6, 7, Dumont (L'Institut, No. 276); 8, Delvaux (Bull. Acad. Brux., 1838, 147); 9, 10, Diesterweg (B. H. Ztg., xxii. 257):

	$\ddot{\text{P}}$	$\bar{\ddot{\text{Al}}}$	$\bar{\ddot{\text{Fe}}}$	$\bar{\ddot{\text{Mn}}}$	$\dot{\text{Fe}}$	$\dot{\text{H}}$
1. Haute Vienne	27·85	—	56·20	6·76	—	9·29=100 Vauquelin.
2. Siegen, *dark green*	27·72	—	63·45	—	—	8·56=99·73 Karsten.
3. " "	28·39	—	53·66	—	9·97	8 97=100·99 Schnabel.
4. Morbehan, "	28·53	4·50	54·40	—	—	12·40=99·83 Pisani.
5. Allentown, N. J. "	32·61	—	53·74	—	3·77	10·49, $\ddot{\text{Si}}$ 0·72=100·95 Kurlb
6. *Delvauxite*	16·04	—	34·20	—	—	49·76=100 Dumont.
7. "	16·57	—	36·62	—	—	48·81=100 Dumont.
8. "	18·20	—	40 44	—	—	41 13=99·77 Delvaux.
9. Siegen, *dark green*	27·71	—	62·02	—	0·25	10 90=100·88 Diesterweg.
10. " *red*	25·20	—	59·14	2·33	—	13·98=100·65 Diesterweg.

Church (Ch. News, x. 157) shows that dufrenite contains 10·55 p. c. of water, corresponding t the above formula; it loses no water at 100° C. He observes also that the mineral is usually so mixed with hematite that it is difficult to separate it for analysis.

Church also demonstrates (l. c., 145) that the *delvauxite* of Liege is only a *wet* dufrenite. It lost in his trial 20·33 p. c. over sulphuric acid, and nearly 6 p. c. more on heating to 100° C.; the total percentage of water having been found to be 37·23, whence the essential water is only 10–11 p. c., as in dufrenite. He detected a trace of lime. The color of delvauxite given is yellowish-brown to brownish-black or reddish, or that of altered dufrenite; and G.=1·85. An *altered* dufrenite gave Diesterweg (l. c.) $\overset{.....}{\bar{\text{P}}}$ 6·25, $\overset{...}{\bar{\text{Fe}}}$ 80·03, $\dot{\bar{\text{H}}}$ 14·03=100·34.

Pyr., etc.—Same as for vivianite, but less water is given out in the closed tube. B.B. fuses easily to a slag.

Obs.—Occurs near Anglar, Dept. of Haute Vienne, and at Hirschberg in Westphalia (the localities of the specimens, according to Dufrénoy, originally named *dufrenite*); at Rocheforten-Terre, Morbihan, France; Eisenfeld near Siegen. Also at Allentown, N. J., as a fibrous leek-green coating, sometimes half an inch thick, in the Green Sand formation; it changes to brown in altering to limonite.

The *delvauxene* is from Besnau, near Visé, in Belgium.

Named after the French mineralogist Dufrénoy.

GLOBOSITE. This name is given by Breithaupt (B. H. Ztg., xxiv. 321, 1865) to a mineral occurring at the Arme Hilfe mine near Hirschberg, in small globular concretions. H.=5—5·5. G.=2·825—2·827. Lustre greasy to adamantine. Color wax-yellow to yellowish-gray. Streak white. Brittle. Analysis on a small quantity of the mineral afforded Fritzsche (l. c.) $\overset{.....}{\bar{\text{P}}}$ 28·39, $\overset{.....}{\bar{\text{As}}}$ *tr.*, $\dddot{\text{Si}}$ 0·24, $\overset{...}{\bar{\text{Fe}}}$ 40·86, $\dot{\text{Cu}}$ 0·48, $\dot{\text{Mg}}$ 2·40, $\dot{\text{Ca}}$ 2·40, $\dot{\bar{\text{H}}}$ and F 23·94=100·05. B.B. in tube yields water; by stronger heat gives the fluorine reaction, depositing a ring of silica, and leaving a red residue not magnetic, but giving with fluxes the reaction for iron. Slowly soluble in muriatic acid. It occurs as above with massive and pulverulent limonite; also in the cobalt mine of Schneeberg in Saxony, with quartz and hypochlorite.

569. CACOXENITE. Kakoxen *J. Steinmann*, Vortr. Böhm. Ges., Prag, 1825. Cacoxene

Occurs in radiated tufts of a yellow or brownish-yellow color.

H.=3—4. G.=3·38. Becomes brown on exposure.

Comp.—Supposed to be an iron-wavellite. O. ratio, fr. anal. 3, 4, for $\overset{...}{\bar{\text{R}}}$, $\overset{.....}{\bar{\text{P}}}$, $\dot{\bar{\text{H}}}$=6 : 5 : 12, whence $\overset{...}{\bar{\text{Fe}}}{}^2\,\overset{.....}{\bar{\text{P}}}+12\,\dot{\bar{\text{H}}}$, from Richardson's analysis. Analysis 5 corresponds to $\overset{...}{\bar{\text{Fe}}}{}^3\,\overset{.....}{\bar{\text{P}}}{}^2+20\,\dot{\bar{\text{H}}}$. Analyses: 1, Steinmann (Leonh. Orykt., 750); 2, Holger (Baumg. ZS., viii. 129); 3, Richardson (Thomson's Min., i. 476); 4, 5, v. Hauer (Jahrb. G. Reichs. 1854, 67):

	$\overset{.....}{\bar{\text{P}}}$	$\overset{...}{\bar{\text{Fe}}}$	$\overset{...}{\bar{\text{Al}}}$	$\dot{\text{Ca}}$	$\dddot{\text{Si}}$	$\dot{\bar{\text{H}}}$. F
1. Zbirow	17·86	36·32	10·01	0·15	8·90	25·95=99·19 Steinmann.
2. "	9·20	36·83	11·29	——	3·30	18·98, $\dot{\text{Mg}}$ 7·58, $\dot{\text{Zn}}$ 1·23, $\dddot{\text{S}}$ 11·29 H.
3. "	20·5	43·1	——	1·1	2·1	30·2, $\dot{\text{Mg}}$ 0·9=97 9 Richardson.
4. " *fibrous yw.*	19·63	47·64	——	——	——	32·73=100 Hauer.
5. " *globular*	25·71	41·46	——	——	——	32·83=100 Hauer.

The alumina of the earlier analyses was from impurities.

Pyr., etc.—Yields water, with trace of fluorine. Fuses on the edges to a black shining slag and colors the outer flame bluish-green. Reactions for iron. Soluble in muriatic acid.

Obs.—Occurs at the Hrbeck mine, near Zbirow in Bohemia, along with earthy limonite Stated by Zepharovich to be sometimes derived from the alteration of *barrandite*.

570. ARSENIOSIDERITE. Arseniosiderite *Dufr.*, Ann. d. M., IV. ii. 348, 1842. Arseno krokit, Arsenocrocites, *Glocker*, Syn., 226, 1847.

In fibrous concretions of a yellowish-brown and somewhat golden color, resembling cacoxenite; the fibres large and easily separable between the fingers.

H.=1—2. G.=3·520, Dufr.; 3·88, Ramm. Lustre silky. Powder yellowish-brown, rather deeper in color than that of yellow ochre. When rubbed in a mortar the powder adheres to the pestle.

Comp.—$\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{As}}{}^{5}$, $\overset{\cdot\cdot\cdot}{\overline{\mathrm{Fe}}}{}^{8}$, $\dot{\mathrm{Ca}}{}^{6}$, $\dot{\mathrm{H}}{}^{15}$, or $\mathrm{Ca}^{6}\,\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{As}}+4\,\overset{\cdot\cdot\cdot}{\overline{\mathrm{Fe}}}{}^{2}\,\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{As}}+15\,\dot{\mathrm{H}}$=Arsenic acid 37·9, sesquioxyd of iron 42·1, lime 11·1, water 8·9=100. Analyses: 1, Dufrénoy (Ann. d. M., IV. ii. 343, 182); 2, 3, Rammelsberg (2d Suppl., 20, Pogg., lxviii. 508):

	$\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{As}}$	$\overset{\cdot\cdot\cdot}{\overline{\mathrm{Fe}}}$	$\overset{\cdot\cdot\cdot}{\overline{\mathrm{Mn}}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{K}}$	$\dot{\mathrm{H}}$
1.	34·26	41·31	1·29	8·43	0·76	8·75, $\dddot{\mathrm{Si}}$ 4·04=98·84 Dufrénoy.
2.	[39·16]	40·00	*tr.*	12·18	—	8·66=100 Rammelsberg.
3.	[37·36]	38·31	*tr.*	12·08	—	8·68, $\dddot{\mathrm{Si}}$ 3·57=100 Ramm.

According to Fournet, arseniosiderite is essentially cacoxene with the phosphoric acid replaced by arsenic acid, and having the corresponding formula $\overset{\cdot\cdot\cdot}{\overline{\mathrm{Fe}}}{}^{4}\,\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{As}}{}^{3}+18\,\dot{\mathrm{H}}$; but this exceeds the proportion of water by nearly one-half, and does not take into account the lime.

Pyr., etc.—Like scorodite.

Obs.—Occurs in a manganese bed at Romanêche, Department of Saone-et-Loire, France.

Named from *arsenic* and σίδηρος, *iron.* Changed to *arsenocrocite* (fr. κρόκη, *fibre*) by Glocker, because of a previous use of arsenosiderite (see p. 76).

571. EVANSITE. *D. Forbes*, Phil. Mag., IV. xxviii. 341, 1864.

Massive; reniform or botryoidal.

H.=3·5—4. G.=1·939. Lustre vitreous or resinous; internally waxy. Colorless, or milk-white; sometimes tinged with yellow or blue. Streak white. Translucent, subtranslucent. Fracture subconchoidal.

Comp.—O. ratio for $\overset{\cdot\cdot\cdot}{\overline{\mathrm{R}}}$, $\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{P}}$, $\dot{\mathrm{H}}$=9 : 5 : 18, whence $\overset{\cdot\cdot\cdot}{\overline{\mathrm{Al}}}{}^{2}\,\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{P}}+\overset{\cdot\cdot\cdot}{\overline{\mathrm{Al}}}\,\dot{\mathrm{H}}{}^{3}+15\,\dot{\mathrm{H}}$, Dana,=Phosphoric acid 18·4, alumina 39·7, water 41·9=100. Analysis: Forbes (l. c.):

	$\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{P}}$	$\overset{\cdot\cdot\cdot}{\overline{\mathrm{Al}}}$	$\dot{\mathrm{H}}$
($\frac{1}{3}$)	19·05	39·31	39·95, insol. 1·41=99·72 Forbes.

Pyr., etc.—B.B in tube yields neutral water, decrepitates, leaving milk-white powder. Infusible. Moistened with sulphuric acid colors the flame green. On charcoal with cobalt solution gives intense blue. With fluxes trace of iron. Soluble in sulphuric, nitric, and muriatic acids. Fluorine not detected.

Obs.—Occurs at Zsetcznik, Hungary, as reniform or globular concretions on brown hematite.

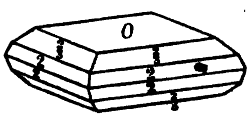
Brought in 1855 from Hungary, by Brooke Evans, of Birmingham, England, after whom it was amed. It was labelled allophane.

72. TORBERNITE. Mica viridis cryst. (fr. Joh.) *v. Born*, Lithoph., i. 42, 1772. Grüner Glimmer (fr. Saxony) *Wern.*, Ueb. Cronst., 217, 1780; Torberit *Wern.* (earliest name); *Karst.*, Ueb. Wern. Verbess., 43, 1793 [later spelt *Torbernit*, as in Ludwig's Wern., i. 308, 1803); Chalkolith [put near Chlorite] *Wern.*, Bergm. J., 376, 1789; Urankalk durch Kupfer gefärbt, Uranites spathosus pt., *Klapr.*, Schrift. Ges. N. Berl., ix. 273, 1789; Beitr., ii. 217, 1797. Uranglimmer *Wern.*, 1800, Ludwig, i. 55, 1803. Urane oxydé *H.*, Tr., 1801. Uranite *Aikin*, Min., 1814. Uran-Mica *Jameson*, Syst., 1820. Uranphyllit *Breith.*, Char., 1820. Phosphate of Uranium containing Phos. Copper *R. Phillips*, Ann. Phil., II. v. 57, 1823. Phosphate of Uranium and Copper *Berz.*, Jahresb., 1823. Kupfer-Uranit *Germ.* Copper-Uranite. Torberite *B. & M.*, 517, 1852. Cuprouranit *Breith.*, B. H. Ztg., xxiv. 302, 1865.

Tetragonal. $O \wedge 1\text{-}\bar{i}=134°\ 8'$; $a=1·03069$. Observed planes: O; rism, $i\text{-}i$; octahedral, $\frac{2}{3}$, $\frac{3}{5}$, 12, $2\text{-}i$. Forms square tables, with often replaced edges; rarely suboctahedral.

$O \wedge 2=108°\ 56'$	$1 \wedge 1$, basal,$=111°\ 6'$
$O \wedge 1=124\ \ 27$	$2 \wedge 2$, basal,$=142\ \ 8$
$O \wedge \frac{2}{3}=135\ \ 49$	$2 \wedge 2$, pyr.,$=96\ \ 3$
$O \wedge \frac{3}{5}=138\ \ 50$	$\frac{2}{3} \wedge \frac{2}{3}$, basal,$=88\ \ 21\frac{1}{2}$
$O \wedge 2\text{-}i=115\ \ 53$	$2\text{-}i \wedge 2\text{-}i$, basal,$=128\ \ 15$

486



Cornwall.

leavage: basal highly perfect, micaceous. Unknown massive or earthy

H.=2—2·5. G.=3·4—3·6. Lustre of *O* pearly, of other faces subadamantine. Color emerald- and grass-green, and sometimes leek-, apple-, and siskin-green. Streak somewhat paler than the color. Transparent—subtranslucent. Fracture not observable. Sectile. Laminæ brittle and not flexible. Optically uniaxial; double refraction negative.

Comp.—O. ratio for $\dot{\mathrm{R}}$, $\bar{\dddot{\mathrm{U}}}$, $\bar{\ddot{\mathrm{P}}}$, $\dot{\mathrm{H}}$=1 : 6 : 5 : 8; whence $\bar{\dddot{\mathrm{U}}}^2\bar{\ddot{\mathrm{P}}}+\dot{\mathrm{Cu}}\dot{\mathrm{H}}+7\dot{\mathrm{H}}$, Dana. Analyses: 1, R. Phillips (l. c.); 2, Berzelius (l. c.); 3, Werther (J. pr. Ch., xliii. 334); 4, Pisani (C. R., lii. 817); 5, Church (Ch. News, xii. 183):

	$\bar{\ddot{\mathrm{P}}}$	$\bar{\dddot{\mathrm{U}}}$	$\dot{\mathrm{Cu}}$	$\dot{\mathrm{H}}$
1. Cornwall	16·0	60·0	9·0	14·5=99·5 Phillips.
2. "	15·57	61·29	8·44	15·05=100·45 Berzelius.
3. "	14·34	59·03	8·27	15·39, $\ddot{\mathrm{S}}\mathrm{i}$ 0·49, earthy substance 0·41 Werther.
4. "	14·0	59·67	8·50	15·00, sand 0·40=97·57 Pisani.
5. "	13·94	61·00	8·56	14·16, $\bar{\ddot{\mathrm{A}}}\mathrm{s}$ 1·96, $\dot{\mathrm{C}}\mathrm{a}$ 0·62=100·24 Church.

Pyr., etc.—In the closed tube yields water. In the forceps fuses at 2·5 to a blackish mass, and colors the flame green. With salt of phosphorus gives a green bead, which with tin on charcoal becomes on cooling opaque red (copper). With soda on charcoal gives a globule of copper. Affords a phosphid with the sodium test. Soluble in nitric acid.

Obs.—Gunnis Lake formerly afforded splendid crystallizations of this species, and also Tincrof and Wheal Buller, near Redruth, and elsewhere in Cornwall. Found also at Johanngeorgenstadt, and Eibenstock and Schneeberg, in Saxony; in Bohemia, at Joachimsthal and Zinnwald; in Belgium, at Vielsalm. A variety from Providence in Cornwall is in 8-sided tables with a low pyramid, and has a leek-green color, with G.=3·329—3·372 (Breith., B. H. Ztg., xxiv. 303).

The angle *O* ∧ 2 is given by Mohs, Haidinger, and Naumann =108° 29′; by Hessenberg (Min. Not., vi. 41) 108° 38′; Kokscharof (Min. Russl., v. 35) 108° 56′; the mean of his measurements of Cornwall and Schlackenwald crystals being 108° 53′ 23″ and 71° 5′ 21″. Similar figures are given by Greg & Lettsom, Min., 384. The angles of B. & M. do not agree with any of the measurements.

First named *torberite* (*torbernite*) by Werner, after the chemist Torber Bergmann [*Lat.* Torbernus, as written by Bergmann himself]. Then, this naming after persons having been denounced as an innovation (see Karsten's Werner's Verbess., 43, 1793), Werner substituted *Chalcolite* (fr. χαλκός, *copper*, signifying, as he says, "ein Kupfer haltender Stein") in allusion to Bergmann's determination in 1780 that the mineral was muriate of copper. When, finally, it was shown by Klaproth to be an ore of uranium instead of copper, Werner, with Karsten and others, threw aside *chalcolite*, because false in signification, and used *Uranglimmer* (uran-mica). Chalcolite has since crept back again, but is no more appropriate now than it was sixty years ago. The name *torberite* was written as it should be, *torbernite*, by some mineralogists of last century.

Both this species and the autunite have gone under the common name of *uranite*; the former also as *Copper-uranite*, the latter *Lime-uranite*.

573. AUTUNITE. Var. of Uranglimmer, Urankalk, or Chalcolite, *of authors prior to* 1819. Sel à base de chaux, òu l'oxide d'urane joue le rôle d'acide, *Berz.*, N. Syst. Min., 295, 1819. Uranit *Berz.*, Jahresb., iv. 46, 1823. Kalk-Uranit *Germ.* Lime-Uranite. Autunite *B. & M.*, 519, 1852. Calcouranit *Breith.*, B. H. Ztg., xxiv. 302, 1865.

Orthorhombic; but form very nearly square, and crystals resembling closely those of torbernite. Cleavage: basal eminent, as in torbernite. *O* ∧ 2-ī=109° 6′, *O* ∧ 2-ĭ=109° 17′, 2-ĭ ∧ 2-ī=95° 52′, 2-ī ∧ 1 (plane on edge 2-ī/2-ĭ)=138° 30′, Descl. Planes 2-ī, 2-ĭ correspond to 2 of torbernite.

H.=2—2·5. G.=3·05—3·19. Lustre of *O* pearly; elsewhere subadamantine. Color citron- to sulphur-yellow. Streak yellowish. Translucent. Optically biaxial, Descl.

Comp.—O. ratio for $\dot{\mathrm{R}}$, $\bar{\dddot{\mathrm{U}}}$, $\bar{\ddot{\mathrm{P}}}$, $\dot{\mathrm{H}}$=1 : 6 : 5 : 8; whence $\bar{\dddot{\mathrm{U}}}^2\bar{\ddot{\mathrm{P}}}+\dot{\mathrm{Ca}}\dot{\mathrm{H}}+7\dot{\mathrm{H}}$, Dana,=Phosphoric acid 15·7, oxyd of uranium 62·7, lime 6·1, water 15·5=100. Analyses: 1, Berzelius (l. c.); 2, Pisani (C. R., lii. 817):

	$\bar{\ddot{\mathrm{P}}}$	$\bar{\dddot{\mathrm{U}}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Mg}}$, $\dot{\mathrm{Mn}}$	$\dot{\mathrm{Ba}}$	$\ddot{\mathrm{Sn}}$	$\dot{\mathrm{H}}$
1. Autun	15·20	61·73	5·88	0·20	1·57	0·06	15·48=100·12 Berzelius.
2. "	13·40	56·47	5·60	—	—	—	20·00=98·67 Pisani.

Pyr., etc.—Same as for torbernite, but no reaction for copper.

Obs.—Autunite is found usually with other ores of uranium, associated with silver, tin, and iron ores. Occurs in the Siebengebirge, in the hornstone of a trachytic range; at Johanngeorgenstadt and Eibenstock; at Lake Onega, Wolf Island, Russia; near Limoges, and at St. Symphorien near Autun; formerly at South Basset, Wheal Edwards, and near St. Day, England. Occurs sparingly at the Middletown (Ct.) feldspar quarry, associated with columbite and albite, in minute tabular crystals and thin scales, of light green and lemon-yellow colors; also in minute crystals at Chesterfield, Mass., on the quartz or albite, and sometimes in the red centres of tourmalines, and at Acworth, N. H., straw-yellow and light green; also in a gneiss quarry on the Schuylkill, near Philadelphia, about ½ m. above the suspension bridge.

Descloizeaux makes autunite to differ from torbernite (Ann. d. M., V. xiv. 1857) in being optically biaxial, and therefore orthorhombic; and the planes 2 of the latter thus become 2-ī and 2-ĭ, as they incline unequally to the base. The angles are still very closely the same, the pyramidal 95° 52′, being in torbernite 96° 6′, Kokscharof; 95° 52′, Hessenberg; 95° 46′, Haidinger. The species are at least closely isomorphous.

Berzelius calls the uranite of Cornwall and that of Autun, respectively, *chalcolite* and *uranite*, in his article announcing the composition, in Jahresb., iv. 146, 147, 1823; and the special application of *uranite* to this species dates from that time. Yet, in order to avoid confusion from the double use of the name, it is better to adopt for the species the name of *autunite*, from one of its noted localities.

FRITZSCHEITE *Breith.*, B. H. Ztg.; xxiv. 302, 1865. A mineral much resembling uranite in its four-sided quadratic (or nearly so) tables, with a perfect basal cleavage; with H.=2—2·5; G.=3·504?; vitreous to pearly in lustre; reddish-brown to hyacinth-red in color and streak; translucent; affording Fritzsche (l. c.) reactions for oxyd of uranium, protoxyd of manganese, vanadic acid, phosphoric acid, and water. The red color is attributed to the manganese, and it is considered a mangan-uranite containing some vanadic acid. It occurs with crystals of autunite and torbernite at Neuhammer, near Neudeck in Bohemia, in a hematite mine; at Johanngeorgenstadt, of fine red color, with torbernite. Red crystals in groups, supposed to be this mineral, have been observed on specimens of uranite from Autun, and from Steinig, near Elsterberg, in Saxon Voigtland. May it be an altered uranite?

574. AMPHITHALITE. Amfithalit *Igelström*, Œfv. Ak. Stockh., 1866, 93, B. H. Ztg., xxv. 309, 1866.

Massive. H.=6. Color milk-white. Subtranslucent.

O. ratio for $\dot{R}$, $\bar{\dddot{R}}$, $\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{P}}$, $\dot{H}$=1 : 10·25 : 7·5 : 5. Analysis: Igelström (l. c.):

$\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{P}}$	$\bar{\dddot{A}}l$	$\dot{M}g$	$\dot{C}a$	$\dot{H}$	
30·06	48·50	1·55	5·76	12·47=93·34	Igelström.

B.B. infusible. Insoluble in acids. Occurs in the quartzite of Horrsjöberg, Wermland, with lazulite, rutile, and cyanite. Named from ἀμφιθαλής, *becrowned*, since it usually occurs surrounded by other beautiful minerals, though unattractive itself.

574A. *Hydrous Phosphate of Alumina and Lime* Damour (L'Institut, 1853, 78). Compact, of a pale or dark brick-red color. Scratches glass feebly. G.=3·194. Supposed by Damour to be a hydrophosphate of alumina and lime. B.B. in a tube gives considerable water; and in a platinum crucible at a red heat loses 12·70 p. c. of water. Found in rolled pebbles with the diamond sand of Bahia.

574B. *Cupreous Phosphate of Alumina.* Domeyko (Min., 2d ed. 425) describes a mineral from San Lorenzo de la Ligna, Chili, occurring in a decomposed feldspathic rock, giving on analysis $\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{P}}$ 17·7, $\ddot{S}i$ 7·6, $\bar{\dddot{A}}l$ 46·3, $\dot{C}u$ 6·3, $\dot{F}e$ 3·3, $\dot{H}$ 18·8=100. Its color is a pale turquois-blue; structure compact, homogeneous, and so soft as to be scratched by the nail.

575. SPHÆRITE. Sphærit *v. Zepharovich*, Ber. Ak. Wien, lvi. 1867.

In globular concretions with a drusy faceted surface, without a distinct fibrous or concentric structure. Cleavage distinct in one direction.

H.=4. G.=2·536. Lustre greasy-vitreous, glimmering. Color light gray, more or less reddish or bluish, the red color from mixture with hematite. Translucent.

Comp.—O. ratio for $\dddot{\bar{\mathrm{Al}}}$, $\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{P}}$, $\dot{\mathrm{H}}=3:2:3\frac{1}{5}$; $\dddot{\bar{\mathrm{Al}}}{}^{5}\,\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{P}}{}^{2}+16\,\dot{\mathrm{H}}$=Phosphoric acid 26·1, alumina 47·4, water 26·5=100. Analyses: A, Boricky (l. c.); B, same, with $\ddot{\mathrm{Si}}$, $\dot{\mathrm{Ca}}$, $\dot{\mathrm{Mg}}$, and some $\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{P}}$ (for these bases) excluded:

	$\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{P}}$	$\dddot{\bar{\mathrm{Al}}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{H}}$	$\ddot{\mathrm{Si}}$
A.	(½) 28·58	42·36	2·60	1·41	24·03	0·87=99·85.
B.	26·80	46·71	—	—	26·49	—=100.

Pyr., etc.—Yields water. B.B. is infusible, and colors the flame bluish-green. With cobalt solution a fine blue.

Obs.—Occurs lining cavities or seams in hematite, at Zajecov, Bohemia, in Lower Silurian schists, along with wavellite.

Alt.—Becomes opaque white, dull, and earthy by alteration.

576. BORICKITE. Delvauxene (fr. Leoben) *v. Hauer*, Jahrb. G. Reichs. 1854, 68; (fr. Nenacovic) *Boricky*, Nat. ZS. Lotos, March, 1867. Borickite *Dana*.

Reniform massive. Compact, without cleavage.

H.=3·5. G.=2·696–2·707. Lustre weak waxy. Color reddish-brown. Streak the same as color. Opaque.

Comp.—O. ratio for $\dot{\mathrm{R}}+\dddot{\bar{\mathrm{R}}}$, $\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{P}}$, $\dot{\mathrm{H}}=3:2:3$, with $\dot{\mathrm{R}}:\dddot{\bar{\mathrm{R}}}=1:7$; $\dot{\mathrm{R}}=\dot{\mathrm{Ca}}$, $\dddot{\bar{\mathrm{R}}}=\dddot{\bar{\mathrm{Fe}}}$; $(\dddot{\bar{\mathrm{Fe}}}, \dot{\mathrm{Ca}}^{3})^{6}\,\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{P}}+15\,\dot{\mathrm{H}}$.

Analyses: 1, v. Hauer (l. c.); 2, Boricky (l. c.):

	$\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{P}}$	$\dddot{\bar{\mathrm{Fe}}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{H}}$
1. Leoben	(½) 20·49	52·29	—	8·16	19·06=100 Hauer.
2. Nenacovic	19·35	52·99	0·41	7·29	19·96=100 Boricky.

Pyr., etc.—Yields water. B.B. fuses easily to a black mass. Soluble in muriatic acid.

Obs.—From Leoben in Styria, and in a Lower Silurian schist at Nenacovic in Bohemia.

PHOSPHATES OR ARSENATES, COMBINED WITH SULPHATES.

580. DIADOCHITE. Diadochit *Breith.*, J. pr. Ch., x. 503, 1837. Phosphoreisensinter *Ramm.*

Reniform or stalactitic; structure curved lamellar.

H.=3. G.=2·035. Lustre resinous, inclining to vitreous. Color yellow or yellowish-brown. Streak uncolored. Fragile; fracture conchoidal.

Comp.—$\dddot{\bar{\mathrm{Fe}}}{}^{2}\,\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{P}}{}^{2}+2\,\dddot{\bar{\mathrm{Fe}}}\,\dddot{\mathrm{S}}{}^{3}+32\,\dot{\mathrm{H}}$=Phosphoric acid 14·3, sulphuric acid 16·2, sesquioxyd of iron 40·4, water 29·1=100. Analysis by Plattner (Ramm. 1st Suppl., 45):

$\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{P}}$ 14·811 $\dddot{\mathrm{S}}$ 15·145 $\dddot{\bar{\mathrm{Fe}}}$ 39·690 $\dot{\mathrm{H}}$ 30·344=100.

Near iron sinter (pitticite), with phosphoric acid in place of arsenic acid

Pyr., etc.—Yields much water in the closed tube, and swells up, becoming lustreless and opaque yellow; when ignited gives off sulphuric acid. B.B. in the forceps swells up and falls to powder, but carefully ignited fuses easily to a grayish-black slag, and colors the flame bluish-green. On charcoal affords a steel-gray magnetic globule. With soda affords metallic particles, and gives a sulphid which blackens silver. With borax and salt of phosphorus reacts for iron. Soluble in muriatic acid.

Obs.—From alum-slate near Gräfenthal and Saalfeld in Thuringia.

Named from διάδοχος, *a successor*, on the supposition that it is an iron sinter, in which phosphoric acid has replaced the arsenic acid.

581. PITTICITE. Eisenpecherz *Karsten* [not *Wern.*], Tab., 66, 98, 1808. Fer oxydé resinite *Haüy*, Tabl., 98, 1809. Pittizit *Hausm.*, Handb., 285, 1813. Eisensinter *Wern.*, Hoffm. Min., iii. b, 302, 1816; iv. b, 141, 1817; fr. Freiesleben G. Arb., v. 74, 261. Arseneisensinter *Germ.* Pitchy Iron Ore. Diarsenate of Iron. Sideretine *Beud.*, Tr., ii. 609, 1832 [not *Pittizite* Beud., p. 484]. Pitticit *Hausm.*, Handb., 1022, 1847.

Reniform and massive.

H.=2—3. G.=2·2—2·5. Lustre vitreous, sometimes greasy. Color yellowish and reddish-brown, blood-red and white. Streak yellow—white. Translucent—opaque.

Comp.—analyses afford varying results. O. ratio for $\not{\text{R}}$, $\dddot{\text{S}}$, $\dddot{\text{A}}\text{s}$, $\dot{\text{H}}$, from Stromeyer's analysis, approximately 6 : 3 : 5 : 15, whence $\not{\text{F}}\text{e}\,\dddot{\text{A}}\text{s}+\not{\text{F}}\text{e}\,\dddot{\text{S}}+15\,\dot{\text{H}}$=Arsenic acid 25·6, sulphuric acid 8·9, oxyd of iron 35·6, water 29·9=100; from the Schwarzenberg ore (No. 6) 12 : 9 : 10 : 24; whence Rammelsberg deduces $\not{\text{F}}\text{e}^3\,\dddot{\text{A}}\text{s}^2+\not{\text{F}}\text{e}\,\dddot{\text{S}}^3+24\,\dot{\text{H}}$; perhaps $2\,\not{\text{F}}\text{e}\,\dddot{\text{A}}\text{s}+3\,(\not{\text{F}}\text{e}, \dot{\text{H}}^3)\,\dddot{\text{S}}+21\,\dot{\text{H}}$; or $2\,\not{\text{F}}\text{e}\,\dddot{\text{A}}\text{s}+\not{\text{F}}\text{e}\,\dddot{\text{S}}^3+21\,\dot{\text{H}}+\not{\text{F}}\text{e}\,\dot{\text{H}}^3$:=Arsenic acid 26·0, sulphuric acid 13·6, oxyd of iron 36·1, water 24·3 =100. 1, Stromeyer (Gilb. Ann., lxi. 181); 2, Laugier (Ann. Ch., xxx. 325); 3, Kersten (Schw. J., liii. 176); 4, 5, Rammelsberg (Pogg., lxii. 139); 6, id. (5th Suppl., 102):

	$\dddot{\text{A}}\text{s}$	$\dddot{\text{S}}$	$\not{\text{F}}\text{e}$	$\not{\text{M}}\text{n}$	$\dot{\text{H}}$
1. Freiberg	26·06	10·14	33·10	0·64	29·26=99·09 Stromeyer.
2. "	20	14	35	*tr.*	30=99 Laugier.
3. "	30·25	——	40·45	——	28·50=99·20 Kersten.
4. Seiglitzstollen	24·67	5·20	54·66	——	15·47=100 Rammelsberg.
5. "	28·45	4·36	58·00	——	12·59=100 Rammelsberg.
6. Schwarzenberg	26·70	13·91	34·85	——	24·54=100 Rammelsberg.

Pyr., etc.—In the closed tube yields water, and at a high heat gives off sulphurous acid. In the forceps and on charcoal like scorodite. With soda on charcoal gives arsenical fumes and a sulphid which blackens silver.

Obs.—Occurs in old mines near Freiberg and Schneeberg in Saxony, and elsewhere. An ore on Hopkins's farm near Edenville, N. Y., is referred by Beck to this species.

For an iron-sinter without the sulphate, see under SCORODITE.

582. BEUDANTITE. *Levy*, Ann. Phil., II. xi. 194, 1826.

Rhombohedral. $R \wedge R$=91° 18′ (mean), Dauber. Occurring planes: O, 5, 10, R, −1, −2, $-\frac{5}{2}$, −4, −5; crystals modified acute rhombohedrons. Cleavage: basal, easy. Basal plane (O) flat, dull; R bright, curved.

H.=3·5—4·5. G.=4—4·3. Lustre vitreous. Subadamantine, resinous. Color dark to clear olive-green, yellowish-green, black, brown. Streak greenish-gray to yellow. Usually opaque, rarely transparent.

Var.—1. A mineral containing phosphoric acid, with little or no arsenic; the mineral from Cork and Dernbach. 2. Containing arsenic acid, with little phosphoric acid; mineral from Horhausen.

$R \wedge R$, in crystals from Cork, 91° 18′, Dauber; from Dernbach, 91° 9′, Dauber; from Horhausen, 92° 30′, Levy; 91° 48′, Dauber. The Cork crystals are black, brown, or green and opaque; G. =4·295, green, Ramm.; those of Dernbach, olive-green to yellowish-green, sometimes transparent, with H.=3·5, G.=4·0018, Sandberger. The Horhausen mineral was the *original* beudantite.

Comp.—Results varying much. Analyses: 1, Sandberger (Pogg., c. 611); 2, Rammelsberg (ib., 581); 3, 4, Percy (Phil. Mag., II. xxxvii. 161); 5, Sandberger (l. c.):

A. *Phosphatic variety.*

		$\dddot{\text{P}}$	$\dddot{\text{A}}\text{s}$	$\dddot{\text{S}}$	$\not{\text{F}}\text{e}$	$\dot{\text{P}}\text{b}$	$\dot{\text{C}}\text{u}$	$\dot{\text{H}}$
1. Dernbach	($\frac{2}{3}$)	13·22	*tr.*	4·61	44·11	26·92	*tr.*	11·44 Sandberger.
2. Cork, *green*	($\frac{2}{2}$)	8·97	0·24	13·76	40·69	24·05	2·45	9·77 Rammelsberg.

	$\ddot{\bar{\mathrm{P}}}$	$\ddot{\bar{\mathrm{As}}}$	$\dddot{\mathrm{S}}$	$\ddot{\bar{\mathrm{Fe}}}$	$\dot{\mathrm{Pb}}$	$\dot{\mathrm{H}}$
3. Horhausen	1·46	9·68	12·31	42·46	24·47	8·49=98·87 Percy.
4. "	*und.*	13·60	12·35	37·65	29·52	8·49=101·61 Percy.
5. "	2·79	12·51	1·70	47·28	23·43	[12·29]=100 Sandberger.

Pyr., etc.—Heated yields water. B.B, alone, the Cork crystals are infusible, but yield on charcoal fumes of sulphurous acid and afford a yellow slag, and with soda a kernel of lead; the Dernbach fuse easily on charcoal with intumescence to a globule of lead, mixed with a black hepatic slag; the Horhausen also fuse easily, affording a gray slaggy globule, and after long blowing the odor of arsenic.

Obs.—Occurs at the Glendone iron mine, near Cork, with quartz and limonite; at Dernbach, near Montabaur, in Nassau; at Horhausen, in Nassau, on limonite.

583. LINDACKERITE. Lindackerit *J. F. Vogl*, Jahrb. G. Reichs., iv. 552, 1853.

Orthorhombic. In oblong rhombohedral tables, grouped in rosettes, and in reniform masses.

H.=2—2·5. Lustre vitreous. Color verdigris- to apple-green. Streak paler to white.

Comp.—$2\,\dot{\mathrm{C}}\mathrm{u}^3\,\ddot{\bar{\mathrm{As}}}+\dot{\mathrm{N}}\mathrm{i}^3\,\dddot{\mathrm{S}}+7\,\dot{\mathrm{H}}$, Lindacker, who obtained (l. c.):

$\ddot{\bar{\mathrm{As}}}$ 28·58 $\dddot{\mathrm{S}}$ 6·44 $\dot{\mathrm{C}}\mathrm{u}$ 36·34 $\dot{\mathrm{N}}\mathrm{i}$ 16·15 $\dot{\mathrm{F}}\mathrm{e}$ 2·90 $\dot{\mathrm{H}}$ 9·32=99·73.

Pyr., etc.—B.B. on charcoal gives alliaceous fumes, and fuses to a black bead. With borax and salt of phosphorus a copper reaction. Soluble after long heating in muriatic acid, the solution giving a yellowish-brown precipitate with sulphuretted hydrogen.

Obs.—From Joachimsthal.

584. SVANBERGITE. Svanbergit *Igelström*, Œfv. Ak. Stockh., 1854, 156.

Rhombohedral. $R \wedge R$=90° 35′; $R \wedge 4\,R$ (occurring planes)=154° 30′, Dauber; $R \wedge R$=87½° to 88°, Breith., with other rhombohedrons of 95° 16′ and 82° 26′.

H.=5. G.=3·30; 2·571, Breith.; 3·29, Blomstrand. Lustre vitreous to adamantine. Color honey-yellow to yellowish-brown, reddish-brown, and rose-red. Streak reddish or colorless. Subtransparent.

Comp.—Analyses: 1, Igelström (l. c., and J. pr. Ch., lxiv. 252); 2, C. W. Blomstrand (priv. contrib., Dec. 8, 1867):

	$\ddot{\bar{\mathrm{P}}}$	$\dddot{\mathrm{S}}$	$\ddot{\bar{\mathrm{Al}}}$	$\ddot{\bar{\mathrm{Fe}}}$	$\dot{\mathrm{M}}\mathrm{n}$	$\dot{\mathrm{Pb}}$	$\dot{\mathrm{M}}\mathrm{g}$	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\mathrm{N}}\mathrm{a}$	$\dot{\mathrm{H}}$	Cl
1. Wermland	17·80	17·32	37·84	1·40	——	——	——	6·00	12·84	6·80	*tr.* Igelstr.
2. Westana	15·70	15·97	34·95	0·73	*tr.*	3·82	0·24	16·59	——	12·21	—=100·21 Bl.

Blomstrand's analysis gives the O. ratio for $\dot{\mathrm{R}}$, $\ddot{\bar{\mathrm{R}}}$, $\dddot{\mathrm{S}}$, $\ddot{\bar{\mathrm{P}}}$, $\dot{\mathrm{H}}$=3 : 9 : 5¼ : 5 : 6; taking it at 3 : 9 : 6 : 5 : 6, it affords the formula $(\frac{1}{2}\,\dot{\mathrm{C}}\mathrm{a}^3+\frac{1}{2}\,\ddot{\bar{\mathrm{Al}}})^2\,\ddot{\bar{\mathrm{P}}}+2\,\ddot{\bar{\mathrm{Al}}}\,\dddot{\mathrm{S}}+6\,\dot{\mathrm{H}}$=Phosphoric acid 16·0, sulphuric acid 18·0, alumina 34·9, lime 18·9, water 12·2=100. Taking the ratio at 3 : 9 : 5 : 5 : 6, it corresponds to the formula $3\,(\frac{1}{2}\,\dot{\mathrm{C}}\mathrm{a}^3+\frac{1}{2}\,\ddot{\bar{\mathrm{Al}}})^2\,\ddot{\bar{\mathrm{P}}}+5\,\ddot{\bar{\mathrm{Al}}}\,\dddot{\mathrm{S}}+\ddot{\bar{\mathrm{Al}}}\,\dot{\mathrm{H}}^3+15\,\dot{\mathrm{H}}$.

Igelström's analysis affords approximately 3 : 9 : 5 : 5 : 3, and the same formula as the last, excepting 6 $\dot{\mathrm{H}}$ in place of 15 $\dot{\mathrm{H}}$. But it differs widely in the protoxyds, it containing much soda (determined by the loss?), and comparatively little lime.

Pyr., etc.—In a tube acid water. B.B. on coal fuses only on the thinnest edges; with soda in reducing flame a red hepatic mass, which becomes green with water and yields sulphuretted hydrogen with dilute acid. With borax, an iron-colored glass. With cobalt solution a fine blue. But little acted upon by acids.

Obs.—From Horrsjöberg in Wermland, occurring with lazulite, cyanite, pyrophyllite, damourite, hematite, etc. It is near beudantite in crystallization.

585. **FICINITE** *Bernhardi*, Worterb. d. Nat. gesch., iv. 574, Weimar, 1827, Glocker's Min., 556 1831; *Kenngott*, Min. Not., No. xi, and Ueb. 1854, 441, 1859, 32.

Monoclinic, with one perfect cleavage, and a second inclined 129° to the other, both parallel to the orthodiagonal.

H.=5–5·5. G.=3·4–3·53. Lustre waxy or pearly, weak. Color black. Subtranslucent.

Analysis by Ficinus (l. c.): $\overset{\cdot\cdot}{\bar{\text{P}}}$ 12·82, $\dddot{\text{S}}$ 4·07, $\dot{\text{F}}\text{e}$ 58·85, $\dot{\text{M}}\text{n}$ 6·82, $\dot{\text{C}}\text{a}$ 0·17, $\ddot{\text{S}}\text{i}$ 0·17, $\dot{\text{H}}$ 16·87. B.B. fuses to a semimetallic slag, which is magnetic. In acids hardly attacked.

Found at Bodenmais, with garnet, iolite, etc. Also reported as occurring at the Gottesgab mine near Bodenmais, in crystals.

HYDROUS ANTIMONATES.

586. BINDHEIMITE. Blei-Niere (fr. Nertschinsk) *Karst.*, Tab., 50, 77, 78, 1800 (citing anal. by *Bindheim*, Schrift. Ges. Nat. Fr. Berlin, x. 374, 1792). Antimonate of Lead. Antimonblei-spath, Antimonsaures Bleioxyd, *Germ.* Stibiogalenit *Glock.*, Syn., 257, 1847. Bleinerite *Nicol*, Min., 383, 1849.

Amorphous, reniform, or spheroidal; also earthy or incrusting. Structure sometimes curved lamellar.

H.=4. G.=4·60–4·76, Siberia, Hermann; 5·05, white, Cornwall, Heddle; 4·707, brown, ib., Heddle. Lustre resinous, dull, or earthy. Color white, gray, brownish, yellowish. Streak white to grayish or yellowish. Opaque to translucent.

Comp.—$\dot{\text{P}}\text{b}^3\ \overset{\cdot\cdot}{\ddot{\text{S}}}\text{b}+4\ \dot{\text{H}}$, Siberian mineral, Hermann; $\dot{\text{P}}\text{b}^2\overset{\cdot\cdot}{\ddot{\text{S}}}\text{b}+2\frac{1}{2}\ \dot{\text{H}}$, Horhausen, Ramm.; $\dot{\text{P}}\text{b}^3\ \overset{\cdot\cdot}{\ddot{\text{S}}}\text{b}^2+10\ \dot{\text{H}}$, Cornwall, Heddle, anal. 4, 6; the true nature not fully understood.

Analyses: 1, Hermann (J. pr. Ch., xxxiv. 179); 2, C. Stamm (Pogg., c. 618); 3–5, Heddle (Phil. Mag., IV. xii. 126, Greg & Letts. Min., 373); 6, Percy (ib.):

	$\overset{\cdot\cdot}{\ddot{\text{S}}}\text{b}$	$\dot{\text{P}}\text{b}$	$\dot{\text{H}}$	$\dddot{\text{F}}\text{e}$	$\dot{\text{C}}\text{a}$	$\overset{\cdot\cdot}{\ddot{\text{A}}}\text{s}$
1. Nertschinsk	31·71	61·38	6·46	—	—	—=100 Hermann.
2. Horhausen	41·13	48·84	5·43	3·35	*tr.*	*tr.*, $\dot{\text{C}}\text{u}$ 0·84=99·59 Stamm.
3. Cornwall, *white*	42·22	47·04	11·50	—	—	—=100·76 Heddle.
4. " "	42·44	46·68	11·98	—	—	—=101·10 Heddle.
5. " *brown*	46·70	43·94	6·46	1·44	1·34	*tr.*=99·88 Heddle.
6. "	47·36	40·73	11·91	—	—	—=100 Percy.

Pfaff early found in the Nertschinsk mineral (Schw. J., xxvii. 1) $\overset{\cdot\cdot}{\ddot{\text{S}}}\text{b}$ 43·96, $\overset{\cdot\cdot}{\ddot{\text{A}}}\text{s}$ 16·42, $\dot{\text{P}}\text{b}$ 33·10, $\dddot{\text{F}}\text{e}$ 0·24, $\dot{\text{C}}\text{u}$ 3·24, $\ddot{\text{S}}\text{i}$ 2·34, $\dddot{\text{S}}$ 0·62, Fe, Mn, etc., 3·32=103·28. Bindheim (l. c.) made it to contain $\overset{\cdot\cdot}{\ddot{\text{A}}}\text{s}$ 25, $\dot{\text{P}}\text{b}$ 35, $\dddot{\text{F}}\text{e}$ 14, $\dot{\text{H}}$ 10, $\ddot{\text{S}}\text{i}$, $\dddot{\text{A}}\text{l}$ 9, Ag 1·15=95·15.

Pyr., etc.—In the closed tube gives off water. B.B. on charcoal reduced to a metallic globule of antimony and lead, coating the charcoal white at some distance from the assay, and yellow nearer to it.

Obs.—A result of the decomposition of other antimonial ores.

From Nertschinsk in Siberia; Horhausen; near Endellion in Cornwall, with jamesonite, from which it is derived.

Bleinierite is German for *Lead-kidney-ite!* and *Stibiogalenite* implies the presence of galena or sulphid of lead; hence the substitute above after the earliest analyst of the species.

B. NITRATES.

590. NITRE	$\dot{\text{K}}\ \overset{\cdot\cdot}{\ddot{\text{N}}}$	$\text{N}\,\Theta_2\vert\Theta\ \vert\text{K}$
591. SODA NITRE	$\dot{\text{N}}\text{a}\ \overset{\cdot\cdot}{\ddot{\text{N}}}$	$\text{N}\,\Theta_2\vert\Theta\ \vert\text{Na}$
592. NITROCALCITE	$\dot{\text{C}}\text{a}\ \overset{\cdot\cdot}{\ddot{\text{N}}}+\dot{\text{H}}$	$(\text{N}\,\Theta_2)_2\vert\Theta_2\vert\text{Ca}+\text{aq}$
593. NITROMAGNESITE	$\dot{\text{M}}\text{g}\ \overset{\cdot\cdot}{\ddot{\text{N}}}+n\ \dot{\text{H}}$	$(\text{N}\,\Theta_2)_2\vert\Theta_2\vert\text{Mg}+n\ \text{aq}$

590. NITRE. Nitrate of Potash. Saltpetre. Salpeter *Germ.* Kalisalpeter *Hausm*, Handb., 849, 1813. Potasse nitratée.

Orthorhombic. $I \wedge I = 118° 50'$, $O \wedge 1\text{-}\bar{i} = 130° 8'$; $a : b : c = 1{\cdot}1861 : 1 : 1{\cdot}692$. $1\text{-}\breve{i} \wedge 1\text{-}\breve{i}$, top, $= 109° 57'$, $2\text{-}\breve{i} \wedge 2\text{-}\breve{i}$, ib., $= 71°$ at 19° C., and 71° 44′ at 100° C., B. and M. Generally in thin crusts, silky tufts, and delicate acicular crystallizations.

H.=2. G.=1·937. Lustre vitreous. Streak and color white. Subtransparent. Brittle. Taste saline and cooling.

Comp.—$\dot{K}\,\ddot{\bar{N}}$=Nitric acid 53·4, potash 46·6=100. Klaproth obtained for an African specimen (Beitr., i. 317) Nitrate of potash 42·55, sulphate of lime 25·54, chlorid of calcium 0·20, carbonate of lime 30·40=98·60.

Pyr., etc.—Deflagrates vividly on burning coals, and detonates with combustible substances. Colors the flame violet (potash). Dissolves easily in water; not altered by exposure.

Obs.—Found generally in minute needle-form crystals, and crusts on the surface of the earth, on walls, rocks, etc. It forms abundantly in certain soils in Spain, Egypt, and Persia, especially during hot weather succeeding rains. Also manufactured from soils where other nitrates (nitrate of lime or soda) form in a similar manner, and beds called *nitriaries* are arranged for this purpose in France, Germany, Sweden, Hungary, and other countries. Refuse animal matter, also, putrified in calcareous soils, gives rise to the nitrate of lime. Old plaster, lixiviated, affords about 5 p. c. of nitre. In India it is obtained in large quantities for the arts.

Nitre requires for its formation dry air and long periods without rain; the potash comes mainly from the debris of feldspathic rocks in the soil. The oxydation of the nitrogen of the air is promoted by organic matters; hence the nitre is generally associated with azotized decomposed organic substances. A nitre crust from the vicinity of Constantine, Algeria, afforded $\dot{K}\,\ddot{\bar{N}}$ 86·00, $\dot{Ca}\,\ddot{\bar{N}}$ and $\dot{Mg}\,\ddot{\bar{N}}$ 3·00, Na Cl 6·00, $\dot{H}$ 3·50, insol., etc., 1·50=100, Boussingault.

In Madison Co., Kentucky, it is found scattered through the loose earth covering the bottom of a large cave. Also in other caverns in the Mississippi valley. Those of Tennessee, along the limestone slopes and in the gorges of the Cumberland table-land, afford it abundantly.

Nitre, according to Frankenheim, is dimorphous, like carbonate of lime; one form *prismatic* (aragonite-like), the other *rhombohedral* (calcite-like). The prismatic is the normal one between −10° C. and 300° C.; and between these temperatures the rhombohedral is easily transformed into the prismatic through the presence of some foreign substance. Above 300° the rhombohedral is the normal one, the prismatic here changing to it, and retaking again its form on a diminution of temperature (Pogg., xcii. 354).

591. SODA NITRE. Soude nitratée native *M. de Rivero*, Ann. d. M., vi. 596, 1821. Nitrate of Soda. Soda Nitre. Nitre cubique. Natron-Salpeter *Leonh.*, Handb., 246, 1826. Nitratin *Haid.*, Handb., 1835.

Rhombohedral. $R \wedge R = 106° 33'$; $a = 0{\cdot}8276$. Cleavage: rhombohedral, perfect. In efflorescences; also massive, granular.

H.=1·5—2. G.=2·09—2·29; 2·290, Tarapaca, Hayes. Lustre vitreous. Color white; also reddish-brown, gray, and lemon-yellow. Transparent. Rather sectile. Fracture indistinctly conchoidal. Taste cooling. Crystals strongly doubly refracting.

Comp.—$\dot{Na}\,\ddot{\bar{N}}$=Nitric acid 63·5, soda 36·5=100. Hochstetter obtained from the Chilian mineral (v. Leonh., 1846, 235) $\dot{Na}\,\ddot{\bar{N}}$ 94·291, Na Cl 1·990, $\dot{K}\,\dddot{S}$ 0·239, $\dot{K}\,\ddot{\bar{N}}$ 0·426, $\dot{Mg}\,\ddot{\bar{N}}$ 0·858, insol. 0·203, $\dot{H}$ 1·993.

Pyr., etc.—Deflagrates on charcoal with less violence than nitre, causing a yellow light, and also deliquesces. Colors the flame intensely yellow. Dissolves in three parts of water at 60° F.

Obs.—In the district of Tarapaca, northern Chili, the dry pampa for 40 leagues, at a height of 3,300 feet above the sea, is covered with beds of this salt several feet in thickness, along with gypsum, common salt, glauber salt, and remains of recent shells, the last indicating the former presence of the sea. De Rivero, l. c.; J. H. Blake, Am. J. Sci., xxxix. 375, 1840.

A. A. Hayes obtained from masses collected by Mr. Blake, Nitrate of soda 64·98, sulphate of soda 3·00, common salt 28·69, iodids 0 63, shells and marl 2·60=99·90.

In 1837, 150,900 quintals of this salt refined were shipped from Yquique; in 1866, 1,000,000 quintals. It is used for the manufacture of nitric acid and nitre.

O ∧ $\frac{2}{3}$-2 in soda nitre equals nearly *O* ∧ $\frac{2}{3}$ in apatite.

92. NITROCALCITE. Kalksalpeter *Haus.*, Handb., 1813. Nitrate of lime. Chaux nitratée. Nitrocalcite *Shep.*, Min., ii. 84, 1835. Calcinitre *Huot*, Min., ii. 430, 1841.

In efflorescent silken tufts and masses. Color white or gray. Taste sharp and bitter.

Comp.—$\dot{\mathrm{C}}\mathrm{a}\,\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{N}}+\dot{\mathrm{H}}$=Nitric acid 59·4, lime 30 7, water 9·9=100.

Pyr., etc.—On burning coals it slowly fuses with a slight detonation, and dries. Very deliquescent before, but not after, being desiccated by heat.

Obs.—It occurs in silky efflorescences, in many limestone caverns, as those of Kentucky. The salt forms in covered spots of earth, where the soil is calcareous, and is extensively used in the manufacture of saltpetre. According to Hausmann, a large part of the so-called nitre in nature is this salt.

593. NITROMAGNESITE. Nitrate of Magnesia *Beud.*, Tr., ii. 384, 1832. Nitromagnesite *Shep.*, Min., ii. 85, 1835. Magnesinitre *Huot*, Min., ii. 431, 1841. Magnésie nitratée. Magnesiasalpeter.

In efflorescences. White. Taste bitter.

Comp.—The salt contains, when pure and anhydrous, nitric acid 72·3, magnesia 27·7.

Obs.—From limestone caves, along with nitrocalcite.

The existence of this species as a natural product has not yet been clearly made out.

4. BORATES.

Boric acid occurs in but few minerals; viz., Datolite, Danburite, Axinite, and Tourmaline, with the following. It is a remarkable fact that in all of them, as far as known, the crystallization is either hemihedral or oblique. Boracite and Rhodizite are hemihedral isometric; Tourmaline hemihedral rhombohedral; Datolite is monoclinic; while Danburite and Axinite are triclinic. In Tourmaline and Axinite boric acid acts the part of a base.

ARRANGEMENT OF THE SPECIES.

1. O. ratio for bases and acid 1 : 1.

94. **Sassolite**	$\dot{\mathrm{H}}^3\,\overset{\cdots}{\overline{\mathrm{B}}}$	$\mathrm{B}\vert\Theta_3\vert\mathrm{H}_3$
95. **Szaibelyite**	$(\frac{5}{6}\,\dot{\mathrm{M}}\mathrm{g}+\frac{1}{6}\,\dot{\mathrm{H}})^3\,\overset{\cdots}{\overline{\mathrm{B}}}+\frac{1}{6}\,\dot{\mathrm{H}}$	$\mathrm{B}_2\vert\Theta_6\vert(\frac{1}{6}\,\mathrm{H}_2+\frac{5}{6}\,\mathrm{Mg})_3+\frac{1}{6}\,\mathrm{aq}$
96. **Hydroboracite**	$(\frac{1}{2}\,(\dot{\mathrm{C}}\mathrm{a},\,\dot{\mathrm{M}}\mathrm{g})^3+\frac{1}{2}\,\dot{\mathrm{H}}^3)\,\overset{\cdots}{\overline{\mathrm{B}}}$	$\mathrm{B}_2\vert\Theta_6\vert(\frac{1}{2}\,\mathrm{H}_2+\frac{1}{2}\,(\Theta\mathrm{a},\,\mathrm{Mg}))_3$

2. O. ratio for bases and acid 1 : 4.

97. **Boracite**	$\dot{\mathrm{M}}\mathrm{g}^3\,\overset{\cdots}{\overline{\mathrm{B}}}{}^4+\frac{1}{3}\,\mathrm{Mg\,Cl}$	$\mathrm{B}_8\Theta_9\vert\Theta_6\vert\mathrm{Mg}_3+\frac{1}{3}\,\mathrm{Mg\,Cl}_2$
98. **Rhodizite**		

3. O. ratio for bases and acid 1 : 6 or 1 : 12; part or all of the water probably basic, and thus, rationally, 1 : 8.

599. **Borax**	$(\frac{1}{2}\dot{N}a+\frac{1}{2}\dot{H})\dddot{B}+4\frac{1}{2}\dot{H}$	$B\Theta\|\Theta\|(\frac{1}{2}H+\frac{1}{2}Na)+2\frac{1}{4}aq$
600. **Bechilite**	$(\frac{1}{2}\dot{C}a+\frac{1}{2}\dot{H})\dddot{B}+1\frac{1}{2}\dot{H}$	$(B\Theta)_2\|\Theta_2\|(\frac{1}{2}H_2+\frac{1}{2}\bar{C}a)+1\frac{1}{2}aq$
601. **Howlite**	$(\frac{1}{2}\dot{C}a+\frac{1}{2}\dot{H})\dddot{B}+\frac{2}{3}\dot{H}$ $+\frac{1}{6}[(\frac{1}{2}\dot{C}a^3+\frac{1}{2}\dddot{B})^2\ddot{S}i^3]$	$(B\Theta)_2\|\Theta_2\|(\frac{1}{2}H_2+\frac{1}{2}\bar{C}a)+\frac{2}{3}aq$ $+Q$
602. **Ulexite**	$(\frac{1}{6}\dot{N}a+\frac{2}{6}\dot{C}a+\frac{3}{6}\dot{H})\dddot{B}+2\frac{1}{2}\dot{H}$	$(B\Theta)_2\|\Theta_2\|(\frac{3}{6}H_2+\frac{1}{6}Na_2+\frac{2}{6}\bar{C}a)+2\frac{1}{2}aq$
603. **Cryptomorphite**	$(\frac{1}{5}\dot{N}a+\frac{3}{5}\dot{C}a+\frac{1}{5}\dot{H})\dddot{B}+\dot{H}$	$(B\Theta)_2\|\Theta_2\|(\frac{1}{5}H_2+\frac{1}{5}Na_2+\frac{3}{5}\bar{C}a)+aq$
604. **Larderellite**	$(\frac{1}{4}NH^4O+\frac{3}{4}\dot{H})\dddot{B}+\frac{1}{4}\dot{H}$	$B\Theta\|\Theta\|\frac{3}{4}H+\frac{1}{4}Am)+\frac{1}{8}aq$
605. **Lagonite**	$\dddot{\bar{F}}e\dddot{B}^3+3\dot{H}$	$(B\Theta)_2\|\Theta_2\|\beta\bar{F}e+aq$

Appendix.—606. **Warwickite** $\dddot{B}$, $\ddot{T}i$, $\dot{M}g$, $\dot{F}e$

594. SASSOLITE. Sale sedativo naturale *U. F. Hoefer*, Memoria, Firenze, 1778; *Mascagni*, Mem. Soc. Ital., viii. 487. Native Sedative Salt. Acidum boracis, *vulgo* Sal sedativum, *Bergm.*, Sciagr., 1782. Native Boracic Acid *Kirw.*, 1796. Sassolin *Karst.*, Tab., 40, 75, 1800. Aci boracique *Fr.* Boric Acid.

Triclinic. $I \wedge I' = 118^\circ\ 30'$, $O \wedge I = 95^\circ\ 3'$, $O \wedge I' = 80^\circ\ 33'$, B. & M. Twins: composition-face *O*. Cleavage: basal very perfect. Usually in small scales, apparently six-sided tables, and also in stalactitic forms, com-posed of small scales.

H.=1. G.=1·48. Lustre pearly. Color white, except when tinged yellow by sulphur; sometimes gray. Feel smooth and unctuous. Taste acidulous, and slightly saline and bitter.

Comp.—$\dot{H}^3\dddot{B}$=Boric acid 56·4, water 43·6=100. The native stalactitic salt, according t Klaproth (Beitr., iii. 97), contains, mechanically mixed, sulphate of magnesia and iron, sulphate of lime, silica, carbonate of lime, and alumina.

Pyr., etc.—In the closed tube gives water. B.B. on platinum wire fuses to a clear glass an tinges the flame yellowish-green. Some specimens react for sulphur or ammonia in the close tube. Soluble in water and alcohol. Dissolves in 2·97 parts of water at 100° C., and 10·7 part at 50° C.

Obs.—This long known compound, the *Sal sedativum Hombergii*, was first detected in natur by Hoefer in the waters of the Tuscan lagoons of Monte Rotondo and Castelnuovo, and afterwar in the solid state at Sasso by Mascagni. The hot vapors of the lagoons consist largely of bori acid. To collect it the vapors are made to pass through water, which absorbs the boric acid; th waters are then evaporated by means of the steam from the springs. They yield seven to eigh thousand pounds troy per day. These lagoons spread over a surface of about 30 miles; and i the distance, clouds of vapor are seen rising in large volumes among the mountains. The crud borax contains 20 p. c. or more of impurities, among which Wittstein and Payen found 13· p. c. of sulphates (the most abundant, sulph. ammonia 8·5 p. c., sulph. magnesia 2·6 p. c.).

Exists also in other natural waters, as at Wiesbaden; Aachen; Krankenheil near Fölz; Clea Lake, in Lake Co., California; and it has been detected in the waters of the ocean.

Occurs also abundantly in the crater of Vulcano, one of the Lipari isles, forming a layer o sulphur, and about the fumaroles, where it was discovered by Dr. Holland in 1813.

Kenngott states that artificial crystals are *monoclinic*; with $I \wedge I = 118^\circ\ 4'$, $I \wedge i\text{-}\bar{\imath} = 120^\circ\ 59'$ and twinned parallel to $i\text{-}\bar{\imath}$ (Ber. Ak. Wien, xii. 26).

595. SZAIBELYITE. Szaibelyit *K. F. Peters*, Ber. Ak. Wien, xliv. 143, June, 1861.

In small nodules bristled with acicular crystals.

H.=3–4. G.=3. Color white outside, yellow within. Streak whit Translucent. Optically biaxial.

Comp.—O. ratio for $\dot{Mg}$, $\dddot{B}$, $\dot{H}=15:18:4$; formula $3\,\dot{Mg}^5\dddot{B}^2+4\,\dot{H}$, Stromeyer; or, if part of this water be basic, $(\frac{5}{6}\,\dot{Mg}+\frac{1}{6}\,\dot{H})^3\dddot{B}+\frac{1}{6}\,\dot{H}$.

Analyses: 1, 2, Stromeyer (Ber. Ak. Wien, xlvii. 347); 3, Sommaruga (ib., xlviii. 548):

	$\dddot{B}$	$\dot{Mg}$	$\dot{H}$	Cl	$\bar{F}e$	$\ddot{Si}$
1. *Needles*	36·66	52·49	6·99	0·49	1·66	0·20=98·49 Strom.
2. *Kernels*	34·60	49·44	12·37	0·20	3·20	——=99·81 Strom.
3. *Needles*	37·38	53·25	6·77	0·51	1·78[a]	0·31=100 Sommaruga.

[a] 2 Fe^2O^3, 3 H O.

Anal. 1 and 3 afford, after separating impurities, the iron as $\bar{F}e^2\dot{H}^3$:

$\dddot{B}$	$\dot{Mg}$	$\dot{H}$
38·35	54·65	7·00
38·38	54·67	6·95

Pyr., etc.—Yields water. B.B. splits open, glows, and fuses to a pale, hornlike, brownish-gray mass, coloring the flame yellowish-red.

Obs.—Occurs in kernels imbedded in a gray granular limestone at Werksthal in southeastern Hungary.

Named after Szajbelyi, who collected the limestone containing it.

596. HYDROBORACITE. *G. Hess*, Pogg., xxxi. 49, 1834. Hydrous Borate of Lime and Magnesia.

Resembles fibrous and foliated gypsum.

H.=2. G.=1·9—2. Color white, with spots of red from iron. Thin plates translucent.

Comp.—$\dot{Ca}^3\dddot{B}^4+\dot{Mg}^3\dddot{B}^4+18\,\dot{H}=(\frac{1}{2}\,\dot{Ca}+\frac{1}{2}\,\dot{Mg})^3\dddot{B}^4+9\,\dot{H}$; or, making the water basic, $(\frac{1}{2}\,\dot{H}+\frac{1}{2}(\dot{Ca},\dot{Mg}))^3\dddot{B}$;=Boric acid 47·8, lime 14·3, magnesia 10·2, water 27·7=100. Analyses by Hess (Pogg., xxxi. 49):

	$\dddot{B}$	$\dot{Ca}$	$\dot{Mg}$	$\dot{H}$
1.	49·92	13·30	10·43	26·33=100.
2.	49·22	13·74	10·71	26 33=100.

Pyr., etc.—B.B. fuses to a clear glass, tinging the flame slightly green, and not becoming opaque. In a matrass affords water. Somewhat soluble in water, and yielding a slightly alkaline reaction. Dissolves easily in muriatic and nitric acids.

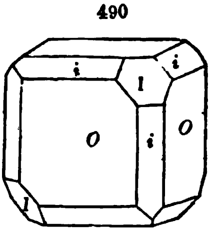
Obs.—Hydroboracite was first observed by Hess, in a collection of Caucasian minerals. The specimen was full of holes filled with clay, containing different salts. It may be mistaken for gypsum, but is readily distinguished by its fusibility.

597. BORACITE. Kubische Quarz-Krystalle (fr. Lüneburg) *Lasius*, Crell's Ann., ii. 333, 1787. Lüneburger Sedativ-Spath *Westrumb*, Kl. phys.-ch. Abh., iii. 167, 1789. Borazit *Wern.*, Bergm. J., 1789, 393, 1790, 234. Borate of Magnesia. Magnésie boratée *Fr.* Parasit *O. Volger*, Pogg., xcii. 77, 1854. Massive Boracite of Stassfurt=Stasfurtit *G. Rose*, Pogg., xcvii. 632, 1856.

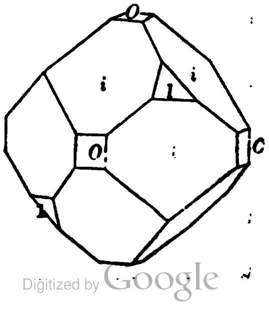
Isometric; tetrahedral. Figs. 1, 29, 30, and the annexed. Observed planes as in the figures, with also 2-2, 5-$\frac{5}{3}$, on alternate angles only. Cleavage: octahedral, in traces. Cubic faces sometimes striated parallel to alternate pairs of edges, as in pyrite.

H.=7, in crystals; 4·5, massive. G.=2·974, Haidinger; 2·9134, massive, Karsten. Lustre vitreous, in-

490



491



clining to adamantine. Color white, inclining to gray, yellow, and green Streak white. Subtransparent—translucent. Fracture conchoidal, uneven Pyroelectric, and polar along the four octahedral axes.

Var.—1. *Ordinary.* In crystals. 2. *Massive,* with sometimes a subcolumnar structure; *Stassfurtite* of Rose. It resembles a fine-grained white marble or granular limestone. *Parasite* of Volger is the plumose interior of some crystals of boracite.

Comp.—$\dot{Mg}^3 \ddot{B}^4 + \frac{1}{2}$ Mg Cl=Boric acid 62·6, magnesia 26·8, chlorid of magnesium 10·6=100 Analyses: A. of crystals: 1, Stromeyer (Gilbert's Ann., xlviii. 215); 2, Arfvedson (Ak. H. Stockh., 1822, 92); 3, Rammelsberg (Pogg., xlix. 445); 4, Weber (Pogg., lxxx. 282); 5, 6, Potyka (Pogg., cvii. 433); 7, 8, Siewert and Geist (J. pr. Ch., lxxvii. 338).

B. Of Massive Boracite or Stassfurtite: 1, Karsten (Pogg., lxx. 557, 1847); 2, C. F. Chandler (Inaug. Diss.); 3, Siewert & Drenkham (ZS. Nat. Ver. Halle, xi. 365); 4, H. Ludwig (Arch. Pharm., II. xcvi. 129); 5, Heintz (J. pr. Ch., lxxvi. 243); 6, Potyka (Pogg., cvii. 433); 7, Kromayer (Arch. Pharm., II. xcviii. 139):

				$\ddot{B}$	$\dot{Mg}$	$\ddot{Fe}$	MgCl	$\dot{H}$	
A. 1.	Lüneburg,	*trp. cryst.*		[67]	33	——	——	——	=100 Strom.
2.	"	"		[69·7]	30·8	——	——	——	=100 Arfv.
3.	"	"		[69·77]	30·23	——	——	——	=100 Ramm.
4.	"	*opaque*	($\frac{1}{2}$)	[64·48]	31·39	0·61	——	3·52	=100 Weber.
5.	"	*trp.*		62·91	25·24	$\dot{Fe}$ 1·59	10·90	0·55	=101·19 Potyka.
6.	"	*clouded*		61·19	26·19	" 1·66	10·41	0·94	=100·39 Potyka.
7.	"		($\frac{1}{2}$)	[61·82]	25·48	" 1·33	11·42	——	=100 Siewert.
8.	"		($\frac{1}{2}$)	[61·80]	25·44	" 1·44	11·32	——	=100 Geist.
B. 1.	*Massive*			[69·49]	29·48	1·03	——	——	=100 Karsten.
2.	"			[69·18]	29·93	$\dot{Fe}$ 0·89	——	——	=100 Chandler.
3.	"			69·05	30·83	0·32	——	— –	=100·20 S & D.
4.	"			[58·45]	23·80	——	11·75	6·00	=100 Ludwig.
5.	"			[61·22]	25·74	0·43	10·98	1·63	=100 Heintz.
6.	"			[60·77]	26·15	$\dot{Fe}$ 0·40	10·73	1·95	=100 Potyka.
7.	"			[58·90]	24·93	——	9·97	6·20	=100 Kromayer.

An *iron-boracite* (Eisenstassfurtit) from Stassfurt is described by Huyssen (Jahrb. Min. 1865, 329), having half the $\dot{Mg}$ replaced by $\dot{Fe}$.

Westrumb, who was the first to detect in boracite the boric acid (Sedativsalz=Sedative salt of old authors), found (l. c., and also Schrift. Ges. N. Fr. Berlin, ix.) Boric acid 68·0, magnesia 13·5, lime 11·0, alumina 1·0, oxyd of iron 0·75, silica 2·0=96·25. In another trial he obtained $\ddot{B}$ 65·0, $\dot{Mg}$ 20·5, $\dot{Ca}$ 7·0, $\dot{Fe}$ 1·25, $\ddot{Al}$ 2·25, $\ddot{Si}$ 1·0, with 2 of water or loss on ignition=99·0. Several of the subsequent analysts failed to detect the chlorine.

Pyr., etc.—The massive variety gives water in the closed tube. B.B. both varieties fuse at 2 with intumescence to a white crystalline pearl, coloring the flame green; heated after moistening with cobalt solution assumes a deep pink color. Mixed with oxyd of copper and heated on charcoal colors the flame deep azure-blue (chlorid of copper). Soluble in muriatic acid.

Soluble in powder in dilute muriatic, nitric, or sulphuric acids, and the massive kind most readily so. Alters very slowly on exposure, owing to the chlorid of magnesium present, which takes up water.

It is the frequent presence of this deliquescent chlorid in the massive mineral, thus originating, that led to the view that there was a hydrous boracite (stassfurtite). See on this point Bischof's Steinsalzwerke bei Stassfurt, p. 86, and Steinbeck in Pogg., cxxv. 68. *Parasite* of Volger is a result of the same kind of alteration in the interior of crystals of boracite, which gives the somewhat plumose character it has, and the water. Weber's analysis above was probably made on such an altered crystal.

Obs.—Observed in beds of anhydrite, gypsum, or salt. In crystals at Kalkberg and Schildstein in Lüneburg, Hanover; at Segeberg, near Kiel, in Holstein; at Luneville, La Meurthe, France; massive, or as part of the rock of the Salt Mine at Stassfurt, Prussia.

Boracite was first shown to be pyroelectric by Haüy in 1791.

598. RHODIZITE. Rhodizit *G. Rose*, Pogg., xxxiii. 253, 1834, xxxix. 321. Rhodicit *Hausm.*

Isometric and tetrahedral, like boracite. Planes 1 smooth and shining, *i* often uneven.

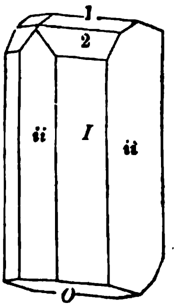
H.=8. G.=3·3–3·42. Lustre vitreous, inclined to adamantine. Color white. Translucent. Pyroelectric.

Pyr., etc.—B.B. in the platinum forceps fuses with difficulty on the edges to a white opaque glass, tinging the flame at first green, then green below and red above, and finally red throughout. With borax and salt of phosphorus fuses to a transparent glass. Supposed to be lime-boracite.

Obs.—Found by G. Rose in minute crystals on red tourmalines from near Sarapulsk and Schaitansk in the vicinity of Katharinenburg, and named from ῥοδίζειν, in allusion to its tinging flame red. The largest crystals seen were two lines in diameter.

599. BORAX. Tinkal of *India*. Chrysocolla (ex nitro confecta), Borras, *Agric.*, 1546. Borax *Wall.*, Min., 1748. Borate of Soda. Boraxsaures Natron *Germ.* Soude boratée *Fr.*

492



Monoclinic. *C*=73° 25′, *I* ∧ *I*=87°, *O* ∧ 2-ì=132° 49′; *a* : *b* : *c*=0·4906 : 1 : 0·9095. Observed planes as in the annexed figure, with also 4-ì. *O* ∧ *I*=78° 40′ and 101° 20′, *O* ∧ 1=139° 30′, *O* ∧ 2=115° 53′, *O* ∧ 4-ì=114° 51½′, *O* ∧ *i*-ì=90°, *i*-*i* ∧ *I*=133° 30′. Cleavage: *i*-*i* perfect; *I* less so; *i*-ì in traces. Plane of composition *i*-*i*; *O* ∧ *O* =146° 50′.

H.=2—2·5. G.=1·716. Lustre vitreous—resinous; sometimes earthy. Color white; sometimes grayish, bluish or greenish. Streak white. Translucent—opaque. Fracture conchoidal. Rather brittle. Taste sweetish-akaline, feeble.

Comp.—$\dot{N}a\,\dddot{B}^2+10\,\dot{H}$; or $(\frac{1}{2}\,\dot{N}a+\frac{1}{2}\,\dot{H})\,\dddot{B}+4\frac{1}{2}\,\dot{H}$=Boric acid 36·6, soda 16·2, water 47·2.

Pyr., etc.—B.B. puffs up, and afterward fuses to a transparent globule, called the glass of borax. Fused with fluor spar and bisulphate of potash it colors the flame around the assay a clear green. Soluble in water, yielding a faintly alkaline solution. Boiling water dissolves double its weight of this salt.

Obs.—Borax was originally brought from a salt lake in Thibet. The borax is dug in masses from the edges and shallow parts of the lake, and in the course of a short time the holes thus made are again filled. This crude borax was formerly sent to Europe under the name of tincal, and there purified. It is announced by Dr. J. A. Veatch as existing in the waters of the sea along the California coast, and in those of many of the mineral springs of California (J. Frankl. Inst., 1860) Crystals, 2 or 3 inches across, occur in the mud of Borax Lake, near Clear Lake, Cal., 65 m. N.W. of Suisun Bay and 36 m. from the Pacific. It has also been found at Viquintizoa and Escapa in Peru; at Halberstadt in Transylvania; in Ceylon. It occurs in solution in the mineral springs of Chambly, St. Ours, etc., Canada East (Hunt, Logan's G. Rep., 1853).

The waters of Borax Lake, California, contain, according to G. E. Moore, 535·08 grains of crystallized borax to the gallon (Am. J. Sci., xli. 257).

Borax is now extensively made from the boric acid of the Tuscan lagoons, by the reaction of this acid on carbonate of soda. This salt is employed in several metallurgical operations as a flux, is sometimes used in the manufacture of glass and gems, and extensively in the process of soldering.

Named borax from the Arabic *buraq*, which included also the *nitre* (carbonate of soda) of ancient writers, the *natron* of the Egyptians.

Prof. Bechi has analyzed a borate occurring as an incrustation at the Tuscan lagoons, which afforded $\dddot{B}$ 43·56, $\dot{N}a$ 19·25, $\dot{H}$ 37·19=100, giving the formula $\dot{N}a\,\dddot{B}^2+6\,\dot{H}$ (Am. J. Sci., II. xvii. 128).

600. BECHILITE. Hayesine? *Bechi*, Am. J. Sci., II. xvii. 129, 1854. Bechilite *Dana*. Hydrous Borate of Lime.

In crusts, as a deposit from springs.

Comp.—O. ratio for $\dot{C}a$, $\dddot{B}$, $\dot{H}$=1 : 6 : 4; $(\frac{1}{2}\,\dot{C}a+\frac{1}{2}\,\dot{H})\,\dddot{B}+1\frac{1}{2}\,\dot{H}$=Boric acid 52·2, lime 20·9, water 26·9=100. Analysis: Bechi (l. c.):

$\dddot{B}$ 51·13 $\dot{C}a$ 20·85 $\dot{H}$ 26·25 $\ddot{S}i$, $\ddot{\bar{A}}l$, $\dot{M}g$ 1·75=99·98.

Pyr., etc.—Yields water. B.B. fuses easily, coloring the flame reddish-yellow; moistened with sulphuric acid the flame is colored green.

Obs.—Found by Bechi as an incrustation at the baths of the boric acid lagoons of Tuscany

Artif.—A hot-water solution of ulexite, after concentration and cooling, yielded Lecanu (J Pharm., III. xxiv. 22) scales of a salt having the above ratio, as determined by him. Krau obtained, under similar circumstances, the compound $\dot{\mathrm{Ca}}^2\,\dddot{\mathrm{B}}^3+6\,\dot{\mathrm{H}}$, or 5 $\dot{\mathrm{H}}$ after drying over sulphuric acid, and 3 $\dot{\mathrm{H}}$ after heating to 120° C.

The *Hayesine* of D. Forbes (Phil. Mag., IV. xxv. 113), from the waters of the hot springs, Baños del Toro, in the Cordilleras of Coquimbo, may be of the above species. It occurs in the waters in the form of snow-white silky or feathery flakes, and also as a flaky sediment at the bottom.

Forbes suggests that the mineral is formed by the action of hot vapors, volcanic in source, on the lime of the waters through which they pass.

601. HOWLITE. Silicoborocalcite *H. How*, Phil. Mag., IV. xxxv. 1868. Howlite *Dana*.

In small rounded imbedded nodules. Texture compact, without cleavage; also chalk-like or earthy.

H.=3·5; often less. G.=2·55. Lustre subvitreous, glimmering. Color white. Subtranslucent, or translucent in thin splinters. Fracture nearly even and smooth.

Comp.—A hydrous borate of lime, similar to *bechilite*, combined with one-sixth of a silicate, analogous to *danburite*. O. ratio for $\dot{\mathrm{R}}$, $\dddot{\mathrm{B}}$, $\ddot{\mathrm{Si}}$, $\dot{\mathrm{H}}$=4 : 14 : 4 : 5; corresponding to $[(\frac{1}{2}\dot{\mathrm{Ca}}+\frac{1}{2}\dot{\mathrm{H}})\dddot{\mathrm{B}}+\frac{3}{4}\dot{\mathrm{H}}]+\frac{1}{6}[(\frac{1}{2}\dot{\mathrm{Ca}}^3+\frac{1}{2}\dddot{\mathrm{B}})^2\ddot{\mathrm{Si}}^3]$=Boric acid 43·0, silica 15·8, lime 29·4, water 11·8=100. How deduces the O. ratio 4 : 15 : 4 : 5; but as the boric acid was not directly determined, its preference to the preceding is not certain. How writes the formula $2\,\dot{\mathrm{Ca}}\,\ddot{\mathrm{Si}}+2\,(\dot{\mathrm{Ca}}\,\dddot{\mathrm{B}}^2+\dot{\mathrm{H}})+\dot{\mathrm{H}}^3\dddot{\mathrm{B}}$. Analyses: 1–3, How; 4, the mean after excluding the lime as gypsum:

	$\ddot{\mathrm{Si}}$	$\dddot{\mathrm{B}}$	$\dddot{\mathrm{S}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{H}}$
1. *Compact*	15·19	[43·33]	1·03	*tr.*	28·90	11·55
2. "	15·44	[44·10]	0·80	*tr.*	28·04	11·62
3. *Chalky*	14·64	[42·45]	1·86	*tr.*	28·85	12·20
4. Mean, gypsum excl.	15·25	[44·22]	—	—	28·69	11·84

Obs.—Occurs in Nova Scotia in nodules, of the size mostly of filberts, or ¼ in. to ½ in., and rarely 1 to 2 in. through, imbedded in anhydrite or gypsum, at Brookville, about 3 m. S. of Windsor, and associated with ulexite. The harder kind (anal. 1, 2) occurs in anhydrite, and the softer (anal. 3) in gypsum.

602. ULEXITE. Boronatrocalcit *Ulex*, Ann. Ch. Pharm., lxx. 49, 1849. Natron-Kalk-Borat. Ulexite *Dana*, Min., 695, 1850. Natronborocalcite. Tinkalzit (fr. Africa) *Kletzinsky*, Polyt. Centr., 1384, 1859.

In rounded masses, loose in texture, consisting of fine fibres, which are acicular or capillary crystals.

H.=1. G.=1·65, N. Scotia, How. Lustre silky within. Color white. Tasteless.

Comp.—O. ratio for $\dot{\mathrm{Na}}$, $\dot{\mathrm{Ca}}$, $\dddot{\mathrm{B}}$, $\dot{\mathrm{H}}$=1 : 2 : 18 : 18, Ramm.,$=(\frac{1}{2}\dot{\mathrm{R}}+\frac{1}{2}\dot{\mathrm{H}})\dddot{\mathrm{B}}+\frac{5}{2}\dot{\mathrm{H}}$=Boric acid 45·6, lime 12·3, soda 6·8, water 35·3=100. How deduces for the N. Scotia mineral the ratio 1 : 2 : 15 : 15=Boric acid 44·0, lime 14·1, soda 7·8, water 34·1=100. Analyses: 1, Ulex (l. c.); 2, A. Dick (Phil. Mag., IV. vi. 50); 3, Rammelsberg (Pogg., xcvii. 301); 4, Helbig (Dingler's Pol. J., cxlvii. 319); 5–8, Kraut (Arch. Pharm., II. cxii. 25, Jahresb., 1862, 759, Ann. Ch. Pharm., cxxxix. 252); 9, Lunge (ib., cxxxviii. 51); 10, Kletzinski (Polyt. Centr., 1859, 1384, Ramm. Min. Ch., 988); 11, Phipson (C. R., lii. 407); 12, Salvetat (ib., 536); 13, H. How (Am. J Sci., II. xxiv. 230); 14, id. (ib., xxxii. 9):

	$\dddot{\mathrm{B}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Na}}$	$\dot{\mathrm{K}}$	$\dot{\mathrm{H}}$	Na Cl	
1. Iquique	[49·5]	15·9	8·8	—	25·8.	—	=100 Ulex.
2. "	[45·46]	14·32	8·22	0·51	27·22	2·65,	$\dddot{\mathrm{S}}$ 1·10, sand 0·32=100 Dick.

		$\dddot{\bar{B}}$	$\dot{Ca}$	$\dot{Na}$	$\dot{K}$	$\dot{H}$	Na Cl	
3.	Iquique	[43·70]	13·13	6·67	0·83	35·67	——	=100 Ramm.
4.	"	[46·30]	14·03	5·17	——	32·61	1·89	=100 Helbig.
5.	"	42·48	14·39	7·72	——	35·51	——	=100 Kraut.
6	"	[47·20]	16·24	6·38	——	30·18	——	=100 Kraut.
7.	"	[48·22]	17·68	5·42	——	28·68	——	=100 Kraut.
8.	Africa	45·74	13·45	7·03	——	33·78	——	=100 Kraut.
9.	Iquique	44·38	12·69	5·58	——	36·85	——,	$\dot{Mg}$ 0·50=100 Lunge.
10.	W. Africa	36·91	14·02	8·59	——	37·40	2·19,	$\dot{Na}\dddot{S}$ 0·89=100 Kletzinski.
11	Iquique	34·71	14·45	11·95	——	34·00	——,	$\underline{Cl}$ 1·34, $\dddot{S}$ 1·10, $\dddot{Si}$ 0·60, sand 2·00=100·15 P.
12.	"	34·74	15·78	8·33	——	35·00	0·81,	$\dddot{S}$ 0·34, earthy 2·90=100 Salvetat.
13.	N. Scotia	[41·97]	13·95	8·36	——	34·39	——,	$\dddot{S}$ 1·29, $\dot{Mg}$ 0·04=100 How.
14.	"	[44·10]	14·20	7·21	——	34·49	——	=100 How.

G. of anal. 10=1·912.

In analysis 3, 3·17 chlorid of sodium, 0·41 sulphate of soda, and 0·39 sulphate of lime are excluded.

Pyr., etc.—Yields water. B.B. fuses at 1 with intumescence to a clear blebby glass, coloring the flame deep yellow. Moistened with sulphuric acid the color of the flame is momentarily changed to deep green. Not soluble in cold water, and but little so in hot; the solution alkaline in its reactions.

Obs.—Occurs in the dry plains of Iquique, Southern Peru; in the province of Tarapaca* (where it is called *tiza*), in whitish rounded masses, from a hazelnut to a potato in size, which consist of interwoven fibres of the ulexite, with pickeringite, glauberite, halite, gypsum, and other impurities; on the West Africa coast; in Nova Scotia, at Windsor, Brookville, and Newport (H. How), filling narrow cavities, or constituting distinct nodules or mammillated masses imbedded in white gypsum, and associated at Windsor with glauber salt, the lustre internally silky and the color very white; in Nevada, in the salt marsh of the Columbus Mining District, forming layers 2–5 in. thick alternating with layers of salt, and in balls 3–4 in. through in the salt.

Named after Ulex, who gave the first correct analysis of the mineral.

Alt.—Occurs altered to gypsum.

Hayesine Dana (Hydrous Borate of Lime *A. A. Hayes*, Am. J. Sci., xlvi. 377, xlvii. 215, 1844 Borocalcite; Hydroborocalcite *Hausm.*, Handb., 1429, 1847) from southern Peru, is the above. It comes from the same locality, and has the same appearance; and all analyses of the Peruvian mineral since that by Hayes have found soda to be an essential constituent. Hayes obtained $\dddot{\bar{B}}$ 46·11, $\dot{Ca}$ 18 89, $\dot{H}$ 35·00=100, with the formula $\dot{Ca}\dddot{\bar{B}}^2+6\dot{H}$; and he attributed the soda found by Ulex to the mixed glauberite.

603. CRYPTOMORPHITE. *H. How*, Am. J. Sci., II. xxxii. 9, 1861.

In kernels apparently uncrystalline, but under a high magnifying power shown to consist of thin tables or plates, rhombic in outline, and about 80° in angle.

Without lustre. Color white.

Comp.—O. ratio for $\dot{Na}$, $\dot{Ca}$, $\dddot{\bar{B}}$, $\dot{H}$, according to How, from an imperfect analysis, 1 : 3 : 27 : 12 =Boric acid 58·5, lime 15·6, soda 5·8, water 20·1=100, and no satisfactory formula. 1 : 3 : 24 12 would give the more probable composition $(\frac{1}{3}(\dot{Na},\dot{Ca})+\frac{1}{3}\dot{H})\dddot{\bar{B}}+\dot{H}$=Boric acid 55·6, lime 16·7 soda 6·2, water 21·5=100. Analysis: How (l. c.):

	$\dddot{\bar{B}}$	$\dot{Ca}$	$\dot{Na}$	$\dot{H}$	$\dot{Mg}$	$\dddot{S}$
A.	53·98	14·21	7·25	19·76	0·62	8·98=100.
B.	59·10	15·55	5·61	19·72	——	——

B is the result after removing the magnesia and part of the soda in the state of sulphates as impurities.

Pyr., etc.—Same as under ulexite.

Obs.—Occurs in white lustreless kernels of the size of a pea or bean lying between crystals of

---

[*] The province of Tarapaca is between 19° and 21½° S. lat., and 3000 to 3500 feet above the sea.

glauber salt. The tabular character of the material is supposed to be evidence of distinction from ulexite, which is capillary in its forms. Breadth of tables about ·0048 of an inch, Robb.

Named from κρυπτη, *concealed*, and μορφη, *form*, in allusion to the invisibility of the structure except under a microscope. Found at Windsor, Nova Scotia.

604. LARDERELLITE. *Bechi*, Am. J. Sci., II. xvii. 130.

Very light, white, and tasteless. Appearing under the microscope to be made up of minute oblique rectangular tables; M ∧ T=110°, Amici.

Comp.—$NH^4O\,\dddot{\bar{B}}^4+4\dot{H}$; or, more probably, making the water partly basic, $(\frac{1}{4}NH^4O+\frac{3}{4}\dot{H})\dddot{\bar{B}}+1\frac{1}{4}\dot{H}$. Analysis by E. Bechi (l. c.):

$\dddot{\bar{B}}$ 68·556 NH^4O 12·734 $\dot{H}$ 18·325

Dissolves in hot water, and is transformed into a new salt, represented by the formula $NH^4O\,\dddot{\bar{B}}^6+9\dot{H}$, or $(\frac{1}{3}NH^4O+\frac{2}{3}\dot{H})\dddot{\bar{B}}^2+2\frac{1}{3}\dot{H}$.

Obs.—Occurs at the Tuscan lagoons.

605. LAGONITE. Borate de Fer *Omalius d'Halloy*, 1833. Lagonite *Huot*, Min., i. 290, 1841. Sideroborine *Huot*, i. 273, 1841. Lagunit *Kenng.*

An earthy mineral of an ochreous yellow color.

Comp.—$\dddot{\bar{Fe}}\,\dddot{\bar{B}}^3+3\dot{H}$=Boric acid 49·5, sesquioxyd of iron 37·8, water 12·7=100. Analysis by Prof. Bechi (Am. J. Sci., II. xvii. 129):

$\dddot{\bar{B}}$ 47·95 $\dddot{\bar{Fe}}$ 36·26 $\dot{H}$ 14·02 $\dot{Mg}$, $\dot{Ca}$, and loss 1·77

Occurs as an incrustation at the Tuscan lagoons. First mentioned by Beudant.

606. WARWICKITE. *Shepard*, Am. J. Sci., xxxiv. 313, 1838, xxxvi. 85, 1839. Enceladite *T. S. Hunt*, ib., II. ii. 30, 1846, xi. 352.

Monoclinic? *I* ∧ *I*=93°–94°. Usual in rhombic prisms with obtuse edges truncated, and the acute bevelled, summits generally rounded; surfaces of larger crystals not polished. Cleavage: macrodiagonal perfect, affording surface with vertical striæ and traces of oblique cross cleavage.

H.=3–4. G.=3·19–3·43; 3·351, small crystals, and 3·423, large id., Brush. Lustre of cleavage surface submetallic-pearly to subvitreous; often nearly dull. Color dark hair-brown to dull black, sometimes a copper-red tinge on cleavage surface. Streak bluish-black. Fracture uneven. Brittle.

Comp.—Essentially a borotitanate of magnesia and iron, with 15 to 20 p. c. of boric acid, Smith and Brush (Am. J. Sci., II. xvi. 293). T. S. Hunt found in small lustrous unaltered crystals (Am. J. Sci., II. xi. 352):

$\ddot{Ti}$ 31·5 $\dot{Mg}$ 43·5 $\dot{Fe}$ 8·1 ign. 2·0

with a loss of 14·99 p. c., which Smith and Brush show to be boric acid.

Pyr., etc.—Yields water. B.B. infusible, but becomes lighter in water; moistened with sulphuric acid gives a pale green color to the flame. With salt of phosphorus in O.F. a clear bead yellow while hot and colorless on cooling; in R.F. on charcoal with tin a violet color (titanic acid With soda a slight manganese reaction. Decomposed by sulphuric acid; the product, treat with alcohol and ignited, gives a green flame, and boiled with muriatic acid and metallic tin givs on evaporation a violet-colored solution.

Obs.—Occurs in granular limestone 2½ m. S.W. of Edenville, N. Y., with spinel, chondrodit serpentine, etc. Crystals usually small and slender; sometimes over 2 in. long and ¾ in br The latter are the *enceladite* of Hunt.

5. TUNGSTATES, MOLYBDATES, VANADATES.

ARRANGEMENT OF THE SPECIES.

TUNGSTATES AND MOLYBDATES.

610. **Wolframite**	A	$(\frac{1}{5}\,\dot{\mathrm{Fe}}+\frac{4}{5}\,\dot{\mathrm{Mn}})\,\dddot{\mathrm{W}}$	$₩\,\Theta_2\|\Theta_2\|(\frac{1}{5}\,\mathrm{Fe}+\frac{4}{5}\,\mathrm{Mn})$
	B	$(\frac{2}{5}\,\dot{\mathrm{Fe}}+\frac{3}{5}\,\dot{\mathrm{Mn}})\,\dddot{\mathrm{W}}$	$₩\,\Theta_2\|\Theta_2\|(\frac{2}{5}\,\mathrm{Fe}+\frac{3}{5}\,\mathrm{Mn})$
	C	$(\frac{4}{5}\,\dot{\mathrm{Fe}}+\frac{1}{5}\,\dot{\mathrm{Mn}})\,\dddot{\mathrm{W}}$	$₩\,\Theta_2\|\Theta_2\|(\frac{4}{5}\,\mathrm{Fe}+\frac{1}{5}\,\mathrm{Mn})$
	D	$\dot{\mathrm{Fe}}:\dot{\mathrm{Mn}}=2:1,\ 3:1,\ 5:1$	
611. **Hübnerite**		$\dot{\mathrm{Mn}}\,\dddot{\mathrm{W}}$	$₩\,\Theta_2\|\Theta_2\|\mathrm{Mn}$
612. **Ferberite**		$(\frac{8}{9}\,\dot{\mathrm{Fe}}+\frac{1}{9}\,\dot{\mathrm{Mn}})^4\,\dddot{\mathrm{W}}^3$	$₩_3\,\Theta_6\|\Theta_8\|(\frac{8}{9}\,\mathrm{Fe}+\frac{1}{9}\,\mathrm{Mn})$
613. **Megabasite**		$(\frac{1}{5}\,\dot{\mathrm{Fe}}+\frac{4}{5}\,\dot{\mathrm{Mn}})^4\,\dddot{\mathrm{W}}^3$	$₩_3\,\Theta_6\|\Theta_8\|(\frac{1}{5}\,\mathrm{Fe}+\frac{4}{5}\,\mathrm{Mn})$
614. **Scheelite**		$\dot{\mathrm{Ca}}\,\dddot{\mathrm{W}}$	$₩\,\Theta_2\|\Theta_2\|$Ȼa
615. **Cuproscheelite**		$(\frac{3}{4}\,\dot{\mathrm{Ca}}+\frac{1}{4}\,\dot{\mathrm{Cu}})\,\dddot{\mathrm{W}}$	$₩\,\Theta_2\|\Theta_2\|(\frac{3}{4}$ Ȼa $+\frac{1}{4}$ Ȼu$)$
616. **Stolzite**		$\dot{\mathrm{Pb}}\,\dddot{\mathrm{W}}$	$₩\,\Theta_2\|\Theta_2\|$Ᵽb
617. **Wulfenite**		$\dot{\mathrm{Pb}}\,\dddot{\mathrm{Mo}}$	$\mathrm{Mo}\,\Theta_2\|\Theta_2\|$Ᵽb
618. **Pateraite**		$\dot{\mathrm{Co}}\,\dddot{\mathrm{Mo}}$	$\mathrm{Mo}\,\Theta_2\|\Theta_2\|$Ȼo

II. VANADATES.

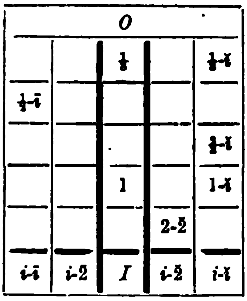
619. **Dechenite**	$(\dot{\mathrm{Pb}},\dot{\mathrm{Zn}})\,\dddot{\mathrm{V}}$	Ꝟ $\Theta_2\|\Theta_2\|$(Ᵽb, Zn)
620. **Descloizite**	$\dot{\mathrm{Pb}}^2\,\dddot{\mathrm{V}}$	Ꝟ $\Theta\|\Theta_4\|$Ᵽb_2
621. **Vanadinite**	$3\,\dot{\mathrm{Pb}}^3\,\dddot{\mathrm{V}}+\mathrm{Pb\,Cl}$	Ꝟ$\|\Theta_6\|$Ᵽ$\mathrm{b}_3+\frac{1}{3}$ Ᵽb Cl_2
622. **Volborthite**	$\dot{\mathrm{Cu}},\ \dddot{\mathrm{V}},\ \dot{\mathrm{H}}$	
623. **Chileite**		

0. **WOLFRAMITE.** Lupi Spuma, Lapis niger ex quo conflatur candidum plumbum [=Tin], *gric.*, Foss., 255, 1546. Volfram, Ferrum arsenico mineralisatum, Spuma Lupi (fr. tin veins), *ll.*, Min., 268, 1747. Magnesia [=Manganese] parva cum portione martis et jovis mixta, fram (fr. Altenberg), *Cronst.*, Min., 107, 1758. Wolfram=Tungstic Acid, Iron, and Mang., *uyar*, Chem. Zergl. Wolframs., 1785. Tungstate of Iron and Manganese. Scheelin ferruginé., Tr., iv. 1801. Wolframit *Breith.*, Char., 227, 1832.

Orthorhombic. *I* ∧ *I*=101° 5′, Rose (101° 45′, Kerndt; 101°, Descloizeaux); r ∧ *i*-ī=140° 32′; *i*-ī ∧ ½-ī=117° 20′; 1-ĭ ∧ 1-ĭ, over the summit, =99° 12. *i*-ī ∧ *i*-2̆=157° 38′. Crystals often monoclinic in habit, half of the planes, 1, ½-ī, and 2-2̆, being absent or much smaller than the other half. Cleavage: *i*-ĭ perfect, *i*-ī imperfect. Twins: planes of composition *i*-ī, [illegible]-ĭ, and rarely ⅓-ĭ. Also irregular lamellar; coarse divergent columnar; massive granular, the particles strongly coherent.

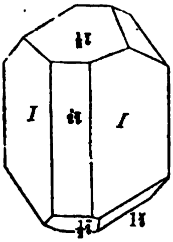
H.=5—5·5. G.=7·1—7·55. Lustre submetallic. Color dark grayish or brownish-black. Streak dark reddish-brown to black. Opaque. Sometimes weak magnetic.

Var.—The most important varieties depend on the proportions of the iron and manganese Those rich in manganese have G.=7·19—7·54, but generally below 7·25, and the streak is mostly black. Those rich in iron have G.=7·2—7·54, and a dark reddish-brown streak, and they are sometimes feebly attractable by the magnet.

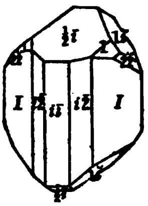


Observed Planes.

494



495



Comp.—$(\dot{\mathrm{Fe}}, \dot{\mathrm{Mn}})\,\dddot{\mathrm{W}}$; mostly either $2\,\dot{\mathrm{Fe}}\,\dddot{\mathrm{W}} + 3\,\dot{\mathrm{Mn}}\,\dddot{\mathrm{W}}$, or $4\,\dot{\mathrm{Fe}}\,\dddot{\mathrm{W}} + \dot{\mathrm{Mn}}\,\dddot{\mathrm{W}}$; but also ratios 2 : 1, 3 : 1, 5 : 1, and 1 : 4.

Analyses: 1, G. J. Pöpplein (Mining Mag., II. i. 359); 2, C. S. Rodman (priv. contrib.); 3, Bernouilli (Pogg., cxi. 603); 4, 5, Schaffgotsch (Pogg., lii. 475); 6, Ebelmen (Ann Ch. Phys., III. viii. 505); 7, Kussin (Ramm. 3d Suppl., 127); 8, Bernouilli (l. c); 9, Weidinger (ZS. Pharm., 185, 71); 10, R. Schneider (J. pr. Ch., xlix. 322); 11–16, Kerndt (J. pr. Ch., xlii. 81); 17, Bernouilli (l. c.); 18, 19, Schaffgotsch (l. c.); 20, Kerndt (l. c.); 21–24, Bernouilli (l. c.); 25, R. Petzold (Pogg., xciii. 474); 26, Ebelmen (l. c.); 27, Rammelsberg (2d Suppl., 175): 28–30, Kerndt (l. c.); 31–33, R. Schneider (l. c.); 34, F. A. Genth (Am. J. Sci., II. xxviii. 253); 35, Berzelius (Schw. J., xvi. 476):

I. Ratio of $\dot{\mathrm{Fe}}\,\dddot{\mathrm{W}}$ *to* $\dot{\mathrm{Mn}}\,\dddot{\mathrm{W}} = 1 : 4$.

		G.		$\dddot{\mathrm{W}}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Mn}}$	$\dot{\mathrm{Ca}}$	
1.	St. Francis R., Mo.	6·67	(¾)	75·40	5·69	19·38	1·13	=100·60 Pöpplein.
2.	Madison Co., "			74·65	4·96	20·25	——	=99·81 Rodman.
3.	Zinnwald			76·20	5·60	17·94	——	=99·74 Bernouilli.

II. Ratio of $\dot{\mathrm{Fe}}\,\dddot{\mathrm{W}}$ *to* $\dot{\mathrm{Mn}}\,\dddot{\mathrm{W}} = 2 : 3$.

		G.		$\dddot{\mathrm{W}}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Mn}}$	$\dot{\mathrm{Ca}}$	
4.	Zinnwald	7·191		75·33	9·55	15·12	——	=100 Schaffgotsch.
5.	"	7·191		75·66	9·49	14·85	——	=100 Schaffgotsch.
6.	"		(⅜)	75·99	9·62	13·96	0·48	=100 05 Ebelmen.
7.	"			75·92	9·38	14·04	——	=99·34 Kussin.
8.	"			75·15	9·72	13·99	*tr.*, $\ddot{\mathrm{Cb}}$ 1·10	=99·96 Bernouill
9.	"			75·62	8·73	12·17	2·27, $\ddot{\mathrm{Ti}}$ 1·89, $\dot{\mathrm{H}}$ 0·31	=100·9
10.	"			76 01	9·81	13·90	1·19	=100·91 R. Schneider.
11.	"	7·223		76·34	9·61	14·21	——	=100·13 Kerndt.
12.	"	7·231—7·22		75·62	9·55	14·85	——	=100·0[illegible] Kerndt.
13.	Monroe, Ct.	7·411—7·486		75·47	9·53	14·26	——	=99·26 Kerndt.
14.	"	7·208—7·269		75·96	9·74	14·50	——	=100·00 Kerndt.
15.	Schlackenwald	7·482—7·535		75·68	9·56	14·30	——	=99·54 Kerndt
16.	Altenberg	7·198—7·189		75·44	9·64	14·90	——	=99·98 Kerndt

III. Ratio of $\dot{\mathrm{Fe}}\,\dddot{\mathrm{W}}$ *to* $\dot{\mathrm{Mn}}\,\dddot{\mathrm{W}} = 2 : 1$ *nearly.*

		G.		$\dddot{\mathrm{W}}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Mn}}$	$\dot{\mathrm{Ca}}$	
17.	Traversella			75·99	16·29	3·45	4·03	=99·76 Bernouilli.

IV. Ratio of $\dot{\mathrm{Fe}}\,\dddot{\mathrm{W}}$ *to* $\dot{\mathrm{Mn}}\,\dddot{\mathrm{W}} = 3 : 1, 4 : 1,$ *or* $5 : 1$.

		G.		$\dddot{\mathrm{W}}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Mn}}$	$\dot{\mathrm{Ca}}$	
18.	Ehrenfriedersdorf			76·10	19·16	4·74	——	=100 Schaffgotsch.
19.	Chantelcup	7·437		76·00	18·33	5·67	——	=100 Schaffgotsch.

	G.	$\dddot{W}$	$\dot{\rm Fe}$	$\dot{\rm Mn}$	$\dot{\rm Ca}$	
20. Chanteloup	7·48—7·51	75·83	19·32	4·84	——	=99·99 Kerndt.
21. "		75·68	18·77	5·01	0·22	=99·68 Bernouilli.
22. "		75·75	18·08	5·75	——	, $\ddot{\rm Cb}$ 0·31=99·89 Bernouilli.
23. Zinnwald		75·98	18·51	5·02	——	, $\ddot{\rm Cb}$ 0·52=100·03 Bernouill
24. "		76·13	18·49	5·10	——	=99·72 Bernouilli.
25. Stolberg		76·57	18 98	4·90	0·70	=100·95 Petzold.
26. Limoges		(⅘) 76·20	19·19	4·48	——	, $\dot{\rm Mg}$ 0·80=100·67 Ebelm.
27. Harzegerode	7·143	75 56	20·17	3·54	——	=99·27 Rammelsberg.
28. "	7·23	75·90	19·25	4·80	——	=99·95 Kerndt.
29. Monte Video	7·5—7·513	76·02	19·21	4·75	——	=99·98 Kerndt.
30. Nertschinsk	7·5	75·64	19·55	4·81	——	=100·00 Kerndt.
31. Harz, Glasebach		76·04	19·61	4·98	——	, $\dot{\rm Mg}$ *tr.*=100·92 Sch.
32. " Pfaffenberg		76·21	18·54	5·23	——	" 0·86=100·74 Sch.
33. " Meiseberg		76·25	20·27	3·96	——	" 0·15=100·91 Sch.
34. Flowe M., N. C.	7·496	75·79	19·80	5·35	0·32	, $\ddot{\rm Sn}$ *tr.*=101·26 Genth.
35. Cumberland		74·67	17·59	5·64	——	, $\ddot{\rm Si}$ 2·10=100 Berzelius.

Vauquelin gives for the composition of a wolfram from the Department of Haute Vienne, $\dddot{W}$ 3·60, $\dot{\rm Fe}$ 14·46, $\dot{\rm Mn}$ 11·95=100 (Ann. Ch. Phys., xxx. 261); and Richardson found for one from ohemia, $\dddot{W}$ 73·60, $\dot{\rm Fe}$ 11·20, $\dot{\rm Mn}$ 15·75=100·55 (Thom. Min., i. 487). The former analysis corresponds nearly to the ratio 5 : 4 for the two tungstates; and the latter to 3 : 4 nearly.

Hoppe-Seyler (Ann. Ch. Pharm., cxl. 247) found indium in two specimens of wolfram; one ontained 0·228 p. c.

The metal tungsten was first recognized in this mineral by the brothers J. Joseph and F 'Elhuyar, in 1785 (Ch. Anal. of Wolfram, etc., translated from the Spanish by Ch. Cullen, London 755, a work of which a German translation by Gren was published at Halle in 1786). They btained from the Zinnwald mineral Tungstic acid 65·0, oxyd of manganese 22·0, of iron 13·5= 00·5.

Pyr., **etc.**—B.B. fuses easily (F.=2·5—3) to a globule, which has a crystalline surface and is agnetic. With salt of phosphorus gives a clear reddish-yellow glass while hot, which is paler cooling; in R.F. becomes dark red; on charcoal with tin, if not too saturated, the bead assumes cooling a green color, which continued treatment in R.F. changes to reddish-yellow. With da and nitre on platinum foil fuses to a bluish-green manganate. Decomposed by aqua regia ith separation of tungstic acid as a yellow powder, which, when treated B.B., reacts as under ngstite (p. 186). Wolfram is sufficiently decomposed by concentrated sulphuric acid, or even uriatic acid, to give a colorless solution, which, treated with metallic zinc, becomes intensely ue, but soon bleaches on dilution.

Obs.—Wolfram is often associated with tin ores; also in quartz, with native bismuth, tungstate lime, pyrite, galenite, blende, etc. It occurs at Cornwall, much to the detriment of the tin ores. ound in fine crystals at Schlackenwald, Schneeberg, Geyer, Freiberg, Altenberg, Ehrenfriedersdorf, nnwald, and Nertschinsk, and other places mentioned above; at Chanteloup, near Limoges, in ance; near Redruth and elsewhere in Cornwall; in Cumberland (the ratio 2 : 3 at Lochfells, at of 4 : 1 at Godolphin's Ball); on the Island of Rona, one of the Hebrides; in the auriferous nd of the Wicklow rivers, Ireland, with tin. Also in S. America, at Oruro in Bolivia. The ystals of Zinnwald are remarkable as hemitropes.

In the U. States it occurs at Lane's mine, Monroe, Conn., in quartz, associated with native bisuth and the other minerals above mentioned, often pseudomorphous after tungstate of lime; in all quantities at Trumbull, Conn., at the topaz vein; massive and in crystals on Camdage farm, ar Blue Hill Bay, Me.; at the Flowe mine, Mecklenburg Co., N. C., with scheelite, crystals th planes *I*, *i-ī*, *½-ī*, *1-ĭ*; in Missouri, near Mine la Motte, and in St. Francis Co., 1½ m. from Francis River; in a gneiss boulder on the W. shore of Chief Island, L. Couchiching, Canada est; at Mammoth mining district, Nevada.

This species is shown to be isomorphous with columbite by G. Rose (Pogg., lxiv. 171). **Des-izeaux** found in the angles of wolfram some evidence that the crystals were monoclinic. But Rose shows from the twins that the form is orthorhombic and not oblique.

Alt.—Wolfram occurs altered to scheelite by a substitution of lime for iron.

1. HÜBNERITE. *E. Riotte*, Reese River (Cal.) Reveille, 1865; *H. Credner*, in B. H. Ztg., xxiv. 370, 1865.

Orthorhombic. $I \wedge I=105°$. Cleavage: *i-ĭ* very perfect. Commonly columnar masses or foliated.

H.=4·5. G.=7·14, Breith. Lustre adamantine on face of cleavage; elsewhere greasy. Color brownish-red to brownish-black. Streak yellowish-brown. Opaque. Fracture uneven.

Comp.—$\dot{M}n\,\dddot{W}$=Tungstic acid 76·6, protoxyd of manganese 23·4=100. **Analyses**: 1, Riott & Hübner (l. c.); 2, C. S. Rodman (priv. contrib.):

	$\dddot{W}$	$\dot{M}n$	$\dot{F}e$	
1. Nevada	76·4	23·4	——	=99·8 R. & H.
2. "	[75·45]	24·31	0·24	=100 Rodman.

Pyr., etc.—B.B. in the forceps less fusible than wolfram; with the fluxes gives manganese and tungstic acid reactions. Partially soluble in muriatic acid, leaving a yellow residue, soluble in ammonia.

Obs.—From the Erie and Enterprise veins, in Mammoth dist., Nevada, in a vein 3—4 feet wide in argillite, with scheelite, fluor, and apatite.

612. FERBERITE. Ferberit *K. L. T. Liebe*, Jahrb. Min. 1863, 641, attributing the name to Breithaupt.

Massive, granular, with some imperfect planes of crystallization. Cleavage: *i-ĭ* very distinct.

H.=4—4½. G.=6·801, Breith.; 7·109, Ramm. Lustre imperfectly vitreous, a little submetallic-adamantine. Color black. Streak brownish-black to blackish-brown. Opaque.

Comp.—Tungstate of iron with a little manganese; O. ratio for $\dot{R}$. $\dddot{W}$=1 : 2·14 to 1 : 2·23, or nearly 1 : 2¼ (instead of 1 : 3, as in wolfram); giving the formula $\dot{R}^4\dddot{W}^3$, with $\dot{F}e$: $\dot{M}n$=8 : 1. **Analyses**: 1, Liebe (l. c.); 2–4, Rammelsberg (J. pr. Ch., xcii. 263):

	$\dddot{W}$	$\ddot{S}n$	$\dot{F}e$	$\dot{M}n$	$\dot{M}g$	$\dot{C}a$	
1. Spain, *Ferberite*	70·11	0·14	23·29	3·02	0·42	1·75,	$\dddot{\overline{A}}l$ 1·17=99·90 Liebe.
2. " "	69·83		26·68		3·09		=99·60 Ramm.
3. " "	70·65		25·97	2·17	—	1·52	=100 Ramm.
4. " "	69·88	0·16	25·34	3·00	—	1·62	=100 Ramm.

Pyr., etc.—B.B. on charcoal fuses easily to a magnetic globule.

Obs.—Occurs in the Sierra Almagrera in southern Spain, in argillaceous schist, with quartz. Named after R. Ferber of Gera.

613. MEGABASITE. Megabasit *Breith.*, B. H. Ztg., xi. 189, 1852. Blumit *K. L. T. Liebe*, Jahrb. Min. 1863, 652, attributing name to Breithaupt.

Orthorhombic, with the angles of wolfram, Blum. Cleavage: *i-ĭ* distinct; *I* in traces. Occurs in fine needles.

H.=3·5—4. G.=6·45, fr. Schlackenwald, Ramm.; 6·967, ib., Breith.; 6·969, fr. Sadisdorf, id.; 6·939, fr. Morococha, id. Lustre vitreous, a little adamantine. Color brownish-red, clove-brown to yellowish-brown, with a reddish-brown to hyacinth-red translucency. Streak pale yellowish brown to ochre-yellow.

Comp.—Tungstate of manganese with a little iron; O. ratio for $\dot{R}$, $\dddot{W}$=1 : 2¼, as in ferberite; formula $\dot{R}^4\dddot{W}^3$, with $\dot{F}e$: $\dot{M}n$=1 : 4.

Rammelsberg gives the O. ratio 1 : 3; but his anal. 3, which he says was made on the purest material, sustains 1 : 2¼.

Analyses: 1–3, Rammelsberg (3d Supp., 127, Min. Ch., 309):

	$\dddot{W}$	$\dot{Fe}$	$\dot{Mn}$	$\dot{Ca}$	$\ddot{Si}$	$\dddot{\bar{Al}}$	$\bar{P}$, F	ign.
1. Schlackenwald	[67·05]	6·72	19·73	3·02	1·08	1·01	0·61	0·78=100.
2. "	71·71	7·19	21·10	—	—	—	—	—=100.
3. "	71·5	5·4	23·1	—	—	—	—	—=100.

Pyr., etc.—Same as for wolframite.

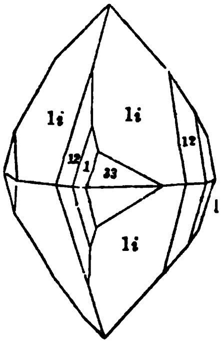
Obs.—Occurs at Schlackenwald, where it is sometimes altered, as shown by Blum to lithomarge; also at Sadisdorf; at Morococha, Peru.

614. SCHEELITE. Tennspat, Lapides stanniferi spathacei "lik en huit spat" (fr. Bohemia), *Wall.*, Min., 303, 1747. Not Tungsten von Bastnaes [=Cerite] *Cronst.*, Ak. H. Stockh., 1751, Min., 183, 1758. Stannum spathosum subdiaphanum album *Linn.*, Syst., 1768. Tungsten (= TUNGSTIC ACID and Lime) *Scheele*, Ak. H. Stockh., 1781. Schwerstein *Wern.*, Bergm. J., 386, 1789; *Karst.*, Tab., 26, 1791. Scheelerz *Karst.*, Tab., 56, 1800, 74, 1808. Tungstate of Lime. Scheelin calcaire *H.*, Tr., iv. 1801. Scheelspath *Breith.*, Char., 23, 1820. Scheelit *Leonh.*, Handb., 594, 1821.

Tetragonal; hemihedral. *O* ∧ 1-*i* = 123° 3′; *a* = 1·5369. Observed planes: *O*; vertical *I*, *i*-*ī*, but not common; pyramids, ⅓, ½, 1, ⅓-*i*, ½-*i*, 1-*i*, 3-3, 1-2; hemihedral in the planes 3-3 and 1-2.

O ∧ 1=114° 44′
O ∧ 3-3=101 38
O ∧ 1-2=120 21
1 ∧ 1, pyr.,=100 4
1 ∧ 1, bas.,=130 33
1-*i* ∧ 1-*i*, pyr.,=107° 18′
1-*i* ∧ 1-*i*, bas.,=113 54
1 ∧ 1-*i*=140 2
1-2 ∧ 1=156 59
3-3 ∧ 1=151 16

496



Schlackenwald.

Cleavage: 1 most distinct, 1-*i* interrupted, *O* traces. Twins: composition-face *I*; also *i*-*i*. Crystals usually octahedral in form, resembling f. 496. Also reniform with columnar structure; and massive granular.

H.=4·5—5. G.=5·9—6·076. Lustre vitreous, inclining to adamantine. Color white, yellowish-white, pale yellow, brownish, greenish, reddish; sometimes almost orange-yellow. Streak white. Transparent—translucent. Fracture uneven. Brittle.

Comp.—$\dot{Ca}\dddot{W}$=Lime 19·4, tungstic acid 80·6=100.

Analyses: 1, Klaproth (Beitr., iii. 44); 2, Berzelius (Afh. i Fys., iv. 305); 3, 4, Brandes & Bucholz (Schweig. J., xx. 285); 5, Himmelbach (ZS. G., xv. 607); 6, Bernouilli (Pogg., cxi. 607); 7, Choubine (Ann. d. M. Russ., 317, 1841); 8, Rammelsberg (Pogg., lxxviii. 514); 9, Bowen (Am. J. Sci., v. 118); 10, F. A. Genth (Am. J. Sci., II. xxviii. 252); 11, Domeyko (Ann. d. M., IV. iii. 15); 12, Delesse (Bull. G. Soc., II. x. 17):

	$\dddot{W}$	$\dot{Ca}$	$\ddot{Si}$	$\dddot{\bar{Fe}}$
1. Cornwall	75·25	18·70	1·50	1·25, $\dddot{\bar{Mn}}$ 0·75=97·45 Klaproth.
2. Westmannland, Sweden	80·42	19·40	—	—=99·82 Berzelius.
3. Schlackenwald	78·00	19·06	2·00	—=99·06 Brandes & Bucholz.
4. Zinnwald	76·50	16·60	2·94	1·50, $\dot{Ca}$ and $\dddot{\bar{Al}}$ 1·1=98·54 Brandes & B.
5. Riesengebirge	80·10[a]	19·30	—	*tr.*, $\dddot{\bar{Al}}$, $\dot{Mg}$ *tr.*, ign. 0·50 Himmelbach.
6. Traversella	80·70	19·25	—	—=99·95 Bernouilli.
7. Katherinenburg	78·41	18·88	—	—, $\dot{Mg}$ 0·65=97·94 Ch. G.=6·071.
8. Neudorf	78·64	21·56	—	—=100·20 Rammelsberg. G.=6·08
9. Monroe, Ct.	76·05	19·36	2·54	1·03, $\dddot{\bar{Mn}}$ 0·31=99·29 Bowen.
10. Bangle M., N. C.	79·52	19·31	—	0·18, $\ddot{Sn}$ 0·13, $\dot{Cu}$ 0·08=99·22 Genth.
11. Llamuco, Chili	75·75	18·05	0·75	—, $\dot{Cu}$ 3·30=97·85 Domeyko.
12. Framont	80·35	19·40	—	—=99·75 Delesse.

[a] Trace of silica.

The brothers Elhuyart obtained (see for ref. under WOLFRAM) $\dddot{W}$ 68, $\dot{C}a$ 30, ign. 2=100.

Pyr., etc.—B.B. in the forceps fuses at 5 to a semi-transparent glass. Soluble with borax to a transparent glass, which afterward becomes opaque and crystalline. With salt of phosphorus forms a glass, colorless in outer flame, in inner green when hot, and fine blue cold; varieties containing iron require to be treated on charcoal with tin before the blue color appears. In muriatic or nitric acid decomposed, leaving a yellow powder soluble in ammonia.

Obs.—Tungstate of lime is usually associated with crystalline rocks, and is commonly found in connection with tin ore, topaz, fluorite, apatite, molybdenite, or wolfram, in quartz.

Occurs at Schlackenwald and Zinnwald in Bohemia; in the Riesengebirge; in fine crystals at Caldbeck Fell, near Keswick, with apatite, molybdenite, and wolfram. Also at Schellgaden in Salzberg; Neudorf in the Harz; Ehrenfriedersdorf in Saxony; Pösing in Hungary; Traversella in Piedmont, in fine crystals, sometimes transparent; Dalecarlia and Bitsberg in Sweden; Framont in the Vosges, with pyrite in polished crystals, giving Delesse for the angles of octahedron 1, 100° 5′ and 130° 31′, G.=6·05; at the copper mines of Llamuco, near Chuapa in Chili, of a reddish-gray color, mixed with green, due to chrysocolla.

In the United States, crystallized and massive at Lane's Mine, Monroe, and at Huntington, Conn., with wolfram, pyrite, rutile, and native bismuth, in quartz; at Chesterfield, Mass., in albite, with tourmaline; in the Mammoth mining district, Nevada; at Bangle mine, in Cabanas Co., N. C.; and Flowe mine, Mecklenburg Co., some crystals at the latter locality having a nucleus of wolfram.

Tungstic acid was discovered in this species by the Swedish chemist Scheele, in 1781. The word *tungsten*, first used by Cronstedt, is Swedish for *heavy stone*.

Alt.—Occurs altered to wolfram, a tungstate of iron and manganese, by the action of a solution of bicarbonate of iron and manganese, or perhaps mainly through sulphate of iron arising from the decomposition of pyrite. Also to kaolinite (at Ehrenfriedersdorf).

615. CUPROSCHEELITE. *J. D. Whitney*, Proc. Cal. Acad., iii. 287, 1866.

Crystalline-granular. Cleavage distinct in one direction.

H.=4·5—5. Lustre highly vitreous. Color pistachio-green, passing to olive- and leek-green. Streak light greenish-gray.

Comp.—O. ratio for $\dot{R}$, $\dddot{W}$=1 : 3; $\dot{C}u\,\dddot{W}+2\,\dot{C}a\,\dddot{W}$=Tungstic acid 78·43, oxyd of copper 8·95, lime 12·62=100. Analysis: Whitney (l. c.):

$\dddot{W}$ 79·69 $\dot{C}u$ 6·77 $\dot{F}e$ 0·31 $\dot{C}a$ 10·95 $\dot{H}$ 1·40=99·12.

Pyr., etc.—In the closed tube blackens, and gives off water. B.B. fuses on the edges to a black glass, and colors the flame an intense green. On charcoal blackens, fuses with a little intumescence, forming finally a slag containing minute particles of metallic copper. With fluxes gives tungstic acid and copper reactions. Easily soluble in muriatic acid, tungstic acid being separated.

Obs.—Occurs in the vicinity of La Paz, Lower California, in a red metamorphic rock, associated with black tourmaline.

Domeyko has analyzed a mineral from Chili containing 3·3 p. c. of oxyd of copper. See under SCHEELITE, anal. 11.

616. STOLZITE. Scheel-Bleispath *Breith.*, Char., 14, 1820. Tungstate of Lead. Bleischeelat, Wolframbleierz, Scheelsaures Blei, *Germ.* Scheelitine *Beud.*, Tr., ii. 662, 1832. Stolzit *Haid.*, Handb., 504, 1845.

Tetragonal. $O \wedge 1\text{-}i=122°\ 33'$; $a=1{\cdot}567$. Usual forms octahedral. Observed planes: I, 1, $\frac{1}{2}$, 2, $1\text{-}i$; sometimes hemihedral.

$O \wedge \frac{1}{2}=132°\ 4'$	$1 \wedge 1$, pyr.,$=99°\ 44'$	$1\text{-}i \wedge 1\text{-}i$, pyr.,$=106°\ 50'$
$O \wedge 1=114\ 17$	$1 \wedge 1$, bas.,$=131\ 25$	$1\text{-}i \wedge 1\text{-}i$, bas.,$=114\ 54$
$O \wedge 2=102\ 42$	$2 \wedge 2$, pyr.,$=92\ 46$	$2 \wedge 2$, bas.,$=154\ 36$

Crystals often indistinctly aggregated. Cleavage: O imperfect; 1 still more so.

H.=2·75—3. G.=7·87—8·13. Lustre resinous, subadamantine. Color green, yellowish-gray, brown, and red. Streak uncolored. Faintly translucent.

Comp.—$\dot{Pb}\,\dddot{W}$=Tungstic acid 51, oxyd of lead 49=100. Analyses: 1, Lampadius (Schw. J., xxxi. 254); 2, Kerndt (J. pr. Ch., xlii. 116):

	$\dddot{W}$	$\dot{Pb}$	$\dot{Ca}$	$\dot{Fe}$, $\dot{Mn}$	
1. Zinnwald	51·75	48·25	——	——	=100 Lampadius.
2. "	(½) 51·736	45·993	1·397	0·471	Kerndt.

Pyr., etc.—B.B. decrepitates and fuses at 2 to a crystalline, lustrous, metallic pearl. With soda on charcoal yields metallic lead. With salt of phosphorus gives in O.F. a colorless glass, which in R.F. becomes blue on cooling. Decomposed by nitric acid, leaving a yellow residue of tungstic acid.

Obs.—Stolzite occurs at Zinnwald in Bohemia, with quartz and mica; at Bleiberg in Carinthia, with molybdate of lead; in Chili, province of Coquimbo; at Southampton, Mass.

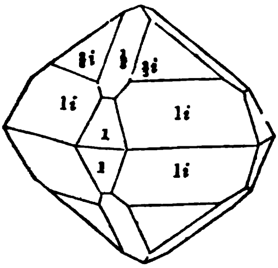
This species was first made known, according to Breithaupt, by Dr. Stolz, of Teplitz.

617. WULFENITE. Plumbum spatosum flavo-rubrum, ex Annaberg Austr. *v. Born*, Lithoph., i. 90, 1772. Kärntherischer Bleispath *v. Jacquin*, Miscell. Austr., ii. 1781, Vienna; *Wulfen*, Abhandl. K. Bleisp., Wien, 1785, fol. Plomb jaune *de Lisle*, iii. 387, 1783. Gelbbleierz *Wern.*, Bergm. J., 384, 1789. Yellow Lead-spar, Molybdenated Lead Ore, *Kirwan*, ii. 212, 1796. Plomb molybdaté *H.*, iii. 358, 1801. Molybdate of Lead. Molybdänbleispath, Bleimolybdat, *Germ.* Melinose *Beud.*, ii. 664, 1832. Wulfenit *Haid.*, Handb., 504, 1841.

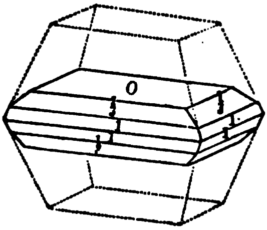
Tetragonal. Sometimes hemihedral. $O \wedge 1\text{-}i = 122°\ 26'$; $a = 1{\cdot}574$. Observed planes: O; square prismatic, I, $i\text{-}i$; octagonal prismatic, $i\text{-}3$, $i\text{-}\frac{3}{2}$, $i\text{-}\frac{4}{3}$, $i\text{-}\frac{5}{3}$; octahedral, $\frac{1}{16}$, $\frac{2}{9}$, $\frac{1}{3}$, 1, $\frac{3}{2}$; $\frac{1}{3}\text{-}i$, $\frac{1}{2}\text{-}i$, $\frac{2}{3}\text{-}i$, $1\text{-}i$, $\frac{3}{2}\text{-}i$. In modified square tables and octahedrons.

$O \wedge 1 = 114°\ 12'$	$1 \wedge 1$, bas.,$=131°\ 35'$	$\frac{2}{3}\text{-}i \wedge \frac{2}{3}\text{-}i$, bas.,$=92°\ 43'$
$1 \wedge 1$, pyr.,$=99\ 40$	$1\text{-}i \wedge 1\text{-}i$, pyr.,$=106\ 44$	$\frac{1}{2}\text{-}i \wedge \frac{1}{2}\text{-}i$, bas.,$=76\ 23$

497

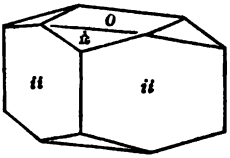


498



Phenixville.

499

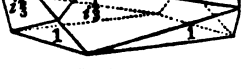


Phenixville.

Cleavage: 1 very smooth; O and $\frac{1}{3}$ much less distinct. Also granularly massive, coarse or fine, firmly cohesive. Often hemihedral in the octagonal prisms, producing thus tables like f. 500, and octahedral forms having the prismatic planes similarly oblique.

H.=2·75—3. G.=6·03—7·01. Lustre resinous or adamantine. Color wax-yellow, passing into orange-yellow; also siskin- and olive-green, yellowish-gray, grayish-white, brown; also orange to bright red.

500



Przibram.

Streak white. Subtransparent—subtranslucent. Fracture subconchoidal Brittle.

Var.—1. *Ordinary.* Color yellow. 2. *Vanadiferous.* Color orange to bright red, a variety occurring at Phenixville, Pa.

Dauber found for the angle 1 ∧ 1, in crystals from Bleiberg, 131° 42′; fr. Berggieshübel, 131° 47′; fr. Phenixville, 131° 50′; fr. Zinnwald, 131° 57′; and v. Zepharovich. for crystals fr. Przibram, 131° 43′ 38″. The last corresponds to 114° 8′ for *O* ∧ 1. Descloizeaux found for *O* ∧ 1 on Antioquia crystals=114° 20′, and 1 ∧ 1=131° 40′.

Comp.— $\dot{\text{Pb}}\dddot{\text{Mo}}$=Molybdic acid 38·5, oxyd of lead 61·5=100. Analyses: 1, Göbel (Schw. J. xxxvii. 71); 2, Melling (Rammelsberg 1st Suppl., 59); 3, 4, Parry and J. Brown (Proc. Phil. Soc Glasgow, April, 1847); 5, C. Bergemann (Pogg., lxxx. 400); 6, 7, J. L. Smith (Am. J. Sci., II. xx 245):

	$\dddot{\text{Mo}}$	$\dot{\text{Pb}}$
1. Carinthia	40·5	59·0=99·5 Göbel.
2. "	40·29	61·90=102·19 Melling.
3. "	39·30	60·35=99·65 Parry.
4. "	39·19	60·23=99·42 Brown.
5. Zacatecas	37·65	62·35=100 Bergemann.
6. Phenixville, *yellow*	38·68	60·48=99·16 Smith. G.=6·95.
7. " *red*	37·47	60·30, $\dddot{\text{V}}$ 1·28=99·05 Smith.

A molybdate of lead from Pamplona, S. A., afforded Boussingault (Ann. Ch. Phys., xlv. 325) $\dot{\text{Pb}}$ 78·8, $\dddot{\text{Mo}}$ 10·0, $\ddot{\text{C}}$ 2·9, H Cl 1·3, $\bar{\ddot{\text{P}}}$ 1·3, $\dddot{\text{Cr}}$ 1·2, $\dddot{\bar{\text{Fe}}}$ 1·7, $\dddot{\bar{\text{Al}}}$ 2·2, quartz 3·7=98·1. He considers it a basic salt, with the formula $\dot{\text{Pb}}^3\dddot{\text{Mo}}$. Klaproth, who made the first complete analysis, obtained $\dddot{\text{Mo}}$ 34·25, $\dot{\text{Pb}}$ 64·02 (Beitr., ii. 275). A crystallized wulfenite from Chili gave Domeyko (Ann. d. M., IV. iii. 15) $\dddot{\text{Mo}}$ 46·12, $\dot{\text{Pb}}$ 47·00, $\dot{\text{Ca}}$ 0·88; corresponding to 2 $\dot{\text{Pb}}\dddot{\text{Mo}}+\dot{\text{Ca}}\dddot{\text{Mo}}$. The red color of the Phenixville mineral was shown to be due to vanadic acid by Smith. The massive wulfenite of Garmisch is a mixture of the mineral with quartz, carbonate of lead, etc. (Wittstein in Viertel-jahrsschr. pr. Pharm., vii. 70).

Pyr., etc.—B.B. decrepitates and fuses below 2; with borax in O.F. gives a colorless glass, in R.F. it becomes opaque black or dirty green with black flocks. With salt of phosphorus in O.F. gives a yellowish-green glass, which in R.F. becomes dark green. With soda on charcoal yields metallic lead. Decomposed on evaporation with muriatic acid, with the formation of chlorid of lead and molybdic acid; on moistening the residue with water and adding metallic zinc, it gives an intense blue color, which does not fade on dilution of the liquid.

Obs.—This species occurs in veins with other ores of lead. Found first at Bleiberg, Schwarzenbach, and Windisch-Kappel, in Carinthia; also at Ruskitza in Austria; at Retzbanya and Szaska in Hungary; at Przibram; at Moldawa in the Bannat, where its crystals are red, and have considerable resemblance to chromate of lead; in the Kirghis Steppes in Russia; at Annaberg, Schneeberg, and Johanngeorgenstadt in Saxony; at Badenweiler in Baden; sparingly at Chalanches, Dept. of Isère, in France; in the gold sands of Rio Chico in Antioquia, Columbia, S. A.; in Lackentyre, Kirkcudbrightshire, Scotland.

It is found in small quantities at the Southampton lead mine, Mass.; in fine yellow and reddish orange to red crystals (fig 499, and also in thin tables) at Wheatley's mine, near Phenixville, Pa.: at the Comstock lode in Nevada; at Empire mine, Inyo Co., Cal.; in the Weaver dist., Arizona.

For recent papers on cryst. see Dauber, Pogg., cvii. 267; Descl., Ann. Ch. Phys., III. li. 448; v. Zepharovich, Ber. Ak. Wien, liv. 278, 1866; J. L. Smith, Am. J. Sci., II. xx. 245.

618. PATERAITE. Paterait *Haid.*, C. v. Hauer, Jahrb. G. Reichs., vii. 196, 1856, xiv. 303.

Amorphous. Color black.

Composition $\dot{\text{Co}}\dddot{\text{Mo}}$. Analysis by Laube (l. c., xiv. 303):

$\dddot{\text{Mo}}$ 30·0 $\dddot{\bar{\text{Bi}}}$ 2·0 $\dddot{\bar{\text{Fe}}}$ 16·6 $\dot{\text{Co}}$ 27·0 $\dot{\bar{\text{H}}}$ 8·6 S 12·0, insol. 3·8=100.

The first examination of this mineral was by Patera, and was only qualitative. He found molybdic acid, silica, bismuth, iron, cobalt, and sulphur. Jokely states (Jahrb. G. Reichs., viii. 35) that it consists principally of vanadic and molybdic acids and cobalt. Laube's analysis confirms Patera's result. The mineral is so intimately mixed with pyrite and bismuthinite that, even with the greatest care, it could not be completely separated. Subtracting the bismuth, iron, and sulphur in the above analysis, molybdate of cobalt remains, which, according to Laube, is the true mineral.

B.B. in the closed tube gives water, a sublimate of molybdic acid, and vapors of sulphurous acid. On charcoal melts easily to a black bead, giving a white coating. With borax, bead green when hot (iron), blue when cold (cobalt). Easily soluble in acids.

Discovered by Vogl, in the Elias mine, Joachimsthal, with uranium ores.

Named from A. Patera, who first examined it.

619. DECHENITE. *C. Bergemann*, Pogg., lxxx. 393, 1850. Aræoxen *v. Kob.*, J. pr. Ch., l. 496, 1850. Eusynchit *Fischer & Nessler*, Ber. Ges. Freiburg, 1854, Jahrb. Min. 1856, 570. ? Rhombischer Vanadit *Zippe*, Ber. Ak. Wien, xliv. 1861 (see under DESCLOIZITE).

Massive, botryoidal, nodular, stalactitic; sometimes traces of a columnar structure.

H.=3—4. G.=5·6—5·81. Lustre of fresh fracture greasy. Color fine deep red to yellowish-red and brownish-red; also leather-yellow. Streak orange-yellow to ochre- and pale yellow.

Var.—The original *dechenite* was from Dahn, near Nieder Schlettenbach, in the Lauter Valley, Rhenish Bavaria, and was dull red to yellowish-red in color, botryoidal in surface, with G.=5·81. *rœoxene* is from the same locality, and is like dechenite in all its characters, except, accord- ng to Bergemann, a duller reddish-brown color, which, however, is not distinctive.

The *Eusynchite* is from Freiburg in Brisgau, yellowish-red to leather-yellow in color, with G.= ·596, Ramm, and H.=3·5; it occurs in nodular and stalactitic forms.

Comp.—$\dot{\mathrm{P}}\mathrm{b}\,\dddot{\mathrm{V}}$, or vanadate of lead, according to the older analyses; but probably in all cases anadate of lead and zinc, with the formula $(\dot{\mathrm{P}}\mathrm{b}, \dot{\mathrm{Z}}\mathrm{n})\,\dddot{\mathrm{V}}$.

Analyses: 1–3, C. Bergemann (l. c.); 4, id. (Jahrb. Min. 1857, 397); 5, v. Kobell (l. c.); 6, ischer & Nessler (l. c.); 7, 8, C. Czudnowicz (Pogg., cxx. 17); 9, Ramm. (J. pr. Ch., xci. 418):

		$\dddot{\mathrm{V}}$	$\dot{\mathrm{P}}\mathrm{b}$	$\dot{\mathrm{Z}}\mathrm{n}$
1.	Dahn, *Dechenite*, *red*	47·16	52·92	——=100·08 Bergemann.
2.	" " "	46·10	53·72	——=99·82 Bergemann.
3.	" " *ywh.*	49·27	50·57	——=99·84 Bergemann.
4.	" *Aræoxene*	16·81	52·55	18·11, $\dddot{\mathrm{A}}\mathrm{s}$ 10·52, $\dddot{\mathrm{A}}\mathrm{l}$, $\dddot{\mathrm{F}}\mathrm{e}$ 1·34, $\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{P}}$ *tr.*=99·83 Berg.
5.	" "	——	48·7	16·32 Kobell.
6.	Freiburg, *Eusynchite*	22·69	55·70	——, $\ddot{\mathrm{S}}\mathrm{i}$ 0·94, $\dddot{\mathrm{V}}$ 20·49=99·82 F. & N.
7.	" "	[28·55]	56·47	16·78, $\ddot{\mathrm{S}}\mathrm{i}$ 3·20, $\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{P}}$ *tr.*=100 Czudn.
8.	" "	[19·17]	53·91	21·41, $\ddot{\mathrm{S}}\mathrm{i}$ 5·51, $\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{P}}$ *tr.*=100 Czudn.
9.	" "	[24·22]	57·66	15·80, $\dot{\mathrm{C}}\mathrm{u}$ 0·68, $\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{P}}$ 1·14, $\dddot{\mathrm{A}}\mathrm{s}$ 0 50=100 Ramm.

The fact that both dechenite and eusynchite contain a considerable amount of oxyd of zinc was iown by G. J. Brush in 1857 (Am. J. Sci., II. xxiv. 116), and the identity of eusynchite and æoxene with dechenite suggested. Fischer & Nessler's method of determining the vanadic acid as incorrect (Czudnowicz).

Pyr., etc.—B.B. fuses easily without decrepitation to a yellow glass. On charcoal in R.F. ves lead globules and a white coating, which, treated with cobalt solution, becomes green (zinc). ith salt of phosphorus and borax gives an emerald-green bead in R.F., becoming yellowish-green yellow in O.F. Decomposed by hot muriatic acid, yielding an emerald-green solution. This ated with alcohol, boiled and decanted from the separated chlorid of lead, yields, after evapora- n, a solution which, diluted with water, has an azure-blue color (v. Kobell).

Obs.—Occurs with other ores of lead.

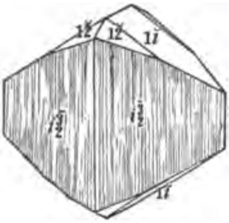
Discovered at Dahn by Dr. Krantz.

Named after the German geologist, von Dechen.

O. DESCLOIZITE. *A. Damour*, Ann. Ch. Phys., III. xli. 72, 78, 1854. Rhombischer Vanadit *Zippe*, Ber. Ak. Wien, xliv. i. 197, 1861, *Tschermak*, ib., ii. 157.

Orthorhombic. $I \wedge I = 100° 28'$; $O \wedge 1\text{-}\bar{i} = 143° 14'$; $a : b : c = 0·747 :$ 1 2052. Angles, Descloizeaux:

501



$i\text{-}\frac{\bar{3}}{2} \wedge i\text{-}\frac{\bar{3}}{2}=122°\ 6'$ $1\text{-}\breve{2} \wedge 1\text{-}\breve{2}$, ov. base, $=91°42$
$1\text{-}\breve{i} \wedge 1\text{-}\breve{i}$, top, $=116\ \ 25$ $1\text{-}\breve{2} \wedge 1\text{-}\breve{i}=147\ \ 35$
$1\text{-}\breve{2} \wedge 1\text{-}\breve{2}$, adj., $=127\ \ 10$ $O \wedge 1\text{-}\breve{i}=148\ \ 12\frac{1}{2}$
$1\text{-}\breve{2} \wedge 1\text{-}\breve{2}$, ov. $1\text{-}\breve{i}$, $=115\ 10$

Cleavage none. Plane $1\text{-}\breve{2}$ brightest, $1\text{-}\breve{i}$ undulated $i\text{-}\frac{\bar{3}}{2}$ vertically striated.

H.=3·5. G.=5·839. Lustre bright. Colo black to olive-brown; smallest crystals olive-green with a chatoyant bronze lustre; by transmitte light along the edges light brown inclining to red; on a surface of fracture colors zoned with straw-yellow, reddish-brown, and black; nearly clear a middle and darkest at extremities of crystals.

Comp.—$\dot{\mathrm{P}}\mathrm{b}^2\dddot{\mathrm{V}}$=Vanadic acid 29·3, oxyd of lead 70·7=100. Analyses: Damour (l. c.):

	$\dddot{\mathrm{V}}$	$\dot{\mathrm{P}}\mathrm{b}$	$\dot{\mathrm{Z}}\mathrm{n}$	$\dot{\mathrm{C}}\mathrm{u}$	$\dot{\mathrm{F}}\mathrm{e}$	$\dot{\mathrm{M}}\mathrm{n}$	$\dot{\mathrm{H}}$	Cl	$\dddot{\overline{\mathrm{Mn}}}$	Sand
(§)	22·46	54·70	2·04	0·90	1·50	5·32	2·20	0·32	6·00	3·44=98·88.

The oxyds of manganese, iron, copper, and zinc are regarded as impurities.

Pyr., etc.—In the closed tube gives water. B.B. on charcoal fuses, and is partially reduce to a globule of metallic lead enveloped in a black scoria. With borax in R.F. a green glass, an with nitre in O.F. a violet color due to manganese. With salt of phosphorus in R.F. a glass a chrome-green color, which is orange-yellow in the O.F. Dissolves in cold dilute nitric acid.

Obs.—Occurs in small crystals, 1 to 2 mm. thick, clustered on a siliceous and ferruginous gangu from South America, and associated with acicular green pyromorphite

Zippe's *vanadite* (l. c.) is referred to descloizite by A. Schrauf (Pogg., cxvi. 355, 1862). Th mineral occurs at Kappel in Carinthia, in small clove-brown rhombic octahedrons, with G.=5· Tschermak obtained in his analysis (Ber. Ak. Wien, xliv. ii. 158) $\dddot{\mathrm{V}}$ 45·7, $\dot{\mathrm{P}}\mathrm{b}$ 54·3=100 (with n zinc, although looked for), and referred the species to dechenite. Grailich & Weiss (Pogg., l. c make the form orthorhombic, and the angles $1\text{-}\breve{2} \wedge 1\text{-}\breve{2}$=125° 28'—125° 56', 113° 15'—113° 35 and 90° 8'—91° 30'. But A. Schrauf finds for the same angles 126°—128°, 114½°—115½°, 91°—92°, agreeing closely with the above of descloizite. Schrauf suggests that both descloizite an vanadite are dechenite; and Tschermak (Pogg., cxvii. 349) that vanadite and dechenite are on species, and descloizite an altered vanadite.

Named after the French mineralogist Descloizeaux.

620A. *Vanadate of Lead*, from Phenixville, Pa. A thin crystalline crust of a dark purple almost black color, but dark hyacinth-red by transmitted light, and of a dark yellow streak occurs covering quartz, ferruginous clay, and wulfenite, at Phenixville. With a magnifying glas it appears to consist of minute lenticular crystals. It could not be wholly separated from th associated wulfenite and other impurities for analysis, and the result obtained is therefore no wholly satisfactory. J. L. Smith found (Am. J. Sci., II. xx. 247, 1855): $\dddot{\mathrm{V}}$ 11·70, $\dddot{\mathrm{M}}\mathrm{o}$ 20·14, Pl 55·01, $\dddot{\overline{\mathrm{Mn}}}$, $\dddot{\overline{\mathrm{Al}}}$ 5·90, $\dot{\mathrm{C}}\mathrm{u}$ 1·13, sand 2·21, aq 2·94=99·03. Subtracting the lead required by the molyb dic acid to make wulfenite, it leaves 22·82 p. c. for the 11·70 of vanadic acid; which is nearer th composition of descloizite than that of dechenite.

621. VANADINITE. Plomb brun, Braunbleierz of Zimapan, *early authors.* Chromate d Plomb brun (from Descotil's anal.) *Brongn.*, Min., ii. 204, 1807. Vanadinbleierz *G. Rose*, Pogg. xxix. 455, 1833. Vanadinit *v. Kob.*, Grundz., 283, 1838. Vanadate of Lead. Vanadinspath Vanadinbleispath, Vanadinsaures Blei, *Germ.* Plomo pardo *Domeyko.*

Hexagonal. In simple hexagonal prisms, and prisms terminating i planes of the pyramids 1, $\frac{5}{2}$, 1-2, and 2-2; 1 ∧ 1, over terminal edge, 142° 58′, $O \wedge 1$=140° 34′, $I \wedge 1$=130°. Usually in implanted globules or incrustations.

H.=2·75—3. G.=6·6623—7·23; 6·886, Carinthia, Ramm.; 6·863, Beresof, Struve. Lustre of surface of fracture resinous. Color light brownish-yellow, straw-yellow, reddish-brown. Streak white or yellowish. Sub translucent—opaque. Fracture uneven, or flat conchoidal. .Brittle.

Comp.—$\dot{\mathrm{P}}\mathrm{b}^3\,\dddot{\bar{\mathrm{V}}} + \frac{1}{3}\,\mathrm{Pb\,Cl}$=Vanadate of lead 90·3, chlorid of lead 9·7=100. **Analyses:** 1, Berzelius (Schw. J., lxiii. 119); 2, R. D. Thomson (Thoms. Min., i. 574); 3, Damour (Ann. d. M., III. xi. 161); 4, Rammelsberg (Min. Ch., 316); 5, 6. Struve (Verh. Min. Ges. St. Petersb., 1857):

	$\dddot{\bar{\mathrm{V}}}$	$\dot{\mathrm{P}}\mathrm{b}$	Pb	Cl	$\dddot{\bar{\mathrm{P}}}$
1. Zimapan	74·00		25·33		——, $\ddot{\mathrm{F}}\mathrm{e}^2\dot{\mathrm{H}}^3$ 0 67=100 Berz.
2. Scotland	23·44	66·33	7·06	2·45	——, $\ddot{\mathrm{F}}\mathrm{e}$ and $\dddot{\mathrm{S}}\mathrm{i}$ 0·16=99·43 Thomson.
3. ?	15·86	63·73	6·62	2·26	——, $\dot{\mathrm{Z}}\mathrm{n}$ 6·35. $\dot{\mathrm{C}}\mathrm{u}$ 2·96, $\dot{\mathrm{H}}$ 3·80=101·60 D.
4. Carinthia	17·41	69·68	6·52	2·23	0·95=96·79 Ramm.
5. Beresof	16·98	71·73	7·18	2·46	3·08=101·43 Struve.
6. "	14·54	71·14	7·18	2·46	2·79=98·11 Struve.

Pyr., etc.—In the closed tube decrepitates and yields a faint white sublimate. B.B. fuses easily, and on charcoal to a black lustrous mass, which in R.F. yields metallic lead and a coating of chlorid of lead; after completely oxydizing the lead in O.F. the black residue gives with salt of phosphorus an emerald-green bead in R.F., which becomes light yellow in O.F. Gives the chlorine reaction with the copper test. Fused with 3 parts of bisulphate of potash forms a clear yellow mass, which on cooling reddens, becoming finally of a pomegranate-yellow color. Decomposed by muriatic acid.

If nitric acid be dropped on the crystals they become first deep red from the separation of vanadic acid, and then yellow upon its solution.

Obs.—This mineral was first discovered at Zimapan in Mexico, by Del Rio. It has since been obtained among some of the old workings at Wanlockhead in Dumfriesshire, where it occurs in small globular masses, sprinkled over calamine, or forming thin coatings on the surface of that mineral, and also in hexagonal crystals, the largest not more than ¼ in. across; also at Beresof in the Ural, with pyromorphite; and near Windisch Kappel in Carinthia, in crystals, the angles as above given. This mineral has never been found at Wicklow, Ireland, although so reported by Thomson (Greg and Lettsom).

Schabus gives for the forms from Windisch Kappel *I*, 1; *I*, 1, ½; *I*, 1, 2-2; *O*, *I*, 1, ½; *O*, *I*, 1, 1-2. The basal angle of pyramid 1 in different crystals was 78° 46′—78° 54′. The angles are very near those of mimetite and pyromorphite, the basal angle in the former being 79° 24′—80° 48′; and in pyromorphite of Bleistadt, 80° 40′ (Pogg., c. 297).

Kokscharof regards the crystals from Beresof as pseudomorphs after pyromorphite; and Struve observes that the crystals contain at centre a portion of unaltered pyromorphite (Min. Russl., iii. 44). Del Rio discovered this species at Zimapan, and obtained from it, in 1801, 80·72 of oxyd of lead, and 14·8 of a new metallic acid, the basis of which he called *Erythronium*. This result was set aside by himself in the Ann. des Sci. Nat. de Madrid, Feb. 1804 (Ann d. M., iv. 1819), and also by Descotils in the Ann. Ch., liii. 1805, both of whom made the acid the chromic, and the mineral a *brown* chromate of lead. The metal vanadium was not discovered by Sefstrom until 1830, and then in iron made of ore from Taberg, Sweden; and in the same year Wöhler showed that Del Rio's lead ore was a vanadate.

522. VOLBORTHITE.

Hess, Bull. Ac. St. Pet., iv. 1838, and J. pr. Ch., xiv. 52. Knauffite.
Vanadate of Copper. Vanadinsaures Kupfer.

Hexagonal. In small six-sided tables, often aggregated in globular forms. leavage: in one direction very perfect.

H.=3—3·5. G.=3·55, Credner. Lustre pearly to vitreous. Color live-green, citron-yellow. Streak clear yellowish-green, nearly yellow. hin splinters translucent.

Comp.—According to Hess (l. c.) a hydrous vanadate of copper.

Pyr., etc.—B.B. on charcoal fuses easily to a black bead, which in the inner flame becomes lackish-gray. With soda on charcoal yields copper; with borax and salt of phosphorus reacous for copper. Fused with soda in the platinum spoon, the mass yields on treatment with ater a solution which, acidulated with muriatic acid and boiled, gives an emerald-green soluon, and this diluted with water becomes blue; v. Kobell.

Obs.—From Syssersk and Nischne Tagilsk in the Urals, where it was found by Dr. A. Volborth, d from several mines of the Permian formation in the government of Perm, especially at the lexandroff mine in the Motowilich District.

622A. **Vanadate of Lime and Copper** (Kalk-Volborthit). Near volborthite, but containing lime, and found at Friedrichsrode in Thuringia. There are two varieties, according to Credner (Pogg., lxxiv. 546, 1848); (1) a green, in thin tables, cleaving easily in one direction, greenish-yellow in streak, pearly in lustre, with G.=3·495; (2) a gray, fine crystalline granular, brownish-yellow in streak, with H.=3·5, and G.=3·860.

Analyses by Credner (l. c.):

	$\dddot{\mathrm{V}}$	$\dot{\mathrm{Cu}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Mn}}$	$\dot{\mathrm{H}}$		
1. *Green*	(½) 36·58	44·15	12·28	0·50	0·40	4·62,	gangue	0·10=98·63
2. *Light-green*	[36·91]	38·90	17·40	0·87	0·53	4·62,	"	0·77=100.
3. *Gray*	39·02	38·27	16·65	0·92	0·52	5·05,	"	0·76=101·19

The results correspond most nearly with the formula $(\dot{\mathrm{Cu}}, \dot{\mathrm{Ca}})^4 \dddot{\mathrm{V}} + aq$. The ratio of $\dot{\mathrm{Cu}}$ to $\dot{\mathrm{Ca}}$ in No. 1 is about 5 : 2; and in 2 and 3, 3 : 2.

623. **Chileite** *Kenng.*, Mohs'sche Min., 28, 1853 (Vanadate of Lead & Copper *Domeyko*, Ann. d. M., IV. xix. 150, 1848; Vanadinkupferbleierz). This ore has a dark brown or brownish black color, and has been observed only in an earthy state, looking much like a ferruginous clay or earth. It occurs in cavities in an arseno-phosphate of lead along with amorphous carbonates of lead and copper. B.B. fuses easily, and affords a black pearl, a little blebby; gives a clear green pearl with salt of phosphorus or borax, and a globule of lead containing copper on charcoal. In nitric acid easily soluble.

Comp.—$\dot{\mathrm{Pb}}^6 \dddot{\mathrm{V}} + \dot{\mathrm{Cu}}^6 \dddot{\mathrm{V}}$. Analyses by Domeyko (l. c.):

	$\dddot{\mathrm{V}}$	$\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{As}}$	$\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{P}}$	$\dot{\mathrm{Cu}}$	$\dot{\mathrm{Pb}}$	Pb Cl	$\dot{\mathrm{Ca}}$	$\dddot{\mathrm{Fe}}, \dddot{\mathrm{Al}}$	$\dddot{\mathrm{Si}}$	$\dot{\mathrm{H}}$		
1.	13·5	4·6	0·6	14·6	54·9	0·3	0·5	3·5	1·0	2·70,	clay	1·0=97·2.
2.	13·33	4·68	0·68	16·97	51·97	0·37	0·58	3·42	1·33	2·70,	"	1·52=97·55.

Considering the arsenic and phosphoric acids as combined with lead, constituting the arsenophosphate with which the mineral is associated, the analysis affords very closely the above formula.

This ore occurs at the silver mine called Mina Grande, or Mina de la Marqueza, in Chili, til recently worked for copper and silver.

623A. *Vanadate from the Lake Superior Copper Region.* An ore similar in color and clayey appearance to Domeyko's mineral, has been announced by J. E. Teschemacher among specimens from the Cliff Mine, in the Lake Superior Copper Region. The presence of vanadium was ascertained by both blowpipe and acid tests. The color is a dark chocolate, and also a bright yellow. The exact state of composition of the vanadic acid is doubtful. There is no oxyd of lead in the ore, and the brown variety is mixed with an earthy oxyd of iron; when carefully separated from the gangue it was found to contain no copper. This Min., 531, 1850.

6. SULPHATES, CHROMATES, TELLURATES.

In crystalline form, specific gravity, and color, the Sulphates vary almost indefinitely. The hardness is not above 4. The Chromates have bright, deep red, and green to brown colors, with the hardness 2·5—3·5. No native hydrous chromates are known.

The compounds of sulphates and carbonates, or sulphato-carbonates, have the crystallization of the sulphates, the carbonic acid being wholly subordinated, as regards the form produced, to the sulphuric, the more powerful acid. Thus *leadhillite* is homœomorphous with anglesite, celestine, etc., *susannite* with dreelite, and *lanarkite* with glauberite; and these species are accordingly here included.

General Pyrognostic Characters of the Sulphates. The sulphates of the alkalies, the alkaline earths, and oxyd of lead, are not decomposed by heating in the matrass or closed tube; other sulphates, such as those of protoxyd of iron, manganese, etc., are partially decomposed with the evolution of sulphurous and sulphuric acids. On charcoal the sulphates of the alkalies and alkaline earths are in R.F. reduced to sulphids, which, moistened with dilute muriatic acid, evolve sulphuretted hydrogen; the other sulphates thus treated give off sulphurous acid, and leave earths or metallic oxyds, or metals or metallic sulphids, and sometimes, where the metal is volatile, coat the coal with oxyd. All non-volatile sulphates when fused with soda or neutral oxalate of potash on charcoal yield a hepatic mass, which is more or less absorbed by the coal; when this is removed, and placed on a bright clean surface of silver with a drop or two of water, it stains the metal yellowish-brown to black from the formation of sulphid of silver; treated with muriatic acid the fused mass evolves sulphuretted hydrogen. In soluble minerals the sulphuric acid may be readily detected on adding to the solution a few drops of soluble baryta salt, which produces a white precipitate, insoluble in acids and in ammonia.

I. ANHYDROUS.

ARRANGEMENT OF THE SPECIES.

1. *Oxygen ratio between bases and acid* 1 : 3.

I. SULPHATITE GROUP.

625. **Sulphatite**	$\dot{H}\dddot{S}$	$S\Theta_2\|\Theta_2\|H_2$

II. CELESTITE GROUP. Orthorhombic; $I \wedge I = 100°-105°$.

626. ? **Taylorite**	$(\frac{5}{6}\dot{K}+\frac{1}{6}NH^4O)\dddot{S}$	$S\Theta_2\|\Theta_2\|(\frac{5}{6}K_2+\frac{1}{6}Am_2)$
627. **Aphthitalite**	$\dot{K}\dddot{S}$	$S\Theta_2\|\Theta_2\|K_2$
628. **Misenite**	$(\frac{1}{2}\dot{K}+\frac{1}{2}\dot{H})\dddot{S}$	$S\Theta_2\|\Theta_2\|(\frac{1}{2}K_2+\frac{1}{2}H_2)$
629. **Thenardite**	$\dot{Na}\dddot{S}$	$S\Theta_2\|\Theta_2\|Na_2$
630. **Barite**	$\dot{Ba}\dddot{S}$	$S\Theta_2\|\Theta_2\|Ba$
631. **Celestite**	$\dot{Sr}\dddot{S}$	$S\Theta_2\|\Theta_2\|Sr$
632. **Anhydrite**	$\dot{Ca}\dddot{S}$	$S\Theta_2\|\Theta_2\|\Theta a$
633. **Anglesite**	$\dot{Pb}\dddot{S}$	$S\Theta_2\|\Theta_2\|Pb$
634. ? **Zinkosite**	$\dot{Zn}\dddot{S}$	$S\Theta_2\|\Theta_2\|Zn$
635. **Leadhillite**	$\dot{Pb}\dddot{S}+3\dot{Pb}\ddot{C}$	$S\Theta_2\|\Theta_2\|Pb+3[\Theta\Theta\|\Theta_2\|Pb]$

III. CALEDONITE GROUP. Orthorhombic; $I \wedge I =$ about 95°.

636. **Caledonite**	$?\dot{Pb}\dddot{S}+(\dot{Pb},\dot{Cu})\ddot{C}$	

IV. DREELITE GROUP. Rhombohedral; $R \wedge R = 92°-94°$.

637. **Dreelite**	$(\frac{3}{4}\dot{Ba}+\frac{1}{4}\dot{Ca})\dddot{S}$	$S\Theta_2\|\Theta_2\|(\frac{3}{4}Ba+\frac{1}{4}\Theta a)$
638. **Susannite**	$\dot{Pb}\dddot{S}+3\dot{Pb}\ddot{C}$	$S\Theta_2\|\Theta_2\|Pb+3[\Theta\Theta\|\Theta_2\|Pb]$
639. **Connellite**	$?\dddot{S}, \dot{Cu}, Cl$	

V. GLAUBERITE GROUP. Monoclinic; $I \wedge I = 83°-86°$.

640. **Glauberite**	$(\frac{1}{2}\dot{Na}+\frac{1}{2}\dot{Ca})\dddot{S}$	$S\Theta_2\|\Theta_2\|(\frac{1}{2}Na_2+\frac{1}{2}\Theta a)$
641. **Lanarkite**	$\dot{Pb}\dddot{S}+\dot{Pb}\ddot{C}$	$S\Theta_2\|\Theta_2\|Pb+[\Theta\Theta\|\Theta_2\|Pb]$

VI. CROCOITE GROUP. Contain chromic acid. Monoclinic.

642. CROCOITE	$\dot{\mathrm{Pb}}\,\dddot{\mathrm{Cr}}$	$\mathrm{Cr}\,\Theta_2\|\Theta_2\|\mathrm{Pb}$

2. *Oxygen ratio between bases and acid* 1 : 2.

I. Contain chromic acid and protoxyd bases.

643. PHŒNICOCHROITE	$\dot{\mathrm{Pb}}^3\,\dddot{\mathrm{Cr}}^2$	$\mathrm{Cr}_2\,\Theta_3\|\Theta_6\|\mathrm{Pb}_3$
644. VAUQUELINITE	$(\frac{2}{3}\dot{\mathrm{Pb}}+\frac{1}{3}\dot{\mathrm{Cu}})^3\,\dddot{\mathrm{Cr}}^2$	$\mathrm{Cr}_2\,\Theta_3\|\Theta_6\|(\frac{2}{3}\mathrm{Pb}+\frac{1}{3}\mathrm{Cu})_3$
645. JOSSAITE		

II. Contain sesquioxyd bases.

646. PETTKOITE	$(\frac{1}{3}\dot{\mathrm{Fe}}^3+\frac{2}{3}\overset{\cdots}{\mathrm{Fe}})\,\dddot{\mathrm{S}}^2$	$\mathrm{S}_2\,\Theta_3\|\Theta_6\|(\frac{1}{3}\mathrm{Fe}+\frac{2}{3}\beta\mathrm{Fe})_3$
647. ALUMIAN	$\overset{\cdots}{\mathrm{Al}}\,\dddot{\mathrm{S}}^2$	$\mathrm{S}_2\,\Theta_3\|\Theta_6\|\beta\,\mathrm{Al}_3$

625. SULPHATITE. Sulphuric Acid. Schwefelsäure *Germ.* Sulphatite *Dana.*

Liquid. G.=1·85. Colorless. Odor pungent. Taste intensely acid.

Comp.—$\dot{\mathrm{H}}\,\dddot{\mathrm{S}}$=Sulphuric acid 81·6, and water 18·4=100.

Obs.—This acid, in a dilute state, has been found in the neighborhood of several volcanoes. It occurs near Sienna, in the cavities of the small volcanic mountain named Zocolino, and in a cavern near Aix, in Savoy. Water strong with sulphuric acid occurs at Alabama, Genesee Co., N. Y.; also at Tuscarora, near Brantford; at Chippewa, Niagara, and at St. David's, Canada West. The first afforded W. J. Craw and H. Erni for 1000 parts of water (Am. J. Sci., II. ix. 449), and the Tuscarora water, T. S. Hunt (Rep. G. Can., 150, 1847, 545, 1863):

	Free $\dddot{\mathrm{S}}$	$\dot{\mathrm{Fe}}\,\dddot{\mathrm{S}}$	$\overset{\cdots}{\mathrm{Al}}\,\dddot{\mathrm{S}}^3$	$\dot{\mathrm{Ca}}\,\dddot{\mathrm{S}}$	$\dot{\mathrm{Mg}}\,\dddot{\mathrm{S}}$	$\dot{\mathrm{K}}\,\dddot{\mathrm{S}}$	$\dot{\mathrm{Na}}\,\dddot{\mathrm{S}}$	$\ddot{\mathrm{Si}}$	Na Cl	
1.	2·0122	0·4356	0·3702	1·1065	0·4592	0·1061	0·1196	0·0656	———	=4·6750 Erni.
2.	2·0070	0·4266	0·3282	1·1161	0·5305	0·0822	0·0945	0·0368	0·0684	=4·6848 Craw.
3.	4·2895*	0·3638	0·4681	0·7752	0·1539	0·0608	0·0502	———	$\overset{\cdots}{\mathrm{P}}$ *tr.*	=6·1615 Hunt.

* SO^3 HO.

The water for Hunt's analysis was taken in October, 1847; another portion taken in April, 1846, afforded Croft 2·9069 of sulphuric acid, with the bases in quite different proportions.

The specific gravity of the Alabama water is 1·00482 at 15° C., Erni; of that of Tuscarora 1·00558.

Sulphuric acid results from the oxydation of sulphuretted hydrogen.

Paramo de Ruiz in New Granada, and Rio Vinagre, are volcanic localities.

626. TAYLORITE. Sulphate of Potash and Ammonia *W. J. Taylor*, Proc. Ac. N. Sci. Philad., 309, 1859.

In small compact lumps or concretions; structure crystalline.

H.=2. Color yellowish-white. Taste pungent and bitter. Unalterable in the air.

Comp.—$(\frac{5}{6}KO+\frac{1}{6}NH^4O)\,SO^3$=Sulphuric acid 47·8, potash 47·0, ammonia 5·2=100. Analyses: W. J. Taylor (l. c.):

	$\dddot{\mathrm{S}}$	$\dot{\mathrm{Na}}$	$\dot{\mathrm{K}}$	NH^4O	
1.	48·40	1·68	43·45	5·37,	org. matter *tr.*=98·90.
2.	48·30	46·49		5·10,	" " *tr.*=99·89.

Pyr., etc.—B.B. on platinum foil blackens and fuses with difficulty, leaving a white bead, which is soluble in water and tastes a little saline and bitter. Heated in a platinum crucible becomes first black and then snow-white, not fusing at a high heat (Taylor).

Obs.—From the guano beds of the Chincha Islands.

An artificial sulphate of potash and alumina is described by Link as early as 1796, in Crell's Annalen, i. 29.

627. APHTHITALITE. Vesuvian Salt *Smithson*, Phil. Trans. R. Soc., 1813. Aphthalose *Beud.*, Tr., ii. 477, 1832. Aphthitalite, *Shepard*, Min., i. 36, 1835. Arcanite *Haid.*, Handb., 492, 1845. Glaserite *Hausm.*, Handb., 1847. Sulphate of Potash. Schwefelsaures Kali, Kalisulphat, *Germ.* Potasse sulfatée *Fr.*

Orthorhombic. $I \wedge I=104^\circ\ 52'$, $O \wedge 1\text{-}\bar{i}=119^\circ\ 46'$; $a:b:c=1{\cdot}749:1:1{\cdot}3$. Observed planes: O, $1\text{-}\bar{i}$, $\frac{1}{3}\text{-}\bar{i}$, $i\text{-}\bar{i}$, $1\text{-}\breve{i}$, $\frac{1}{2}\text{-}\breve{i}$, $i\text{-}\breve{i}$, 1, $2\text{-}\breve{2}$. $O \wedge \frac{1}{3}\text{-}\bar{i}=149^\circ\ 46'$, $O \wedge \frac{1}{2}\text{-}\breve{i}=146^\circ\ 4'$, $1\text{-}\bar{i} \wedge 1\text{-}\bar{i}$, basal, $=120^\circ\ 29'$, $1\text{-}\breve{i} \wedge 1\text{-}\breve{i}$, id., $=106^\circ\ 46'$, $\frac{1}{3}\text{-}\bar{i} \wedge \frac{1}{3}\text{-}\bar{i}$, id., $=60^\circ\ 28'$, $\frac{1}{2}\text{-}\breve{i} \wedge \frac{1}{2}\text{-}\breve{i}=67^\circ\ 52'$. Occurs in thin tables, and in blades made up of aggregated crystals; also massive, or imperfectly mammillary, and in crusts.

H.$=3-3{\cdot}5$. G.$=1{\cdot}731$. Lustre vitreous, inclined to resinous. Color white, sometimes tinged with blue or green. Transparent to translucent, or opaque. Taste saline and bitter, disagreeable. Unalterable in the air.

Comp.—$\dot{K}\,\dddot{S}$=Potash 54·1, sulphuric acid 45·9=100. A specimen from Vesuvius contained Sulphate of potash 71·4, sulphate of soda 18·6, chlorid of sodium 4·6, chlorid of ammonium, copper, and iron 5·4=100 (Phil. Trans., 1813).

Pyr., etc.—Fuses before the blowpipe without intumescence. Soluble in water.

Obs.—Found at Vesuvius, upon lava, in delicate crystallizations, and also in masses an inch or more in thickness.

Named *aphthalose* by Beudant, in 1832, from ἄφθιτος, *unalterable*, and ἅλς, *salt*; and changed, by Shepard, to the less incorrect form from these Greek words, *aphthitalite*. *Glaserite* was used in the last edition of this work, a name given by Hausmann in 1847, after the chemist Christoph Glaser (1664), the salt having been early called *Sal polychrestum Glaseri*. But if aphthitalite is rejected, *Arcanite* of Haidinger (derived from one of its alchemistic names, *Arcanum duplicatum*) comes next in order of priority.

628. MISENITE. *A. Scacchi*, Mem. G. sulla Campania, 98, 1849.

In silky fibres of a white color. Soluble; taste acid and bitter.

Comp.—$\dot{K}\,\dddot{S}+\dot{H}\,\dddot{S}$. Analysis by Scacchi (l. c., J. pr. Ch., lv. 54):

$\dddot{S}$ 56·93 $\dot{K}$ 36·57 $\dddot{\bar{A}}l$ 0·38 $\dot{H}$ 6·12=100.

Pyr., etc.—Fuses easily in the flame of a spirit lamp, imparting a violet color to it. Soluble in water.

Obs.—Occurs in a hot tufa cavern, near Misene.

629. THENARDITE. *J. L. Casaseca*, Ann. Ch. Phys., xxxii. 308, 1826. Anhydrous Sulphate of Soda. Pyrotechnite *Scacchi*, Mem. Incend. Vesuv. Napoli, 1855.

Orthorhombic. $I \wedge I=103^\circ\ 26'$, $O \wedge 1\text{-}\bar{i}=120^\circ\ 36'$, Hausmann; $a:b:c=1{\cdot}6905:1:1{\cdot}267$, $O \wedge 1\text{-}\breve{i}=126^\circ\ 51'$, $1\text{-}\breve{i} \wedge 1\text{-}\breve{i}$, top, $=73^\circ\ 42'$, basal$=106^\circ\ 18'$, $1 \wedge 1=135^\circ\ 41'$, $123^\circ\ 43'$, $74^\circ\ 18'$. Cleavage: basal, nearly perfect.

H.$=2-3$. G.$=2{\cdot}55$, Streng; 2·73, Casaseca. Lustre vitreous. Color white to brown. Translucent.

Comp.—$\dot{N}a\,\dddot{S}$=Soda 56·3, sulphuric acid 43·7=100 Analyses: 1, Casaseca (l. c.); 2, A. Dick (Phil. Mag., IV. v. 373); 3, Streng (Jahrb. Min. 1863, 566):

	$\dddot{S}$	$\dot{N}a$	$\dot{K}$	$\dot{H}$	Cl	
1. **Espartinas**	99·78		—	—	—	, $\dot{N}a\,\ddot{C}$ 0·22=100 Casaseca.
2. **Tarapaca**	55·11	42·37	—	—	—	, insol. 2·19=99·67 Dick.
3. **Bolivia**	54·31	41·52	0·46	0·60	0·01	, insol. 3·39=100·29 Streng.

Pyr., etc.—Colors the blowpipe flame deep yellow. Wholly soluble in water.

Obs.—Occurs in Spain, at Espartinas, 5 leagues from Madrid and 2½ from Aranjuez. The water exudes during winter from the bottom of a basin, and becoming concentrated in the summer season, deposits crystals of thenardite. Also in nitre plains of Bolivia; at Tarapaca, with glauberite and ulexite, the crystals of which locality give some of the angles nearly of trona, according to H. J. Brooke (l. c.). Also on the scoria of Vesuvius (*pyrotechnite*) of the eruption of 1855; on solution and evaporation, octahedral crystals were obtained by Scacchi having the planes I, $1\text{-}\bar{i}$, 1, $3\text{-}\breve{3}$, with $I \wedge I$=118° 37′, $1\text{-}\bar{i} \wedge 1\text{-}\bar{i}$, over base,=128° 58′, $1 \wedge 1$, basal,=135° 21′, pyramidal,=123° 39′, 74° 36′, $3\text{-}\breve{3} \wedge 3\text{-}\breve{3}$, basal,=153° 41′. pyramidal, 63° 48′, 123° 2′.

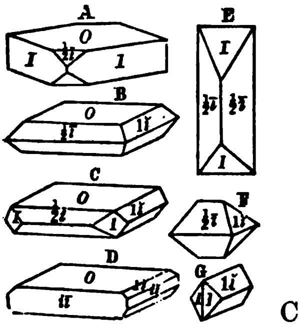
Kayser has analyzed an acicular saline efflorescence from a mine near Clausthal, and obtained (B. H. Ztg., xviii. 1859, No. 18) $\dot{N}a\,\dddot{S}$ 91—95·3, $\dot{M}g\,\dddot{S}$ 1·6—4·0, $\dot{F}e\,\dddot{S}$ 0·2, $\dot{C}a\,\dddot{S}$ 1·6—1·8, with $\dot{H}$ 1—1·8.

630. BARITE. Lapis Bononiensis, Litheosphorus, *F. Licetus*, Utini, 1640; *Mentzel*, in Misc. Ac. N. Cur., 1673, 1674, and Lap. Bon. in obscuro lucens, 1675. (1) Lysesten, Bononiensisksten, Gypsum irregulare, lamellosum, etc., *Wall.*, Min., 56, 1747; (2) Marmor metallicum, Spatum tessulare (G.=4·266), *id.*, 58, 1747. (1) Gypsum spatosum pt., Marmor metallicum, Spatum Bononiense (G.=4·5), Tungspat, *Cronst.*, Min., 21, 1758; (2) Terra calcarea phlogisto et acido vitrioli mixta, Leswersten, Lapis hepaticus, *id.*, 25, 1758. Gypsum ponderosum *v. Born*, Lithoph., i. 14, 1772. Spath pesant ou séléniteux *de Lisle*, Crist., 1772, with figs.; ib., 1783. Heavy Spar; Bolognian Spar; Cauk, Calk, Cawk, *Derbysh. Miners*, Withering, Phil. Tr., 1784. Schwerspath *Wern.*, etc. Spathum ponderosum=Terra ponderosa vitriolata *Bergm.*, Sciagr., 1782. Sulphate of Baryta. Baryte sulfatée *Fr.* Schwefelsaures Baryte *Germ.* Stangenspath *Wern.* Strahlbaryt. Baroselenite *Kirw.*, Min., i. 136, 1794. Barytite *Delameth.*, T. T., ii 8, 1797. Baryt *Karst.*, Tab., 38, 75, 1800. Baryte *H.*, Tr., ii. 1801. Barytine *Beud.*, Tr., 441. 1824. Barytes.

Hepatit *Karst.*, Tab., 38, 75, 1800;=Lapis hepaticus *Cronst.*, v. supra;=Terr. pond. vit petroleo imbuta *Bergm.*, Sciagr., 1782;=Leberstein pt. *Germ.*;=Fetid Heavy Spar. Allomorphit *Breith.*, J. pr. Ch., xv. 322, 1838. Calstronbarite *Shep.*, Am. J. Sci., xxxiv. 161, 1838. Barytocölestin *v. Waltersh.*, Pogg., xciv. 137, 1855.

Orthorhombic. $I \wedge I$=101° 40′, $O \wedge 1\text{-}\bar{i}$=121° 50′; $a : b : c$=1·6107 : 1 : 1·2276. Observed planes: O; vertical, I, $i\text{-}\bar{i}$, $i\text{-}\breve{i}$, $i\text{-}\bar{\tfrac{3}{2}}$, $i\text{-}\bar{2}$, $i\text{-}\bar{4}$, $i\text{-}\breve{\tfrac{3}{2}}$, $i\text{-}\breve{2}$, $i\text{-}\breve{3}$; macrodomes, $\frac{1}{8}\text{-}\bar{i}$, $\frac{1}{6}\text{-}\bar{i}$, $\frac{1}{5}\text{-}\bar{i}$, $\frac{1}{4}\text{-}\bar{i}$, $\frac{1}{3}\text{-}\bar{i}$, $\frac{1}{2}\text{-}\bar{i}$, $1\text{-}\bar{i}$, $\frac{3}{2}\text{-}\bar{i}$; brachydomes, $\frac{1}{8}\text{-}\breve{i}$, $\frac{1}{2}\text{-}\breve{i}$, $\frac{5}{6}\text{-}\breve{i}$, $1\text{-}\breve{i}$; octahedrons, $\frac{1}{8}$, $\frac{1}{6}$, $\frac{1}{4}$, $\frac{1}{3}$, $\frac{1}{2}$, $\frac{2}{3}$, 1; $1\text{-}\bar{2}$, $\frac{3}{2}\text{-}\bar{3}$; $\frac{1}{2}\text{-}\breve{2}$, $1\text{-}\breve{2}$, $\frac{3}{2}\text{-}\breve{3}$.

505

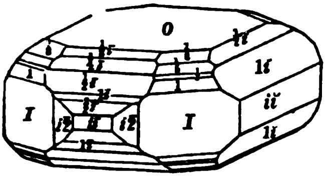


$O \wedge \frac{1}{4}\text{-}\bar{i}$=158° 4′
$O \wedge \frac{1}{2}\text{-}\bar{i}$=141 8
$O \wedge 1\text{-}\bar{i}$=121 50
$O \wedge \frac{3}{2}\text{-}\bar{3}$=111 36
$O \wedge \frac{1}{4}$=152 33
$O \wedge \frac{1}{2}$=133 54
$O \wedge \frac{1}{3}$=145 17
$O \wedge 1$=115 42
$O \wedge \frac{1}{2}\text{-}\breve{i}$=146 43
$O \wedge 1\text{-}\breve{i}$=127 18
$O \wedge i\text{-}\bar{i}$ or $i\text{-}\breve{i}$=90

$1 \wedge 1$, mac.,=110° 38′
$1 \wedge 1$, brac.,=91 22
$1 \wedge 1$, bas.,=128 36
$i\text{-}\bar{2} \wedge i\text{-}\bar{2}$=135 40
$i\text{-}\breve{2} \wedge i\text{-}\breve{2}$=116 55
$\frac{1}{2}\text{-}\bar{i} \wedge \frac{1}{2}\text{-}\bar{i}$, top,=102 17
$1\text{-}\bar{i} \wedge 1\text{-}\bar{i}$, " =63 40
$\frac{1}{2}\text{-}\breve{i} \wedge \frac{1}{2}\text{-}\breve{i}$, " =113 26
$1\text{-}\breve{i} \wedge 1\text{-}\breve{i}$, " =74 36
$i\text{-}\breve{i} \wedge I$=129 10
$i\text{-}\breve{i} \wedge i\text{-}\breve{2}$=148 27

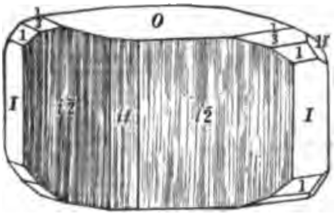
Crystals usually tabular, as in figures; sometimes prismatic in the direction of the vertical axis (f. 507). Cleavage: basal rather perfect; *I* somewhat less so: *i*-ĭ imperfect. Twins: plane of composition *i*-ĭ, the compound character being apparent in the striæ of the plane *O*. Also in globular forms, fibrous or lamellar, crested; coarsely laminated, laminæ convergent and often curved; also granular; colors sometimes banded as in stalagmite.

506



Cheshire.

507



Virginia.

H.=2·5—3·5. G.=4·3—4·72; 4·4864, G. Rose, a pure colorless crystal. Lustre vitreous, inclining to resinous; sometimes pearly. Streak white. Color white; also inclining to yellow, gray, blue, red, or brown, dark brown. Transparent to translucent—opaque. Sometimes fetid, when rubbed. Optic-axial plane brachydiagonal.

Var.—1. *Ordinary.* (*a*) Crystals usually broad or stout; sometimes very large, weighing 100 lbs.; sometimes in slender needles. Dauber, after careful measurements, made $I \wedge I = 101° 40'$, and $O \wedge \frac{1}{2}\text{-}\bar{i} = 141° 6'$, varying but two minutes in the latter from former measurements (Pogg., cviii. 440). (*b*) *Crested;* massive aggregations of tabular crystals, the crystals projecting at surface into crest-like forms. (*c*) *Columnar;* the columns often coarse (*Stangenspath*) and loosely aggregated, and either radiated (*strahlbaryt*) or parallel; rarely fine fibrous. Werner's *stangenspath* was from Freiberg. (*d*) In globular or nodular concretions, subfibrous or columnar within. *Bologna Stone* is here included, being radiated, globular, often reddish-gray in color. It is from a bed of clay in Mt. Paterno. near Bologna, and was early a source of wonder because of the phosphorescence it exhibited after heating with charcoal. "Bologna phosphorus" was made from it in the form of sticks, by powdering the mineral and uniting it again with gum. (*e*) Lamellar, either (*α*) straight or (*β*) curved; the latter sometimes as aggregations of curved scale-like plates (the *krumschaliger Schwerspath* of Werner). (*f*) Granular. (*g*) Compact or cryptocrystalline. (*h*) Earthy. (*i*) Stalactitic and stalagmitic; similar in structure and origin to calcareous stalactites and stalagmites.

2. *Fetid;* so called from the odor given off when struck, which odor is due to carbonaceous matters present. (Anal. 6–8.)

3 *Allomorphite* Breith.; a kind having the form and cleavage of anhydrite, and found at Unterwirbach, near Rudolstadt, in Schwarzenburg; G.=4·36—4·48. Probably pseudomorphous; Breithaupt regards it as a case of dimorphism.

4. *Calcareobarite* Thomson (Min., i. 105) is a white barite from Strontian in Argyleshire, containing, probably as mixture, 6·6 p. c. of lime, and some silica and alumina. He found $\ddot{S}$ 35·23, $\dot{B}a$ 48·95, $\dot{S}r$ 0·79, $\dot{C}a$ 6·60, $\dot{F}e$ 0·45, $\ddot{S}i$ 4·14, $\ddot{A}l$ 3·46, moisture 0·57=100·19; G.=4·1907. A part of the *krumschaliger Schwerspath* of Werner—specimens from Freiberg—is referred here by Breithaupt, who gives for $I \wedge I$ 101° 53', and G.=4·02—4·29.

5. *Celestobarite;* the spar containing much sulphate of strontian, as that of Binnen valley, Switzerland (anal. 2), to which von Waltershausen applied the name *baryto-celestine*, and also that of anal. 3, 4. The angles of the Binnen spar, according to Hugard, are intermediate between those of barite and celestite.

6. *Calstronbarite*, from Schoharie, N. Y., has the aspect of a mere mixture. Shepard made it a compound (l. c.) of *carbonates* of strontia (22·30) and lime (12·15), with 65·55 p. c. of sulphate of baryta, and says it is partly *soluble in muriatic acid with effervescence.* Von Hauer found a specimen from Schoharie labelled *calstronbarite* to consist of sulphates alone.

Cawk is the ordinary barite of the Derbyshire lead mines. Withering, who first analyzed it (Phil. Trans., lxxiv. 293, 1784), describes it as occurring in roundish forms, consisting of rhomboidal laminæ confusedly aggregated and white or reddish in color, with G.=4·330; and a second variety as radiated fibrous, somewhat silky in lustre, and at times concentric in structure, yellowish-white, and opaque, with G.=4·00. Greg & Lettsom (1858) confine the term to an opaque earthy variety of the Derbyshire lead mines.

The barite of Muszar, Hungary, and of Botler, near Rosenau, was early called *Wolnyn*. It is common barite, in crystals, usually oblong in the direction of the vertical axis, and generally with $i\text{-}\bar{i}$ and O large, and also $i\text{-}\breve{2}$ large. A. Schrauf mentions the following as other occurring planes O, $4\text{-}\bar{i}$, $1\text{-}\breve{i}$, $\frac{1}{2}\text{-}\bar{i}$, $\frac{1}{8}\text{-}\bar{i}$, $8\text{-}\breve{i}$, $2\text{-}\breve{i}$, $1\text{-}\breve{i}$, 1, 2, $1\text{-}\breve{2}$, $2\text{-}\breve{2}$, $3\text{-}\breve{3}$, $4\text{-}\breve{4}$ (Ber. Ak. Wien, xxxix. 286). Leonhard says that at Muszar it occurs in the cavities of alumstone.

Comp.—$\dot{B}a\,\dddot{S}$=Sulphuric acid 34·3, baryta 65·7. Sulphate of strontian and silica are often present, and sometimes sulphate of lime. clay, bituminous or carbonaceous substances Analyses: 1, Stromeyer (Unters., 222); 2, Waltershausen (Pogg., xciv. 133); 3, Rammelsberg (Min. Ch., 259); 4, Jordan (Schw. J., lvii. 358); 5, Heidingsfeld (Ramm. 5th Suppl., 207); 6, 7, John (Unters., ii. 73, 69); 8, Klaproth (Beitr., v. 121):

	$\dot{B}a\,\dddot{S}$	$\dot{S}r\,\dddot{S}$	$\dot{C}a\,\dddot{S}$	$\ddot{\overline{F}}e$	$\dddot{S}i$, $\ddot{\overline{A}}l$	$\ddot{C}$, Bit.	$\dot{\overline{H}}$		
1. Nutfield, *cryst.*	99·37	—	—	0·12	—	—	—	=99·49	Stromeyer.
2. Binnen, "	87·79	9·07	—	—	2·83	—	—	=98·15	Waltershausen.
3. Görzig, " *bnh.*	83·48	15·12	—	0·25	0·89	—	—	=99·74	Rammelsberg.
4. Clausthal. *fol.*	86·00	6·75	—	—	5·75	—	0·37	=98·87	Jordan.
5. *Calstronbaryte?*	83·10	7·10	6·12	1·83	—	—	—	=99·74	Heidingsfeld.
6. Kongsberg, *Hepatite*	93·55		3·58	0·87		2·00			John.
7. Andrarum, "	92·75	—	2·00	1·50	—	2·00	1·25		John.
8. " "	85·25	—	6·00	5·00	$\ddot{\overline{A}}l$ 1·00	0·50	2·25 (loss incl.)		Klaproth.

G. of anal. 2=3·977; 4, 4·4888.

In pure colorless crystals from Silbach, of G.=4·4864 (Rose), Rammelsberg found no impurities except a trace of strontian (Min. Ch., 259). Freiesleben found 8 p. c. of silica in a variety from Nassau.

Allomorphite, according to Gerngross, contains 1·9 p. c. of sulphate of lime as impurity, but von Hauer found none (Jahrb. G. Reichs., 1853, 152).

Pyr., etc.—B.B. decrepitates and fuses at 3, coloring the flame yellowish-green; the fused mass reacts alkaline with test paper. On charcoal reduced to a sulphid. With soda gives at first a clear pearl, but on continued blowing yields a hepatic mass, which spreads out and soaks into the coal. If a portion of this mass be removed, placed on a clean silver surface, and moistened, it gives a black spot of sulphid of silver. Should the barite contain sulphate of lime, this will not be absorbed by the coal when treated in powder with soda. Insoluble in acids

Obs.—Occurs commonly in connection with beds or veins of metallic ores, as part of the gangue of the ore. It is met with in secondary limestones. sometimes forming distinct veins, and often in crystals along with calcite and celestite.

At Dufton, in Westmoreland, England, large transparent crystals occur, sometimes of gigantic dimensions; some were found lying in the mud at the bottom of a cavern, and one weighed 100 lbs. Other English localities exist in Cornwall, near Liskeard, etc., in Cumberland and Lancashire, in Derbyshire, Staffordshire, etc.; fine stalactitic at Newhaven in Derbyshire; in Scotland, in Argyleshire, at Strontian; in Perthshire, of a bright yellow color at Ballindean; at the Cumberland lead mine; in Ireland, in thick veins in old red sandstone, at Ballynascreen in Londonderry.

The septaria of Durham, England, which are cut and polished for tables, etc., have the veinings lined with brown heavy spar, adding much to their beauty. Some of the most important European localities are at Felsöbanya and Kremnitz, at Freiberg, Marienberg, Clausthal, Przibram, and at Roya and Roure in Auvergne.

In the United States, in *N. Hamp.*, at Piermont. In *Mass.*, at Hatfield and Leverett. In *Conn.*, at Cheshire, large crystals, sometimes transparent (f. 506, and simpler forms), intersecting in veins red sandstone with vitreous copper and green malachite; at Berlin, Farmington, and Southington. In *N. York*, at Pillar Point, opposite Sackett's Harbor, massive, 2–3 ft. thick, in compact limestone, affording large slabs, beautiful when polished; at Schoharie, a fibrous variety with calcite, the two often mechanically mingled; in St. Lawrence Co., fine tabular crystals in De Kalb, at Fowler with specular iron, at the Parish ore bed, and on the farm of J. Morse, in Gouverneur, with calcite and hematite, and on the banks of Laidlaw lake in Rossie; the crested variety at Hammond, with crystals of pyrite; at Wolcott, Wayne Co., near the stratum of lenticular iron ore, and on the S. side of the Mohawk, opposite Little Falls. In *Penn.*, in crystals at Perkiomen lead mine. In *Virginia*, at Eldridge's gold mine in Buckingham Co. (fig. 507); 3 m. S.W. from Lexington, in Rockbridge Co.; a beautiful white variety on the plantation of J. Hord, Esq. Fauquier Co. In *Kentucky*, near Paris, in a large vein. In *Tenn.*, on Brown's Creek; at Haysboro' near Nashville; in large veins in sandstone on the W. end of I. Royale, L. Superior, and on Spar Id., N. shore, one vein (containing also calcite) 14 ft. wide, sometimes in crystals; in trap of N shore, veins numerous. In *Canada*, a vein 27 in. wide at Landsdown, affording fine crystals. In fine crystals near Fort Wallace. New Mexico.

The white varieties of barite are ground up and employed as a white paint, either alone or mixed with white lead.

For recent papers on cryst., see Dauber, l. c.; Pfaff, Pogg., cii. 464; Hessenberg, Min. Not., iii. and iv. Above, the cleavage prism is made the vertical *I*, as done by Phillips. Brooke and Miller, and many other authors, this position giving the simplest symbols. Naumann makes this prism the dome 1-ī, and *i*-ĭ the basal plane *O*, while *O* above is his *i*-ī. The planes following the order on page 616, are, in Naumann's position, as follows: *i*-ĭ; "vertical," 1-ī, *i*-ī, *O*, $\frac{1}{2}$-ī, 2-ī, 4-ī, $\frac{3}{8}$-ī, [illegible], $\frac{1}{8}$-ī; "macrodomes," *i*-8̆, *i*-6̆, *i*-5̆, *i*-4̆, *i*-3̆, *i*-2̆, *I*, *i*-$\frac{3}{2}$; "brachydomes," 8-ĭ, 2-ĭ, $\frac{8}{3}$-ĭ, 1-ĭ: "octahedrons," 8-8̆, 6-6̆, 5-5̆, 4-4̆, 3-3̆, 2-2̆, $\frac{3}{2}$-$\frac{3}{2}$, 1; 2, 3-$\frac{3}{2}$; 2-4̆, 1-2̆, $\frac{3}{2}$-2̆.

Named from βάρος, *weight*, or βαρύς, *heavy*.

Alt.—Heavy Spar occurs altered to calcite, spathic iron, cerussite, quartz, limonite, red iron ore, pyrite, psilomelane, göthite.

631. CELESTITE. Fasriger Schwerspath [=Fibrous Heavy Spar] (fr. Frankstown. Pa.) *Schütz*, Beschr. Nordamer. Foss., 12, Leipz., 1791. Schwefelsaurer Strontianit aus Pennsylvanien *Klapr.*, Beitr., ii. 92, 1797. Strontiane sulfatée (fr. Sicily) (after Vauquelin's anal.) *Dolomieu*, J. de Phys., xlvi. 203, 1798 (disc. by D. in S. in 1781). Cœlestin *Wern.*, Min. Syst., 1798; *Lenz*, Min., 233, 1800; *Karst.*, Tab., 54, 95, 1808. Sicilianite *Lenz*, Min., 233, 1800. Schützit *Gerhard*, *G. Karst.*, Tab., 36, 75, 1800. Zölestin *other Germ. Orthogr.*

Barytosulphate of Strontian *Thom.*, Min., i. 111, 1836.

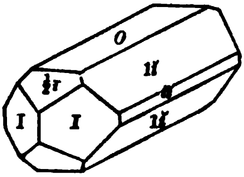
Orthorhombic. *I* ∧ *I*=104° 2′ (103° 30′—104° 30′), *O* ∧ 1-ī=121° 19$\frac{1}{2}$′; $a : b : c=1{\cdot}6432 : 1 : 1{\cdot}2807$. Observed planes: *O*; vertical, *i*-ĭ, *I*, *i*-ī, *i*-2̄, *i*-2̆; domes, $\frac{1}{4}$-ī, $\frac{1}{3}$-ī, $\frac{1}{2}$-ī, $\frac{3}{4}$-ī, 1-ī; $\frac{1}{12}$-ĭ, $\frac{1}{4}$-ĭ, $\frac{1}{3}$-ĭ, $\frac{1}{2}$-ĭ, $\frac{2}{3}$-ĭ, 1-ĭ, 2-ĭ; octahedral, $\frac{1}{4}$, $\frac{1}{3}$, 1; in the zone 1: 1-ĭ, 1-2̄, 1-3̄, 1-4̆, 1-6̆, 1-16̆; in the zone *I*: 1-ĭ, $\frac{5}{3}$-$\frac{5}{2}$, $\frac{3}{2}$-3̆, $\frac{4}{3}$-, $\frac{8}{7}$-8̆, $\frac{24}{23}$-24̆; in the same horizontal zone with $\frac{2}{3}$-ĭ, $\frac{2}{3}$-16̆, $\frac{2}{3}$-6̆, $\frac{2}{3}$-4̆; also 4-$\frac{4}{3}$, $\frac{6}{5}$-$\frac{6}{5}$, $\frac{3}{5}$-3̆, 2-4̆.

O ∧ $\frac{1}{4}$-ī=157° 38′
O ∧ $\frac{1}{2}$-ī=140 35
O ∧ $\frac{3}{4}$-ī=129 3
O ∧ $\frac{1}{4}$=152 29
O ∧ 1=115 38

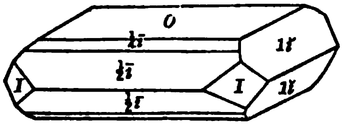
O ∧ 1-ĭ=127° 56′
O ∧ 1-2̄=123 17
O ∧ 1-3̄=125 38
O ∧ 1-4̆=126 35
1 ∧ 1, mac.,=112 35

1 ∧ 1, brach.,=89° 26′
1 ∧ 1, basal,=128 44
i-2̆ ∧ *i*-2̆=114 44
$\frac{1}{2}$-ī ∧ $\frac{1}{2}$-ī, top,=101 11
1-ĭ ∧ 1-ĭ, top,=75 52.

508



509



L. Erie.

Cleavage: *O* perfect; *I* distinct; *i*-ĭ less distinct. Also fibrous and radiated; sometimes globular; occasionally granular.

H.=3—3·5. G.=3·92—3·975; 3·9593, crystals, Beudant; 3·973, fr. Tharand, Breith.; 3·96, fr. Kingston, Hunt. Lustre vitreous, sometimes inclining to pearly. Streak white. Color white, often faint bluish, and sometimes reddish. Transparent—subtranslucent. Fracture imperfectly conchoidal—uneven. Very brittle. Trichroism sometimes very distinct.

Var.—1. *Ordinary.* (*a*) In crystals. The angle $I \wedge I$ varies much, and probably in part in consequence of the presence of some baryta or lime. It was made by Haüy 104° 48′, but with the common goniometer; by Kupffer, 104° 20′; by Phillips, 104°; by Mohs, 103° 58′; by Websky, in an elaborate paper on crystals from Pschow in Upper Silesia (ZS. G., ix. 303), 103° 32′, and he suggests therefore that this mineral may contain lime or baryta; by Dauber, in very exact measurements of Sicily crystals (Pogg., cviii. 447), 104° 4′ 24″ to 104° 7′ 14″, with the deduced mean 104° 6′ 34″; and for the dome 1-ĭ, 75° 45′ 43″; by Kokscharof (Min. Russl., v. 8) from Sicily crystals, 104° 3′ 46″, $O \wedge \frac{1}{2}\text{-}\bar{i}=140°\ 36'$, his calculated results being 104° 3′ 50″ and 140° 35′.

(*b*) Fibrous, either parallel or radiated. (*c*) Lamellar: of rare occurrence. (*d*) Granular. (*e*) Concretionary. (*f*) Earthy; impure usually with carbonate of lime or clay.

2. *Calciocelestite.* Containing much lime.

3. *Barytocelestite*, or Baryto-sulphate of strontia of Thomson, from Drummond I., L. Erie, contains much baryta. Hugard gives for $I \wedge I$ in this Drummond I. variety 108½°, an angle intermediate between that of barite and celestite (see below).

Comp.—$\dot{\rm Sr}\,\dddot{\rm S}$=Sulphuric acid 43·6, strontia 56·4=100. Analyses: 1, Klaproth (l. c.); 2, Vauquelin (l. c.); 3, 4, 6, 7, Stromeyer (Unters., 203); 5, Maddrell (Ramm. Min. Ch., 260); 8, R. Brandes (Schw. J., xxi. 177); 9, v. Hauer (Jahrb G. Reichs., iv. 397); 10, Schmid (Pogg., cxx. 637):

	$\dddot{\rm S}$	$\dot{\rm Sr}$	$\dot{\rm Ba}$	$\dot{\rm Ca}$	$\dddot{\bar{\rm Fe}}$
1. Frankstown, Pa.	42	58	—	—	—=100 Klaproth.
2. Sicily	46	54	—	—	—=100 Vauquelin.
3. "	43·07	56·35	—	—	0·03, $\dot{\rm Ca}\,\ddot{\rm C}$ 0·09, $\dot{\rm H}$ 0·18=99·72 Stromeyer.
4. Dornburg	42·95	56·26	—	—	0·03, $\dddot{\bar{\rm Al}}$ 0·05, $\dot{\rm Ca}\,\ddot{\rm C}$ 0·10, $\dot{\rm H}$, Bit. 0·10=99·49 S.
5. "	43·75	54·73	—	1·41	—=99·90 Maddrell.
6. Süntel, Hanover	42·74	55·18	0·86	0·31	0·04, $\dot{\rm Ca}\,\ddot{\rm C}$ 0·02, $\dot{\rm H}$ 0·05=99·20 Stromeyer.
7. Dehrself, "	42·94	55·01	0·64	—	0·65, $\dddot{\rm Si}$ 0·11, $\dot{\rm H}$ 0·25=99·58 Stromeyer.
8. Fassa	40·85	51·93	1·23	—	0·50, $\dddot{\rm Si}$ 1·00, $\dot{\rm Ca}$, $\dddot{\rm S}$, $\ddot{\rm C}$ 1·83=97·34 Brandes.
9. Ischl	43·82	55·96	—	—	—, $\dot{\rm H}$ 0·41=100·19 Hauer.
10. Erfurt	43·68	53·39	0·51	1·26	0·28=99·12 Schmid.

Wicke found in celestite from a stratum of clay near Wassel—the *calciocelestine* (Arch. d. Pharm., clii. 32)—$\dot{\rm Sr}\,\dddot{\rm S}$ 91·464, $\dot{\rm Ca}\,\dddot{\rm S}$ 8·813, $\dddot{\bar{\rm Fe}}$ 0·003=99·780; G.=4·020. It may be only a mixture.

Thomson gives for the composition of the Drummond I. celestite—*barytocelestite* (l. c.)—$\dddot{\rm S}$ 40·20, $\dot{\rm Sr}$ 35·72, $\dot{\rm Ba}$ 23·06, $\dddot{\bar{\rm Fe}}$ 0·59, $\dot{\rm H}$ 0·72=100·29, and G.=3·921. But his analysis needs confirmation. The celestite of Kingston, C. W., which Thomson ranks with that of Drummond I., is pure celestite according to T. S. Hunt; it has G.=3·96. In the radiated mineral from Nörten, Hanover, Turner found (Ed. Phil. J., ii. 329) $\dot{\rm Sr}\,\dddot{\rm S}$ 78·21, $\dot{\rm Ba}\,\dddot{\rm S}$ 20·41=98·62; and Grüner (Gilb. Ann., lx. 72) $\dot{\rm Sr}\,\dddot{\rm S}$ 73·00, $\dot{\rm Ba}\,\dddot{\rm S}$ 26·17, who analyzed crystals of a bluish milk-white color, having G.=3·9506.

Wittstein finds that the blue color of the celestite of Jena is due to a trace of a phosphate of iron.

Pyr., etc.—B.B. frequently decrepitates, fuses at 3 to a white pearl, coloring the flame strontia-red; the fused mass reacts alkaline. On charcoal fuses, and in R.F. is converted into a difficultly fusible hepatic mass; this treated with muriatic acid and alcohol gives an intensely red flame. With soda on charcoal reacts like barite. Insoluble in acids.

Obs.—Celestite is usually associated with limestone, or sandstone of Silurian, Devonian, Jurassic, and other geological formations. Occurs also in beds of gypsum, rock salt, and clay; and with sulphur in some volcanic regions.

Sicily, at Girgenti and elsewhere, affords splendid groups of crystals along with sulphur and gypsum. Fine specimens are met with at Bex in Switzerland, and Conil in Spain; at Dornburg, near Jena, fibrous and bluish; in the department of the Garonne, France; in the Tyrol; Retzbanya, Hungary; at Nörten, in Hanover; in rock salt, at Ischl, Austria. Also found at Aust Ferry, near Bristol; in trap rocks near Tantallan, in East Lothian; at the Calton Hill, Edinburgh; near Knaresborough, in Yorkshire; at Popayan, New Grenada.

Specimens, finely crystallized, of a bluish tint, are found in the Trenton limestone about Lake Huron, particularly on Strontian Island, and at Kingston in Canada; Chaumont Bay, Schoharie, and Lockport, N. Y., have afforded good specimens; also the Rossie lead mine; Depauville and Stark (farm of James Coill), N. Y. A blue fibrous celestite occurs near Frankstown, Logan's Valley, Huntington Co., Penn., associated with pearl spar and anhydrite, and this was the celestite taken to Europe by Schütz, and named by Werner after an analysis by Klaproth.

The dark blue fibrous celestite of Jena is peculiarly trichroic; and its color also varies with the angle between the principal cleavage and the direction of the fibres; the color with the angle 86°, dark blue; 67°, sky blue; 46°, pale blue (Schmid, Pogg., cxx. 637).

Named from *cœlestis*, *celestial*, in allusion to the faint shade of blue often presented by the mineral.

Artif.—Obtained in crystals at a temperature of 300° C. from solution in water (Dr. Sullivan) in lamellar crystals by fusing a mixture of gypsum and common salt, and treating with water A. Gages.

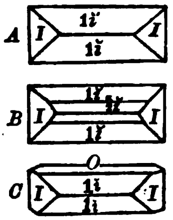
632. **ANHYDRITE.** Muriazit, Salzsaurer Kalk (fr. Hall, Tyrol), *Abbé Poda*, Fichtel's Min. Aufsätze, Wien, 1794, 228. Würfelspath *Wern.*, 1800, Ludwig's Min., i. 51, 166, 1803=Cube Spar. Soude muriatée gypsifère (of Hall) (from Klapr. anal. in Beitr., i. 307, 1795) *H.*, Tr., ii. 1801. Chaux sulfatée anhydre (fr. Bex) *Vauq.*, *H.*, Tr., iv. 1801. Anhydrit *Wern.*, 1803, Ludw., ii. 212, 1804. Würfelgyps *Ludwig*, ii. 169. Anhydrous Sulphate of Lime, Anhydrous Gypsum. Karstenit *Hausm.*, Handb., 880, 1813.

Gekrösstein (fr. Bochnia and Wieliczka) *Wern.*; Tripe Stone *Engl.*; Pierre de tripes *Fr.*;= Anhydrit *Klapr.*, Beitr., iv. 231, 1807. Pierre de Vulpino; Marmor Bardiglio di Bergamo; Bardiglione; Chaux sulfatée quartzifère *Vauq.*, *H.*, Tr., iv. 251, 1801; Siliceous Anhydrous Gypsum. Kieselgyps, Vulpinit, *Ludwig*, ii. 170, 1804.

Orthorhombic. $I \wedge I = 100° \ 30'$, $O \wedge 1\text{-}\bar{i} = 127° \ 19'$; $a : b : c = 1{\cdot}3122 : 1 : 1{\cdot}2024$. Observed planes: O; vertical, I, $i\text{-}\bar{i}$, $i\text{-}\breve{i}$, $i\text{-}\bar{\tfrac{3}{2}}$, $i\text{-}\bar{\tfrac{5}{2}}$, $i\text{-}\breve{\tfrac{3}{2}}$; domes, $1\text{-}\breve{i}$, $\tfrac{5}{2}\text{-}\breve{i}$; octahedral, o, n, f.

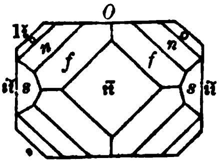
$O \wedge 1\text{-}\breve{i} = 132° \ 30'$
$O \wedge \tfrac{5}{2}\text{-}\breve{i} = 110 \ 8$
$1\text{-}\breve{i} \wedge 1\text{-}\breve{i}$, top, $= 85$
$\tfrac{5}{2}\text{-}\breve{i} \wedge \tfrac{5}{2}\text{-}\breve{i}$, top, $= 40 \ 16$
$i\text{-}\bar{\tfrac{3}{2}} \wedge \tfrac{3}{2}$, ov. $i\text{-}\bar{i}$, $= 122$
$i\text{-}\bar{\tfrac{5}{2}} \wedge i\text{-}\bar{\tfrac{5}{2}} = 143 \ 12$
$i\text{-}\breve{\tfrac{3}{2}} \wedge \breve{i}\text{-}_{2} = 77 \ 26$
$i\text{-}\breve{\tfrac{3}{2}} \wedge i\text{-}\breve{\tfrac{3}{2}}$, ov. $i\text{-}\breve{i}$, $= 102 \ 34$
$s \wedge i\text{-}\bar{i} = 135 \ 35$
$i\text{-}\bar{i} \wedge f = 153 \ 50$ $i\text{-}\bar{i} \wedge n = 143° \ 37'$ $i\text{-}\bar{i} \wedge o = 124° \ 10'$

510



Stassfurt.

511



Aussee.

Fig. 511 view of front side of a thick, rectangular, somewhat tabular crystal, having a zone of planes between $i\text{-}\bar{i}$ and each $1\text{-}\breve{i}$, or the corresponding edge. Cleavage: $i\text{-}\bar{i}$ very perfect; $i\text{-}\breve{i}$ also perfect; O somewhat less so. Also fibrous, lamellar, granular, and sometimes impalpable. The lamellar and columnar varieties often curved or contorted.

H. = 3 – 3·5. G. = 2·899–2·985; 2·956, Aussee; 2·985, Stassfurt. Lustre: $i\text{-}\breve{i}$ and $i\text{-}\bar{i}$ somewhat pearly; O vitreous; in massive varieties, vitreous inclining to pearly. Color white, sometimes a grayish, bluish, or reddish tinge; also brick-red. Streak grayish-white. Fracture uneven; of finely lamellar and fibrous varieties, splintery. Optic-axial plane parallel to $i\text{-}\bar{i}$, or plane of most perfect cleavage; bisectrix normal to O; Grailich.

Var.—1. *Ordinary.* (*a*) Crystallized; cleavable in its three rectangular directions. (*b*) Fibrous; either parallel, or radiated or plumose. (*c*) Fine granular. (*d*) Scaly granular. *Vulpinite* is a scaly granular kind from Vulpino in Lombardy; it is cut and polished for ornamental purposes. It does not ordinarily contain more silica than common anhydrite. A kind in contorted concretionary forms is the tripestone (*Gekrösstein*).

2. *Pseudomorphous*; in cubes after rock salt.

Comp.—$\dot{C}a\,\dddot{S}$=Lime 41·2, sulphuric acid 58·8=100. Analyses: 1, Klaproth (Beitr., iv. 224); 2—4, Stromeyer (Schw. J., xiv. 375); 5, C. W. C. Fuchs (B. H. Ztg., xxi. 198):

	$\dddot{S}$	$\ddot{Si}$	$\ddot{C}$	$\ddot{\overline{Fe}}$	$\dot{C}a$	$\dot{H}$	Bit.	
1. Sulz, *cryst.*	59·78	0·25	—	0·10	43·06	—	—	=103·19 Klaproth.
2. Himmelsberg, *cryst.*	55·80	0·23	0·09	0·25	40·68	2·91	0·04	=100 Stromeyer.

	$\dddot{\mathrm{S}}$	$\ddot{\mathrm{Si}}$	$\ddot{\mathrm{F}}\mathrm{e}$	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\mathrm{H}}$	
3. *Vulpinite, coarse*	56·77	0·26	0·03	41·40	0·94=99·40	Stromeyer.
4. " *fine*	58·01	0·09	—	41·70	0·07=99·86	Stromeyer.
5. Stassfurt, *cryst.*	58·86	—	—	40·21	0·65=99·72	Fuchs.

Vauquelin made the vulpinite to contain 8 p. c. of silica (and hence the name siliceous anhydrite), which the later analyses do not sustain.

Pyr., etc.—B.B. fuses at 3, coloring the flame reddish-yellow, and yielding an enamel-like bead which reacts alkaline. On charcoal in R.F. reduced to a sulphid; with soda does not fuse to a clear globule, and is not absorbed by the coal like barite; is, however, decomposed, and yields a mass which blackens silver; with fluorite fuses to a clear pearl, which is enamel-white on cooling, and by long blowing swells up and becomes infusible. Soluble in muriatic acid.

One hundred parts of water, at 18·75° C., dissolve 0·2 part of anhydrite.

Obs.—Occurs in rocks of various ages, especially in limestone strata, and often the same that contain ordinary gypsum, and also very commonly in beds of rock salt. It was first discovered at the salt mine near Hall in Tyrol, by Abbé Poda; and next that of Bex, Switzerland. Other localities are at Aussee, both crystallized and massive, the former sometimes in splendid geodes (f. 511), the latter brick-red; at Sulz on the Neckar, in Würtemberg; Himmelsberg, near Ilfeld; Bleiberg in Carinthia; Lüneburg, Hanover; Lauterberg in the Harz; Kapnik in Hungary; Ischl in Upper Austria; Aussee in Styria; Berchtesgaden in Bavaria; at Rienthal and elsewhere in the Alps, crystals, or their cavities, within quartz crystals; Stassfurt, in fine crystals.

In the U. States, at Lockport, N. Y., fine blue, in geodes of black limestone, accompanied with crystals of calcite and gypsum. In Nova Scotia it forms extensive beds at the estuary of the Avon and the St. Croix rivers, also near the Five Islands and elsewhere, associated with gypsum, in the Carboniferous formation.

A crystal from Hall, figured by Haüy, was a stout rectangular prism, with planes *I* on the lateral edges, giving *i*-ī ∧ *I*=140° 4′, whence *I* ∧ *I*=100° 8′. The Stassfurt crystals (f. 510, Blum, Jahrb. Min. 1865, 601) have nearly the ordinary forms of barite, and approximate to them in angles. Schrauf makes the angle over *i*-ī of an occurring vertical prism (Pogg., cxvii. 650, 1862) 120°, and v. Rath (Ber. nied. Ges. Bonn, 201, 1862) 121° 24′. Blum states that the prism *I* is the most common; it is vertically striated, and these striations are formed of planes of the other vertical prisms measured by him; measurements only approximations. Schrauf and Blum make the angle 1-ĭ ∧ 1-ĭ=85°; Fuchs (B. H. Ztg., xxi. 198), 84½°; and v. Rath, 84° 34′. In fig. 511 the plane *o* is in the same vertical zone with *s*; and if *o* is made the plane 1 (as done by Brooke and Miller), *n* is 2-2̆, and *f* 3-3̆. B. and M. obtained in their measurements for *i*-ī on *f*, *n*, *o*, 153° 14′, 143° 41′, and 123° 31′ (Phil. Mag., III. 19, 178); and Grailich and Lang, for the same (Ber. Ak. Wien, xxvii. 25), 153° 50′, 143° 37′, 124° 10′. The latter give for their calculated results, 153° 18½′, 142° 59½′, 123° 32½′. The prism *i*-$\breve{\tfrac{3}{2}}$, which has the angle 102° 34′, may be that homologous with *I* of barite; in this case the brachydiagonal above would be the macrodiagonal.

Alt.—Absorbs moisture and changes to gypsum. Extensive beds are sometimes thus altered in part or throughout, as at Bex, in Switzerland, where, by digging down 60 to 100 ft., the unaltered anhydrite may be found. Sometimes specimens of anhydrite are altered between the folia or over the exterior. Also altered to quartz and siderite.

633. ANGLESITE. Vitriol de Plomb *Monnet*, Syst. Min., 371, 1779. Plumbum acido vitriolico mineralisatum *Bergm.*, Sciagr., 116, 1782. Lead mineralized by vitriolic acid *Withering*, Trl. Bergm. Sciagr., 1783. Lead mineralized by vitriolic acid and iron (on I. Anglesea "in immense quantities") *Withering*, ib. Vitriol de Plomb (fr. Andalusia) *Proust*, J. de Phys., xxx. 394, 1787. Bleiglas (fr. the Harz) *Lasius*, Beob. Harzgeb., ii. 355, 1789. Nat. Bleivitriol *Karsten*, Tab., 24, 1791. Lead Vitriol, Sulphate of Lead. Vitriolbleierz *Germ.* Plomb sulfaté *Fr.* Anglesite *Beud.*, Tr., ii. 459, 1832. Sardinian *Breith.*, B. H. Ztg., xxiv. 320, 1865, xxv. 194, 1866.

Orthorhombic. *I* ∧ *I*=103° 43½′; *O* ∧ 1-ī=121° 20¼′, Kokscharof; *a* : *b* : *c*=1·64223 : 1 : 1·273634. Observed planes: *O*; vertical, *I*, *i*-ī, *i*-ĭ, *i*-2̄, *i*-$\breve{\tfrac{4}{3}}$, *i*-$\breve{\tfrac{3}{2}}$, *i*-2̆, *i*-3̆, *i*-$\breve{\tfrac{7}{2}}$; domes, ¼-ī, ½-ī; ⅛-ĭ, ½-ĭ, 1-ĭ, 3-ĭ; octahedral, ⅙, ¼, ⅓, ½, 1, 2; ¾-$\breve{\tfrac{3}{2}}$, 1-2̆; 2-$\breve{\tfrac{4}{3}}$; ½-2̄, ⅔-2̄, 1-2̄, 2-2̄, 1-3̄, $\tfrac{3}{2}$-3̄; 1-4̆, 2-4̆

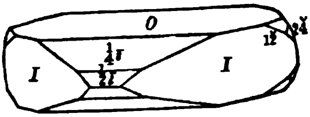
O ∧ ½-ī=140° 37′	*O* ∧ ½-ĭ=147° 11′	*O* ∧ 1=115° 35½′
O ∧ 1-ī=127 48	*O* ∧ 3-ĭ=104 30	*O* ∧ ½=133 46

$O \wedge 2 = 103° 28'$
$i\text{-}\bar{i} \wedge I = 141\ 52$
$i\text{-}\bar{i} \wedge i\text{-}\bar{2} = 158\ 34$
$i\text{-}\bar{i} \wedge \frac{1}{2}\text{-}\bar{i} = 139\ 23$
$i\text{-}\breve{i} \wedge I = 138\ 8$
$I \wedge i\text{-}\breve{2} = 163\ 18$
$I \wedge i\text{-}\bar{2} = 160\ 38$

$I \wedge i\text{-}\breve{3} = 141° 8'$
$I \wedge 1 = 154\ 24\frac{1}{2}$
$I \wedge 2 = 166\ 32$
$1\text{-}\breve{i} \wedge 1\text{-}\breve{2} = 153\ 17$
$1\text{-}\breve{i} \wedge 2\text{-}\breve{4} = 156\ 44$
$1 \wedge 1\text{-}\breve{2} = 151\ 32$
$1 \wedge \frac{3}{4}\text{-}\frac{\bar{3}}{2} = 168\ 37$

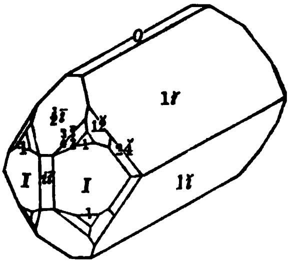
$1 \wedge \frac{1}{2}\text{-}\breve{i} = 147° 25'$
$1\text{-}\breve{i} \wedge 1\text{-}\breve{i}$, top, $= 75\ 35\frac{1}{2}$
$1\text{-}\breve{i} \wedge 1\text{-}\breve{i}$, ov. $i\text{-}\breve{i}$, $= 104\ 24\frac{1}{2}$
$\frac{1}{2}\text{-}\bar{i} \wedge \frac{1}{2}\text{-}\bar{i}$, top, $= 101\ 14$
$i\text{-}\bar{2} \wedge i\text{-}\bar{2}$, front, $= 137\ 8$
$i\text{-}\breve{2} \wedge i\text{-}\breve{2}$, ov. $i\text{-}\breve{i}$, $= 115\ 1$
$i\text{-}\breve{3} \wedge i\text{-}\breve{3}$, ov. $i\text{-}\breve{i}$, $= 134\ 0$

512



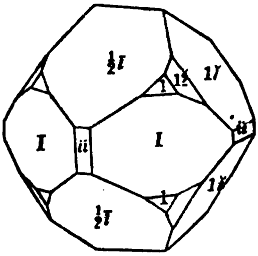
Phenixville.

513



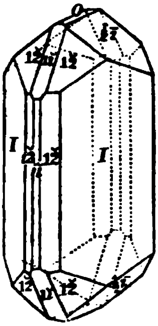
Phenixville.

514



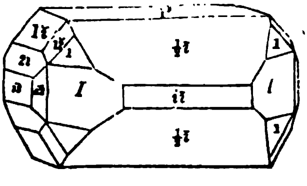
Phenixville.

515



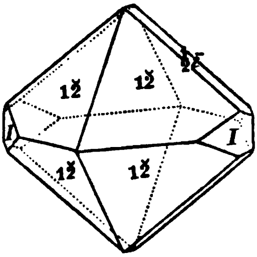
Siegen.

516



Anglesea.

517



Siegen.

Crystals sometimes tabular; often oblong prismatic, and in the direction of either of the axes; as the vertical axis in f. 515; the macrodiagonal in f. 512, 516; the brachydiagonal in f. 513; also thick and short, as in f. 514; also sometimes in octahedral forms, more or less modified, made principally of planes $1\text{-}\breve{2}$, as in f. 517; or of planes 1; or $1\text{-}\breve{3}$, or $1\text{-}\breve{4}$. Cleavage: I, O, but interrupted. The planes I and $i\text{-}\bar{i}$ often vertically striated, and $\frac{1}{2}\text{-}\bar{i}$ horizontally. Also massive, granular, or hardly so. Sometimes stalactitic.

H.=2·75—3. G.=6·12—6·39; 6·35, Phenixville, Smith. Lustre highly adamantine in some specimens, in others inclining to resinous and vitreous. Color white, tinged yellow, gray, green, and sometimes blue. Streak uncolored. Transparent—opaque. Fracture conchoidal. Very brittle.

Comp.—$\dot{\text{P}}\text{b}\,\dddot{\text{S}}$=Sulphuric acid 26·4, oxyd of lead 73·6=100. Analyses: 1, 2, Klaproth (Beitr. iii. 162); 3, Stromeyer (Unters., 226); 4, Thomson (Min., i. 559); 5, J. L. Smith (Am. J. Sci., II xx. 244):

	$\dddot{\mathrm{S}}$	$\dot{\mathrm{Pb}}$	$\ddot{\mathrm{Fe}}$	$\dot{\mathrm{H}}$
1. Wanlockhead	25·75	70·50	——	2·25=98·50 Klaproth.
2. Anglesea	24·8	71·0	1·0	2·0=98·8 Klaproth.
3. Zellerfeld	26·09	72·47	$\ddot{\mathrm{Fe}}\,\dot{\mathrm{H}}^3$ 0·09	0·51, $\ddot{\mathrm{Mn}}$ 0·07=99·23 Strom.
4. Leadhills	25·65	74·05	——	0·30=100 Thomson.
5. Phenixville	(⅔) 26·69	73·26	——	——, $\ddot{\mathrm{Si}}$ 0·20=99·95 Smith.

Pyr., etc.—B.B. decrepitates, fuses in the flame of a candle (F.=1·5). On charcoal in O.F fuses to a clear pearl, which on cooling becomes milk-white; in R.F. is reduced with effervescence to metallic lead. With soda on charcoal in R.F. gives metallic lead, and the soda is absorbed by the coal; when the surface of the coal is removed and placed on bright silver and moistened with water it tarnishes the metal black. Difficultly soluble in nitric acid. Soluble in citrate of ammonia (J. L Smith). Soluble in 22,816 parts of water of 11° C (Fresenius). Soluble 1 part in 30,062 of water (Rodwell).

Obs.—This ore of lead was first observed by Monnet as a result of the decomposition of galenite, and it is often found in its cavities. At Leadhills it occurred, occupying the cubical cavities of galenite, or disposed on the surface of the ore; and this locality, and also that of Wanlockhead, formerly afforded large and beautiful crystals, some transparent and several inches in diameter. First found in England at Parys mine in Anglesea. Occurs also at Melanoweth in Cornwall; in Derbyshire and in Cumberland in crystals; Clausthal, Zellerfeld, and Giepenbach, in the Harz; near Siegen in Prussia; Schapbach in the Black Forest, Badenweiler in Breisgau; and in Sardinia in small but perfect transparent crystals; Fondon in Granada; massive in Siberia, Andalusia, Alston Moor in Cumberland; in Australia, whence it is exported by the ton to England.

In the United States it occurs in large crystals at Wheatley's mine, Phenixville, Pa. (f. 512, 513, 514); less well crystallized in Missouri lead mines; at the lead mine of Southampton, Mass.; at Rossie, N. Y.; with galenite at the Walton gold mine, Louisia Co., Va.

Named from the locality, Anglesea, where it was first found by Dr. Withering.

For recent papers on cryst., Kokscharof, Min. Russl., i. 34, ii. 167, iii. 243, elaborate; v. Lang, Ber. Ak. Wien, very elaborate; Zepharovich, Ber. Ak. Wien. v. i. 369.

Sardinian is distorted anglesite from Monteponi in Sardinia, with which Richter found it to agree in composition; G.=6·380—6·392; H.=3—3·5; white and like anglesite in lustre. Breithaupt makes it hemidomatic (monoclinic or hemihedral); and found for the fundamental prism the angle 101° 52′; and says that the bisectrix of the optical angle is normal to a plane truncating an edge of the fundamental prism, and not to the base as in anglesite. The optical fact stated shows that the prism is normally orthometric; and if the plane referred to be made the base (or plane O) then the mineral agrees with anglesite, both crystallographically and optically. The so-called fundamental prism is prism $\frac{1}{2}$-$\bar{i}$ of anglesite, which has the angle, as above given, 101° 14′. The form approaches fig 516 above.

Alt.—Anglesite occurs altered to cerussite ($\dot{\mathrm{Pb}}\,\ddot{\mathrm{C}}$): also to a hydrous anglesite, according to Breith.

534. ZINKOSITE. Zinkosit *Breith.*, B. H. Ztg., xi. 100, 1852. Anhydrous Sulphate of Zinc.

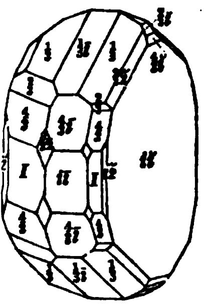
According to Breithaupt, this sulphate occurs at the mine of Barranco Jaroso in the Sierra Almagrera, Spain, in crystals isomorphous with anglesite and barite. Doubtful. G.=4·331.

535. LEADHILLITE. Plomb carbonaté rhomboidal *Bourn.*, Cat., p. 343, 1817. Sulphato-tricarbonate of Lead *Brooke*, Ed. Phil. J., iii. 117, 1820. Leadhillite *Beud.*, Tr., ii. 366, 1832. Bleisulphotricarbonat, Ternärbleierz, *Weiss*. Psimythit *Glocker*, Syn., 256, 1847.

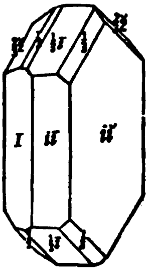
Orthorhombic. $I \wedge I=103°\ 16'$, $O \wedge 1\text{-}\bar{i}=120°\ 10'$; $a : b : c=1·7205 : 1 : 1·2632$. Observed planes as in f. 518, with also $i\text{-}\breve{2}$ replacing edge between I and $i\text{-}\bar{i}$. Hemihedral in I and some other planes; hence monoclinic in aspect, or rhombohedral when in compound crystals.

$O \wedge \frac{1}{3}\text{-}\bar{i}=150°\ 10'$ $i\text{-}\bar{i} \wedge \frac{4}{3}\text{-}\bar{i}=156°\ 27'$ $i\text{-}\breve{i} \wedge I=128°\ 22'$
$O \wedge \frac{1}{3}=126\ 11$ $i\text{-}\breve{i} \wedge \frac{2}{3}\text{-}\breve{2}=128\ 14$ $i\text{-}\breve{i} \wedge i\text{-}\breve{2}=111\ 36$
$i\text{-}\bar{i} \wedge \frac{1}{3}\text{-}\bar{i}=119\ 50$ $i\text{-}\breve{i} \wedge \frac{1}{3}=111\ 30$ $i\text{-}\breve{i} \wedge i\text{-}\bar{i}=90$

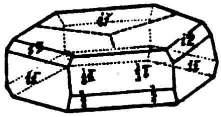
518



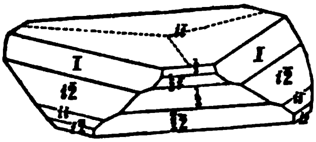
519



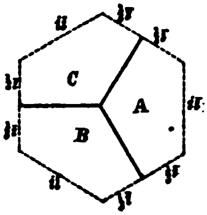
520



521



522



Cleavage: i-ĭ very perfect; i-ī traces. Twins, f. 520, 521 (drawn with i-ĭ as top plane), consisting of 3 crystals; composition-face, 1-ī (see f. 522); also parallel with *I*.

H.=2·5. G.=6·26—6·44. Lustre of i-ĭ pearly, other parts resinous, somewhat adamantine. Color white, passing into yellow, green, or gray. Streak uncolored. Transparent—translucent. Conchoidal fracture scarcely observable. Rather sectile.

Comp.—$\dot{\mathrm{P}}\mathrm{b}\,\dddot{\mathrm{S}}+3\,\dot{\mathrm{P}}\mathrm{b}\,\ddot{\mathrm{C}}$=Sulphate of lead 27·45, carbonate of lead 72·55=100. Analyses , Berzelius (Jahresb., iii. 134); 2, Stromeyer (Gel. Anz. Gött., 113, 1825):

1. Leadhills	$\dot{\mathrm{P}}\mathrm{b}\,\dddot{\mathrm{S}}$	28·7	$\dot{\mathrm{P}}\mathrm{b}\,\ddot{\mathrm{C}}$	71·0=99·7 Berzelius.
2. "		28·3		72·7=100 Stromeyer.

Pyr., etc.—B.B. intumesces, fuses at 1·5, and turns yellow; but white on cooling. Easily educed on charcoal. With soda affords the reaction for sulphuric acid. Effervesces briskly in itric acid, and leaves white sulphate of lead undissolved.

Obs.—This ore has been found at Leadhills, with other ores of lead; also in crystals at Red ill, Cumberland, and near Taunton in Somersetshire. Grenada is also stated to be a locality of , and the island of Serpho, Grecian Archipelago. The crystals seldom exceed an inch in length, id are commonly smaller. Reported by C. U. Shepard (Am. J. Sci., II. xv. 446) from Newberg istrict, S. C., but there is some doubt as to the locality; also from the Morgan silver mine, Sparnburg District, S. C.

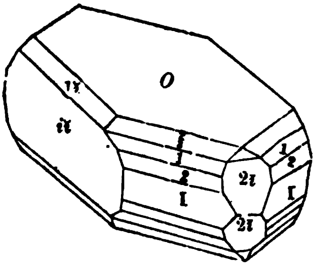
Brooke and Miller, who show that the form of leadhillite is orthorhombic, make the prism ½-ī (of 0′ 20′) the fundamental vertical prism, and appear to regard the species as related to aragonite. ie fact that the twins are not formed parallel to the faces of this prism (as they should be if e prism ½-ī were homologous with the aragonite prism), and the close approximation in angle anglesite, shown above, besides other reasons, have led the author to adopt the position of the ystals here given, which exhibits the anglesite relation. Susannite (rhombohedral) and leadhile (orthorhombic) are mutually dimorphs, and so also are dreelite and anglesite. Now susannite d dreelite are nearly identical in angle; and therefore leadhillite and anglesite must be equally ated. Since in susannite the sulphuric acid dominates over the carbonic acid, and impresses on lead salt its character (or the form of the sulphate), the same should be the case with its corate leadhillite—this species being the very same chemical compound. (See on this subject, J. Sci., II. xviii.). The hemihedrism of the species gives origin to the peculiar rhombohel aspect of the twins. The angles of these twins are near those of susannite. Fig. 1 is tly from Mohs, with other occurring planes, and is introduced to show the relations of the nes in the position of the crystal adopted.

)n crystallization, Haidinger, Ed. Phil. Trans., x. 217; B. & M., Min., 563.

36. CALEDONITE. Cupreous Sulphato-Carbonate of Lead *Brooke*, Ed. Phil. J., iii. 117, 1820. Calédonite *Beud.*, Tr., ii. 367, 1832.

Orthorhombic. $I \wedge I=95^\circ$, $O \wedge 1\text{-}\bar{i}=123^\circ\ 9'$; $a:\breve{b}:c=1{\cdot}5314:1:1{\cdot}0913$. Observed planes as in the annexed figure. $O \wedge 1\text{-}\breve{i}=125^\circ\ 29'$, $O \wedge 2\text{-}\bar{i}=108^\circ\ 5'$, $O \wedge \frac{2}{3}=125^\circ\ 50'$, $O \wedge 1=115^\circ\ 43'$, $I \wedge i\text{-}\breve{i}=132^\circ\ 30'$, $1 \wedge 1$, pyr.,$=105^\circ$ and $96^\circ\ 45'$. Cleavage: I and O indistinct, $i\text{-}\breve{i}$ more obvious. Crystals sometimes large; usually minute; occasionally in divergent groups.

523



H.=2·5–3. G.=6·4. Lustre resinous. Color deep verdigris- or bluish-green; inclining to mountain-green if the crystals are delicate. Streak greenish-white. Translucent. Fracture uneven. Rather brittle.

Comp.—Sulphate of lead combined with carbonate of copper and lead. Analysis by Brooke (l. c.):

$\dot{\mathrm{P}}\mathrm{b}\,\dddot{\bar{\mathrm{S}}}$ 55·8 $\dot{\mathrm{P}}\mathrm{b}\,\ddot{\mathrm{C}}$ 32·8 $\dot{\mathrm{C}}\mathrm{u}\,\ddot{\mathrm{C}}$ 11·4=100 Brooke,

corresponding nearly to $3\,\dot{\mathrm{P}}\mathrm{b}\,\dddot{\bar{\mathrm{S}}}+2\,\dot{\mathrm{P}}\mathrm{b}\,\ddot{\mathrm{C}}+\dot{\mathrm{C}}\mathrm{u}\,\ddot{\mathrm{C}}$, or $1\frac{1}{2}\,\dot{\mathrm{C}}\mathrm{u}\,\ddot{\mathrm{C}}$.

Pyr., etc.—B.B. on charcoal easily reduced. Partially soluble, with a slight effervescence, in nitric acid, leaving a residue of sulphate of lead (Brooke).

Obs.—Occurs at Leadhills, Scotland, accompanying other ores of lead, in crystals with linarite: at Red Gill in Cumberland; also at Retzbanya in Hungary; Tanné in the Harz. Said to occur at Mine la Motte, Missouri. The above figure is by Brooke of a Leadhills crystal.

637. DREELITE. Dréelite *Dufrénoy*, Ann. Ch. Phys., lx. 102, 1835. Dreeit *Glocker*, Syn., 261, 1847.

Rhombohedral. $R \wedge R=93^\circ$ or 94°. Cleavage: rhombohedral, in traces.

H.=3·5. G.=3·2–3·4. Lustre pearly; splendent on a surface of fracture. Streak and color white.

Comp.—$\dot{\mathrm{C}}\mathrm{a}\,\dddot{\bar{\mathrm{S}}}+3\,\dot{\mathrm{B}}\mathrm{a}\,\dddot{\bar{\mathrm{S}}}$. Analysis by Dufrénoy (l. c.):

$\dot{\mathrm{B}}\mathrm{a}\,\dddot{\bar{\mathrm{S}}}$ 61·73 $\dot{\mathrm{C}}\mathrm{a}\,\dddot{\bar{\mathrm{S}}}$ 14·275 $\dot{\mathrm{C}}\mathrm{a}\,\ddot{\mathrm{C}}$ 8·05 $\dddot{\mathrm{S}}\mathrm{i}$ 9·71 $\dddot{\bar{\mathrm{A}}}\mathrm{l}$ 2·405 $\dot{\mathrm{C}}\mathrm{a}$ 1·52 $\dot{\bar{\mathrm{H}}}$ 2·31=100.

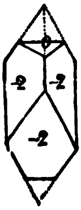
Obs.—In small unmodified crystals, disseminated on the surface and in the cavities of a quartzose rock, at Beaujeu, France. Dept. of the Rhone; also at Badenweiler (Baden).

Named by Dufrénoy after Mr. de Drée, a liberal patron of science.

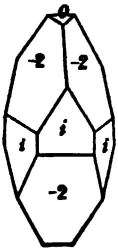
Thomson has analyzed another compound of the sulphates of baryta and lime (Min., i. 106), consisting of 71·9 of the former to 28·1 of the latter; it was from Harrowgate in Yorkshire.

638. SUSANNITE. Sulphato-tricarbonate of Lead pt. (fr. Susanna mine, Leadhills) *Brooke*, Ed. N. Phil. J., iii. 117, 138, 1827. Suzannit *Haid.*, Handb., 505, 1845.

524



525



Rhombohedral. $R \wedge R=94^\circ$, $O \wedge R=128^\circ\ 3'$; $a=1{\cdot}1062$. Observed planes: -2, O, i, 2, 4, $-1\text{-}4$. $O \wedge 2=111^\circ\ 13'$, $O \wedge 4=101^\circ\ 30'$, $2 \wedge 2=72^\circ\ 30'$. Cleavage: O easily obtained.

H.=2·5. G.=6·5–6·55. Lustre resinous—adamantine. Color white, green, yellow, brownish-black. Streak uncolored.

Comp.—Same as for leadhillite. Analysis by Brooke (l. c.): Sulphate of lead 27·5, carbonate of lead 72·5.

Crystals from Nertschinsk, analyzed by Kotschubey, having G.

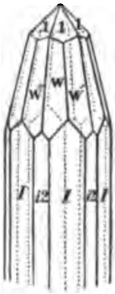
=6·526—6·55, and therefore probably susannite rather than leadhillite, afforded him (Koksch. Min. Russl., 76, 1853) $\dot{P}b\,\ddot{\ddot{S}}$ 27·05, $\dot{P}b\,\ddot{C}$ 74·26=101·31; and $\dot{P}b\,\ddot{\ddot{S}}$ 26·91, $\dot{P}b\,\ddot{C}$ 72·87=99·78.

Obs.—In attached crystals at the Susanna mine, Leadhills in Scotland; at Moldawa in Hungary; Nertschinsk in Siberia. Formerly referred to leadhillite, the compound crystals of which it resembles.

The rhombohedron *R* of susannite, as it is assumed by Haidinger, equals very nearly −2 of dreelite, which it is here made.

639. CONNELLITE. Copper Ore of an azure blue color, composed of needle crystals (fr. Wheal Providence) *Rashleigh*, Brit. Min., ii. 13, pl. 12, f. 1, 6, 1802. Sulphato-chloride of Copper *Connel*, Rep. Brit. Assoc., 1847. Connellite *Dana*, Min., 523, 1850.

527



Wheal Unity?

Hexagonal. $O \wedge 1=126° 50'$; $a=1·1562$. Observed planes as in the annexed figure. From the measurements of Maskelyne, $w=\frac{1}{3}\frac{3}{}\text{-}\frac{1}{1}\frac{3}{1}$. Crystals slender, or acicular; like f. 526; and also hexagonal prisms (*i*-2), with the pyramid 1.

$1 \wedge 1$, ov. summit, $=73° 40'$
$1 \wedge I=143\ 10$
$1 \wedge 1$, adj., $=132\ 50$
$1 \wedge i\text{-}2=133\ 53$
$w \wedge w'=163\ 50$

$w \wedge w''=137° 10'$
$w \wedge i\text{-}2=156\ 2$
$w \wedge I=166\ 54$
$w \wedge 1=152\ 37$
$I \wedge i\text{-}2=150$

Lustre vitreous. Color fine blue. Translucent.

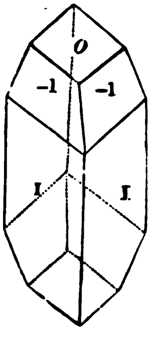
Comp.—From trials by Connell, contains oxyd of copper, sulphuric acid, and chlorid of copper, and supposed to be a compound of a sulphate and chlorid of copper.

Easily soluble in nitric or muriatic acid.

Obs.—In Cornwall, at Wheal Unity and Wheal Damsel, in slender crystals, not over $\frac{1}{100}$ in. in diameter and $\frac{1}{10}$ in. thick; Maskelyne, Phil. Mag., IV. xxv. 39, whence the above figure.

640. GLAUBERITE. Glauberite *Brongniart*, J. d. M., xxiii. 5, 1808. Brongniartin *v. Leonh.* Handb., 270, 1826.

528



Monoclinic. $C=68° 16'$, $I \wedge I=83° 20'$, $O \wedge 1\text{-}i=136° 30'$; $a : b : c=0·8454 : 1 : 0·8267$. Observed planes: *O*; vertical, *I*, *i-i*; hemidomes, 2-*i*, $\frac{3}{2}$-*i*; hemioctahedral, $\frac{1}{3}$, $\frac{1}{2}$, 1, 3, −1; 3-3.

$O \wedge i\text{-}i=111° 44'$
$O \wedge 1=136\ 49$
$O \wedge 3=88\ 57$
$O \wedge I=104\ 15$

$-1 \wedge -1=116° 20'$
$1 \wedge 1=95\ 22$
$3\text{-}3 \wedge 3\text{-}3=136\ 8$

Cleavage: *O* perfect.

H.=2·5—3. G.=2·64—2·85. Lustre vitreous. Color pale yellow or gray; sometimes brick-red. Streak white. Fracture conchoidal; brittle. Taste slightly saline.

Var.—The above angles are from Brooke & Miller. Senarmont found (Ann. Ch. Phys., III xxxi. 157) $I \wedge I=82° 36'—83° 15'$, $O \wedge 1=137° 37'$, $O \wedge 3=89° 6'$, $O \wedge I=104° 52'—105° 17'$, $-1 \wedge -1=116° 18'—116° 52'$, $3\text{-}3 \wedge 3\text{-}3=135° 20'$.

Comp.—$(\frac{1}{2}\dot{\mathrm{N}}\mathrm{a}+\frac{1}{2}\dot{\mathrm{C}}\mathrm{a})\dddot{\mathrm{S}}$=Sulphate of soda 51·1, sulphate of lime 48·9=100; or, Sulphuric acid 57·5, lime 20·1, soda 22·4. Analyses: 1, Brongniart (l. c.): 2, v. Kobell (Gel. Anz. München, Jahrb. Min. 1846, 840); 3, v. Hauer (Ber. Ac. Wien); 4, Hayes (J. Nat. H. Soc. Bost., iv. 498); 5, Ulex (Ann. Ch. Pharm., lxx. 51); 6, Pisani (C. R., li. 731):

	$\dddot{\mathrm{S}}$	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\mathrm{N}}\mathrm{a}$	Cl	$\dddot{\bar{\mathrm{F}}}\mathrm{e}$
1. Villa Rubia	56·5	20·2	23·3	——	——=100 Brongniart.
2. Berchtesgaden	57·29	21·04	21·27	——	——=99·60 Kobell.
3. Ischl	57·52	20·37	21·87	0 31	——=100·07 Hauer.
4. Tarapaca	57·22	20·68	21·32	——	0·14=99·36 Hayes.
5. "	55·0	19·6	21·9	——	——, $\dddot{\mathrm{B}}$ 3·5=100 Ulex.
6. Varengeville		$\dot{\mathrm{N}}\mathrm{a}\dddot{\mathrm{S}}$ 50·50		$\dot{\mathrm{C}}\mathrm{a}\dddot{\mathrm{S}}$ 48·78	clay 0·40=99·68 Pisani.

No. 5 was mixed with some ulexite; No. 6 was brick-red, friable, and resin-like.

Pyr., etc.—B.B. decrepitates, turns white, and fuses at 1·5 to a white enamel, coloring the flame intensely yellow. On charcoal fuses in O.F. to a clear bead; in R.F. a portion is absorbed by the charcoal, leaving an infusible hepatic residue. With soda on charcoal gives the reaction for sulphuric acid. Soluble in muriatic acid. In water it loses its transparency, is partially dissolved, leaving a residue of sulphate of lime and in a large excess this is completely dissolved. On long exposure absorbs moisture and falls to pieces.

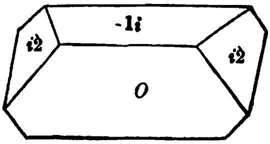
Obs.—In crystals in rock salt at Villa Rubia, near Ocana, in New Castile; also at Aussee, in Upper Austria; in Bavaria; at the salt mines of Vic, in France ($O \wedge I$=104° 11′, Dufr.); at Varengeville, near Nancy, a red variety in salt with polyhalite and anhydrite; and at Borax Lake, California, in blue clay, at a depth of 40 ft., having been obtained in an Artesian boring. Province of Tarapaca, Peru (affording the above figure and Senarmont's angles), with ulexite.

Artif.—On the artificial preparation of glauberite, J. Fritzsche, J. pr. Ch., lxxii. 291. On cryst., Senarmont, Ann. Ch. Phys., III. xxxvi. 157.

641. LANARKITE. Sulphato-Carbonate of Lead *Brooke*, Ed. Phil. J., iii. 117, 1820. Lanarkite *Beud.*, Tr., ii. 366, 1832. Dioxylith *Breith.*, Char., 1832. Kohlenvitriolbleispath, Halbvitriolblei, *Germ.*

Monoclinic. $I \wedge I$=85° 48′; i-2 ∧ i-2, front,=49° 50′, Greg; $O \wedge -1$-i =120° 45′. Plane i 2 usually rounded, and the crystals aggregated lengthwise, and seldom distinct. Cleavage: O perfect; −1-i less perfect. Laminæ flexible as in gypsum.

529



H.=2—2·5. G.=6·3—7; 6·3—6·4, Thomson. Lustre of the cleavage-face pearly; other parts adamantine, inclining to resinous. Streak white. Color greenish-white, pale yellow, or gray. Transparent—translucent.

Comp.—$\dot{\mathrm{P}}\mathrm{b}\dddot{\mathrm{S}}+\dot{\mathrm{P}}\mathrm{b}\ddot{\mathrm{C}}$=Sulphate of lead 53·15, carbonate of lead 46·85. Analyses: 1, Brooke (l. c.); 2, Thomson (Phil. Mag., III. xv. 402):

1. Carbonate of lead 46·9 Sulphate of lead 53·1=100.
2. " " 46·04 " " 43·96=100; G.=6·3197.

Pyr., etc.—B.B. on charcoal easily reduced. Partially dissolved in nitric acid with effervescence. leaving a residue of sulphate of lead (Brooke).

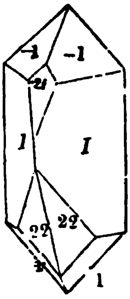
Obs.—At Leadhills, Lanarkshire, Scotland, with caledonite and susannite; of very rare occurrence. Massive in Siberia, and at Tanne, in the Harz; at Biberweier, Tyrol.

642. CROCOITE. Nova minera Plumbi *J. G. Lehman*, Acad. Petrop., 1766; Pallas, Voyages 1770, ii. 235. Minera Plumbi rubra *Wall.*, Min., 1778. Rothes-Bleierz *Wern.*, Auss. Kenns. 296, 1774. Plomb rouge *Macquart*, J. de Phys., xxxiv. 1789; *Vauquelin*, Bull. Soc. Philomath., and J. de Phys., xlv. 393, 1794, xlvi. 152, 311, 1798. Plomb chromaté *H.*, Tr., iii. 1801. Chro-

mate of Lead. Chromsaures Blei, Bleichromat, Chrombleispath, *Germ.* Kallochrom *Hausm.*, Handb., 1086, 1813. Crocoise *Beud.*, Tr., ii. 669, 1832. Crocoisit *v. Kob.*, Grundz., 282, 1838 Krokoit *Breith.*, Handb., ii. 262, 1841.

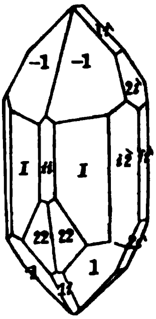
Monoclinic. $C=77°\ 27'$, $I \wedge I=93°\ 42'$, $O \wedge 1\text{-}\grave{i}=138°\ 10'$; $a:b:c=$ 0·95507 : 1 : 1·0414, Dauber. Observed planes: *O*, not common; vertical, *I* (common), $i\text{-}\grave{i}$, $i\text{-}i$ (not common), i-3, i-2, i-$\frac{5}{3}$, i-$\frac{3}{2}$, ? i-$\frac{4}{3}$, i-$\grave{2}$, ? i-$\frac{5}{3}$; clinodomes, $\frac{1}{2}$-$\grave{i}$, 1-$\grave{i}$, ? $\frac{8}{5}$-$\grave{i}$, 2-$\grave{i}$; hemidomes, 6-i, 5-i, 4-i, ? $\frac{7}{2}$-i, 3-i, ? $\frac{8}{3}$-i, 1-i, −8-i, −6-i, ? −5-i, −4-i, −$\frac{5}{2}$-i, −1-i; orthodiagonal hemipyramids, $\frac{1}{2}$, $\frac{2}{3}$, 1, −1, −$\frac{6}{5}$, ? −$\frac{5}{4}$, −$\frac{4}{3}$, ? −$\frac{3}{2}$, −2, −3, −4; $\frac{11}{10}$-$\frac{11}{10}$, −11-$\frac{11}{10}$; $\frac{4}{5}$-$\frac{8}{7}$; −3-$\frac{6}{5}$; −$\frac{4}{5}$-$\frac{4}{3}$; $\frac{8}{3}$-$\frac{3}{2}$; −4-$\frac{8}{5}$; $\frac{5}{2}$-$\frac{5}{3}$, −$\frac{5}{2}$-$\frac{5}{3}$; $\frac{13}{6}$-$\frac{13}{8}$, −3-$\frac{9}{5}$; ? $\frac{7}{3}$-$\frac{7}{4}$; 2-2, −8-2, −$\frac{1}{5}$-2, 3-$\frac{15}{7}$ (=? 3-2); 3-$\frac{12}{5}$; 5-$\frac{5}{2}$; $\frac{13}{2}$-$\frac{13}{5}$; $\frac{6}{5}$-3, $\frac{3}{2}$-3, 3-3, $\frac{9}{2}$-3, 6-3, 9-3, −12-3; −4-$\frac{16}{5}$ (=? 4-3); −$\frac{5}{2}$-$\frac{10}{3}$; $\frac{7}{2}$-$\frac{7}{2}$; $\frac{11}{4}$-$\frac{11}{3}$; ? $\frac{2}{3}$-4, 4-4, −2-4; $\frac{9}{2}$-$\frac{9}{2}$, 18-$\frac{9}{2}$; $\frac{5}{2}$-5, 5-5; 3-6; ? $\frac{7}{3}$-7, −7-7; −8-8; 9-9, −9-9; −11-11; $\frac{13}{5}$-$\frac{13}{3}$; 17-34; clinodiagonal hemipyramids, ? 3-$\grave{2}$, $\frac{8}{5}$-$\grave{2}$, $\frac{2}{3}$-$\grave{2}$, −$\frac{2}{3}$-$\grave{2}$; −$\frac{3}{5}$-$\grave{\frac{3}{7}}$; ? $\frac{5}{6}$-$\grave{\frac{5}{4}}$; $\frac{1}{2}$-$\grave{\frac{1}{3}}$; −$\frac{5}{2}$-$\grave{\frac{5}{3}}$; −$\frac{10}{9}$-$\grave{\frac{5}{3}}$; −$\frac{9}{8}$-$\grave{\frac{7}{5}}$; $\frac{2}{3}$-$\grave{\frac{5}{3}}$; −$\frac{5}{4}$-$\grave{5}$; ? $\frac{10}{9}$-20.

530



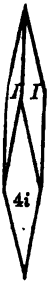
Urals.

531



Urals.

532



Brazil.

$I \wedge i\text{-}\grave{i}=133°\ 9'$ $O \wedge 2\text{-}\grave{i}=118°\ 1'$ $-1 \wedge -1=119°\ 12'$

$O \wedge i\text{-}i=102\ 33$ $i\text{-}\grave{2} \wedge i\text{-}\grave{2}=56\ 10$ $1 \wedge 1=107\ 38$

Cleavage: *I* tolerably distinct; *O* and $i\text{-}i$ less so. Surface *I* streaked longitudinally; the faces mostly smooth and shining. Also imperfectly columnar and granular.

H.=2·5—3. G.=5·9—6·1. Lustre adamantine—vitreous. Color various shades of bright hyacinth-red. Streak orange-yellow. Translucent. Sectile.

Var.—Dauber gives the following observed angles for a large number of crystals from Brazil, Urals, and the Philippines (Ber. Ak. Wien, xlii. 17, 1860):

	Brazil.	Urals.	Philippines.
$I(m) \wedge I(m)$	93° 17′—93° 43′	93° 22′—93° 45′	93° 30′—93° 57′
$I(m) \wedge -1\,(t)$	146 36—145 46	146 4—145 51	146 27—145 40
$-1\,(t) \wedge -1\,(t)$	119 29—118 53	119 20—118 56	119 20—118 52
$O(c) \wedge 1\text{-}\grave{i}\,(z)$		138 14—138 9	
$O(c) \wedge 3\text{-}i\,(x)$		97 44—97 35	
$O(c) \wedge I(m)$			99 11—99

From his numerous exact measurements he deduces for the angle *C*, or the inclination of the axis, in the Brazilian, 77° 14′ 23″; the Uralian, 77° 31′ 20″; the Philippine, 77° 23′ 27″. Kupffer made this angle 78° 1′; Brooke & Miller, 77° 55′; Haidinger obtained from one crystal 77° 10′; and by deductions from other measurements of 4 crystals 77° 29′—77° 57′.

Dauber gives figures of fifty-four different crystals. The Brazilian have usually the plane 4-i, and an extreme variety of this form is shown in f. 532. One form from the Philippines is the fundamental octahedron 1, −1; another *I*, −1, or *I*, −1, $i\text{-}\grave{2}$, in slender prisms; while others approach the Uralian in form.

Comp.—$\dot{P}b\,\dddot{C}r$=Oxyd of lead 68·9, chromic acid 31·1=100. Analyses: 1, Pfaff (Schw. J., xviii. 72); 2, Berzelius (ib., xxii. 54):

1.	$\dddot{C}r$ 31·735	$\dot{P}b$ 67·912=99·647 Pfaff.
2.	31·50	68·50=100 Berzelius.

Vauquelin discovered the metal *chromium* in this mineral in 1794 (l. c., 1794, 1798, and J. d M., ii. 737).

Pyr., etc.—In the closed tube decrepitates, blackens, but recovers its original color on cooling. B.B. fuses at 1·5, and on charcoal is reduced to metallic lead with deflagration, leaving a residue of chrome-oxyd, and giving a lead coating. With salt of phosphorus gives an emerald-green bead in both flames. Fused with bisulphate of potash in the platinum spoon forms a dark violet mass, which on solidifying becomes reddish, and when cold greenish-white, thus differing from vanadinite, which on similar treatment gives a yellow mass (Plattner).

Obs.—First found at Beresof in Siberia, in crystals in quartz veins, or intersecting gneiss or granite; also occurs at Mursinsk and near Nischne Tagilsk in the Ural, in narrow veins, traversing decomposed gneiss, and associated with gold, pyrite, galenite, quartz, and vauquelinite; in Brazil, at Congonhas do Campo, in fine crystals in decomposed granite; at Retzbanya in Hungary, at the mine of St. Anthony; Moldawa in Hungary; on Luzon, one of the Philippines, whence crystals were received by the author in 1842, from El Senor Roxas of Manila, and understood to be from the northern peninsula of Luzon; according to Dr. Hochstetter, at the mines of Labo, in the Province of North Camarines, on the southeastern peninsula of Luzon (Dauber).

This species was first noticed by Lehman (l. c.). The name *Crocoite* is from κρόκος, *saffron*. Berthier, in 1832, gave the word the bad form *Crocoise*, which von Kobell altered (to make it conformable to ordinary mineralogical nomenclature) in 1838, to *Crocoisite*, and Breithaupt, in 1841, to *Crocoite* (Krokoit), and v. Kobell also to this last mentioned form in his later works. Hausmann's *Callochrome* has the priority; but as the name is a poorer one, not mineralogical in form, and the species was not one instituted by Hausmann, we allow *Crocoite* to stand.

643. PHŒNICOCHROITE. Melanochroit *Hermann*, Pogg., xxviii. 162, 1833. Phœnikochroit *Glocker*, Grundr., 612, 1839. Subsesquichromate of Lead *Thom.* Phœnicit *Haid.*, Handb., 504, 1845.

Orthorhombic? Crystals usually tabular, and reticularly interwoven. Cleavage in one direction perfect. Also massive.

H.=3–3·5. G.=5·75. Lustre resinous or adamantine, glimmering. Color between cochineal- and hyacinth-red; becomes lemon-yellow on exposure. Streak brick-red. Subtranslucent—opaque.

Comp.—$\dot{\mathrm{P}}\mathrm{b}^3\,\dddot{\mathrm{C}}\mathrm{r}^2$=Chromic acid 23·1, protoxyd of lead 76·9=100. Analysis: Hermann (Pogg., xxviii. 162):

Chromic acid 23·31 Protoxyd of lead 76·69=100.

The same result was obtained by G. Rose (Jahrb. Min. 1839, 575).

Pyr., etc.—B.B. on charcoal fuses readily to a dark mass, which is crystalline when cold. In R.F. on charcoal gives a coating of oxyd of lead, with globules of lead and a residue of chrome-oxyd. Gives the reaction of chrome with fluxes.

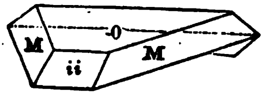
Obs.—Occurs in limestone at Beresof in the Ural, with crocoite, vauquelinite, pyromorphite, and galenite.

Named *Melanochroite* by Hermann, from μέλας, *black*, and χρόα, *color*. But, as the color is red, and not black, and the name is therefore false to the species, Glocker changed it to *Phœnicochroite*, from φοίνικος, *deep red*, and χρόα; and in this he is followed by Hausmann. The abbreviated form *phœnicite* is bad, because it is too much like the name of another mineral, *phenacite*.

644. VAUQUELINITE. Vauqueline *Berz.*, Afh., vi. 100, 1818. Vauquelinite *Berz.*, N. Syst. Min. Paris, 202, 1819. Chromate of Lead and Copper.

Monoclinic. Crystals usually minute, irregularly aggregated. Twins: annexed figure; composition-face a plane on the acute solid angle: $O \wedge O$ (of the two individuals) =134° 30′; $O \wedge i\text{-}\grave{i}$=149° nearly. Also reniform or botryoidal, and granular; amorphous.

533



H.=2·5–3. G.=5·5–5·78. Lustre adamantine to resinous, often faint. Color green to brown, apple-green, siskin-green, olive-green, ochre-brown, liver-brown; sometimes nearly black. Streak greenish or brownish. Faintly translucent—opaque. Fracture uneven. Rather brittle.

Comp.—$\dot{\rm C}{\rm u}^3\,\dddot{\rm C}{\rm r}^2+2\,\dot{\rm P}{\rm b}^3\,\dddot{\rm C}{\rm r}^2=(\dot{\rm C}{\rm u},\dot{\rm P}{\rm b})^3\,\dddot{\rm C}{\rm r}^2$=Oxyd of lead 61·4, oxyd of copper 10·9, chromic acid 27·7=100. Analysis by Berzelius (l. c.):

$\dddot{\rm C}{\rm r}$ 28·33 $\dot{\rm P}{\rm b}$ 60·87 $\dot{\rm C}{\rm u}$ 10·80=100.

Pyr., etc.—B.B. on charcoal slightly intumesces and fuses to a gray submetallic globule, yielding at the same time small globules of metal. With borax or salt of phosphorus affords a green transparent glass in the outer flame, which in the inner after cooling is red to black, according to the amount of mineral in the assay; the red color is more distinct with tin. Partly soluble in nitric acid.

Obs.—Occurs with crocoite at Beresof in Siberia, generally in mammillated or amorphous masses, or thin crusts; also at Pont Gibaud in the Puy de Dome; and with the crocoite of Brazil.

At the lead mine near Sing Sing it has been found by Dr. Torrey in green and brownish-green mammillary concretions, and also nearly pulverulent; and at the Pequa lead mine in Lancaster Co., Pa., in minute crystals and radiated aggregations on quartz and galenite, of siskin- to apple-green color, with cerussite.

Named after Vauquelin, the discoverer of the metal chromium, and also the first one to notice the crystals of this species (J. d. M., No VI. i. 760).

John describes a greenish or brownish *chromo-phosphate of lead and copper* (chromphosphorkupferbleispath) from Beresof, Siberia, as occurring in small crystalline concretions, having the surface covered with capillary prisms; H.=2—3; opaque to subtranslucent; fracture uneven; powder dull greenish. Analysis afforded (Jahrb. Min. 1845, 67) $\dot{\rm P}{\rm b}\,\dddot{\rm C}{\rm r}$ 45·0, $\dot{\rm P}{\rm b}$ 19·0, $\dot{\rm C}{\rm u}$ 11·20, $\overset{\cdot\cdot}{\bar{\rm P}}$ 4·10, $\dddot{\rm C}{\rm r}$ 7·50, manganese *tr.*, $\dot{\bar{\rm H}}$ 1·78, impurities 11·42. To a large extent soluble in nitric or muriatic acid. It is probably only an impure vauquelinite.

645. JOSSAITE *Breith.* (B. H. Ztg., xvii. 54, 1858). From Beresof, occurring in small orange-yellow crystals with vauquelinite. Described as orthorhombic, with $I \wedge I$=110°—118°, and traces of prismatic cleavage; the lustre between vitreous and waxy; streak dull yellowish-white; H.=3·0; G.=5·2. According to Plattner, it gives the reactions of chromic acid and oxyds of lead and zinc.

646. PETTKOITE. Pettkoit *A. Paulinyi*, Jahrb. Min. 1867, 457.

Isometric. Common form the cube; also f. 6, and f. 6 with planes of the dodecahedron. Cleavage: none distinct.

H.=2·5. Lustre bright. Color pure black. Streak dirty greenish. Fracture uneven. Taste sweetish.

Comp.—An acid sulphate of iron; O. ratio for $\dot{\rm F}{\rm e} : \dddot{\bar{\rm F}}{\rm e} : \dddot{\rm S} : \dot{\bar{\rm H}}$=1·5 : 18·5 : 27 : 1·5. Allowing for some hydrated oxyd of iron as impurity (about 10·5 p. c., as 1·51 of water would require 9·1 of $\dddot{\bar{\rm F}}{\rm e}$ for limonite), the formula may be $(\dot{\rm F}{\rm e}^3, \dddot{\bar{\rm F}}{\rm e})\,\dddot{\rm S}^2$, with $\dot{\rm F}{\rm e}^3 : \dddot{\bar{\rm F}}{\rm e}$=1 : 7. Analysis: A. *Paulinyi* (l. c.):

$\dddot{\rm S}$ 45·32 $\dddot{\bar{\rm F}}{\rm e}$ 44·92 $\dot{\rm F}{\rm e}$ 6·66 $\dot{\bar{\rm H}}$ 1·51=98·41.

Pyr., etc.—In a closed tube yields water. B.B. on charcoal yields a magnetic mass; with soda gives the sulphuric acid reaction. Wholly soluble in hot water, with a deposit of a flocculent reddish-brown precipitate. Soluble in dilute muriatic acid.

Obs.—From Kremnitz, in a breccia, along with iron-vitriol (melanterite), in crystals from the size of peas to millets, and in grains. Named after Bergrath v. Pettko.

647. ALUMIAN. *Breith.*, B. H. Ztg., xvii. 53, 1858.

Rhombohedral? Crystals microscopic. Cleavage, traces. Also massive.

H.=2—3. G.=2·702—2·781. Lustre of small crystals vitreous; of masses weak. Color white. Subtranslucent.

Comp.—$\bar{\bar{Al}}\dddot{S}^3$ (?)=Sulphuric acid 60·9, alumina 39·1. According to Utendörffer's determinations (l. c.), contains 37–38 p. c. of alumina, with sulphuric acid, and no water.

Pyr., etc.—B.B. unaltered; only hygroscopic water given off, but at a high temperature sulphuric acid, which may be detected by litmus paper. With cobalt solution a fine blue.

Obs.—From mines in the Sierra Almagrera, southern Spain.

HYDROUS SULPHATES.

ARRANGEMENT OF THE SPECIES.

I. Oxygen ratio for bases and acid 1 : 3; the species coming under the general formula $\dot{R}\dddot{S}+n$ aq, $\bar{\bar{R}}\dddot{S}^3+n$ aq, or $(\dot{R}^3, \bar{\bar{R}})\dddot{S}^3+n$ aq.

A. *Sulphates of Elements in the Protoxyd state.*

1. Contain ammonium. Orthorhombic, with $I \wedge I=100°—108°$.

650. **Mascagnite**	$NH^4O\dddot{S}+\dot{H}$	$S\Theta_2\|\Theta_2\|(NH_4)_2+aq$
651. **Boussingaultite**	(?) $NH^4O, \dot{M}g, \dddot{S}, \dot{H}$	
652. **Lecontite**	$(\dot{N}a, \dot{K}, NH^4O)\dddot{S}+2\dot{H}$	$S\Theta_2\|\Theta_2\|(Na, K, NH_4)_2+2aq$

2. Contain sodium, without magnesium. calcium, or iron.

653. **Mirabilite**	$\dot{N}a\dddot{S}+10\dot{H}$	$S\Theta_2\|\Theta_2\|Na_2+10aq$

3. Contain calcium or magnesium, with or without the alkaline metals; less than 4 of $\dot{H}$ to 1 of $\dddot{S}$. Monoclinic or orthorhombic.

654. **Gypsum**	$\dot{C}a\dddot{S}+2\dot{H}$	$S\Theta_2\|\Theta_2\|\Theta a+2aq$
655. **Kieserite**	$\dot{M}g\dddot{S}+\dot{H}$	$S\Theta_2\|\Theta_2\|Mg+aq$
656. **Polyhalite**	$(\frac{2}{4}\dot{C}a+\frac{1}{4}\dot{M}g+\frac{1}{4}\dot{K})\dddot{S}+\frac{1}{2}\dot{H}$	$S\Theta_2\|\Theta_2\|(\frac{1}{4}K_2+\frac{2}{4}\Theta a+\frac{1}{4}Mg)+\frac{1}{2}aq$
657. **Mamanite**	$(\frac{3}{6}\dot{C}a+\frac{2}{6}\dot{M}g+\frac{1}{6}\dot{K})\dddot{S}+\frac{1}{3}\dot{H}$	$S\Theta_2\|\Theta_2\|(\frac{1}{6}K_2+\frac{3}{6}\Theta a+\frac{2}{6}Mg)+\frac{1}{3}aq$
658. **Picromerite**	$(\frac{1}{2}\dot{M}g+\frac{1}{2}\dot{K})\dddot{S}+3\dot{H}$	$S\Theta_2\|\Theta_2\|(\frac{1}{2}K_2+\frac{1}{2}Mg)+3aq$
659. **Blœdite**	$(\frac{1}{2}\dot{M}g+\frac{1}{2}\dot{N}a)\dddot{S}+2\dot{H}$	$S\Theta_2\|\Theta_2\|(\frac{1}{2}Na_2+\frac{1}{2}Mg)+2aq$

4. Bases and water as in section 3. Crystals tetragonal.

660. **Lœweite**	$(\frac{1}{2}\dot{M}g+\frac{1}{2}\dot{N}a)\dddot{S}+1\frac{1}{4}\dot{H}$	$S\Theta_2\|\Theta_2\|(\frac{1}{2}Na_2+\frac{1}{2}Mg)+1\frac{1}{4}aq$

5. EPSOMITE GROUP. Contain magnesium, iron, manganese, etc.; 4–7 of $\dot{H}$ to 1 of $\dddot{S}$ Orthorhombic; $I \wedge I=90°—93°$.

661. **Epsomite**	$\dot{M}g\dddot{S}+7\dot{H}$	$S\Theta_2\|\Theta_2\|Mg+7aq$
662. **Tauriscite**	$\dot{F}e\dddot{S}+7\dot{H}$	$S\Theta_2\|\Theta_2\|Fe+7aq$
663. **Fauserite**	$(\frac{2}{3}\dot{M}n+\frac{1}{3}\dot{M}g)\dddot{S}+5\dot{H}$	$S\Theta_2\|\Theta_2\|(\frac{1}{3}Mg+\frac{2}{3}Mn)+5aq$

6. COPPERAS GROUP. Basic elements and water as in section 5. Monoclinic, with $I \wedge I = 82°–92°$; or triclinic.

664. MELANTERITE	$\dot{F}e\,\dddot{S}+7\,\dot{H}$	$S\,\Theta_2\vert\Theta_2\vert Fe+7\,aq$
665. PISANITE	$(\dot{F}e, \dot{C}u)\,\dddot{S}+7\,\dot{H}$	$S\,\Theta_2\vert\Theta_2\vert(Fe, \Theta u)+7\,aq$
666. GOSLARITE	$\dot{Z}n\,\dddot{S}+7\,\dot{H}$	$S\,\Theta_2\vert\Theta_2\vert Zn+7\,aq$
667. BIEBERITE	$\dot{C}o\,\dddot{S}+7\,\dot{H}$	$S\,\Theta_2\vert\Theta_2\vert\Theta o+7\,aq$
668. MORENOSITE	$\dot{N}i\,\dddot{S}+7\,\dot{H}$	$S\,\Theta_2\vert\Theta_2\vert Ni+7\,aq$
669. CHALCANTHITE	$\dot{C}u\,\dddot{S}+5\,\dot{H}$	$S\,\Theta_2\vert\Theta_2\vert\Theta u+5\,aq$

7. CYANOCHROITE GROUP. Contain copper and potassium.

670. CYANOCHROITE	$(\frac{1}{2}\,\dot{K}+\frac{1}{2}\,\dot{C}u)\,\dddot{S}+3\,\dot{H}$	$S\,\Theta_2\vert\Theta_2\vert(\frac{1}{2}\,K_2+\frac{1}{2}\,\Theta u)+3\,aq$

B. *Sulphates of Elements in the Sesquioxyd state, or Sesquioxyd and Protoxyd.*

8. ALUNOGEN GROUP. O. ratio for $\bar{R}$, $\dddot{S}$, $\dot{H}=1:3:9$ to $1:3:18$.

671. ALUNOGEN	$\dddot{A}l\,\dddot{S}^3+18\,\dot{H}$	$S\,\Theta_2\vert\Theta_2\vert\beta Al+6\,aq$
672. COQUIMBITE	$\bar{F}e\,\dddot{S}^3+9\,\dot{H}$	$S\,\Theta_2\vert\Theta_2\vert\beta Fe+3\,aq$

9. ALUM GROUP. O. ratio for $\dot{R}$, $\bar{R}$, $\dddot{S}$, $\dot{H}=1:3:12:24$; for bases, acid, and water, $1:3:6$. Crystals isometric.

673. TSCHERMIGITE	$(\frac{1}{4}\,(N\,H^4\,O)^3+\frac{3}{4}\,\dddot{A}l)\,\dddot{S}^3+18\,\dot{H}$	$S\,\Theta_2\vert\Theta_2\vert(\frac{1}{4}\,(N\,H_4)_2+\frac{3}{4}\,\beta Al)+6\,aq$
674. KALINITE	$(\frac{1}{4}\,\dot{K}^3+\frac{3}{4}\,\dddot{A}l)\,\dddot{S}^3+18\,\dot{H}$	$S\,\Theta_2\vert\Theta_2\vert(\frac{1}{4}\,K_2+\frac{3}{4}\,\beta Al)+6\,aq$

10. VOLTAITE GROUP. O. ratio for $\dot{R}$, $\bar{R}$ not $1:3$; for bases, acid, and water, $1:3:4$. Crystals isometric.

675. VOLTAITE	$(\dot{F}e^3, \bar{F}e)\,\dddot{S}^3+12\,\dot{H}$	$S\,\Theta_2\vert\Theta_2\vert(Fe, \beta Fe)+4\,aq$
676. BLAKEITE		

11. HALOTRICHITE GROUP. O. ratio for $\dot{R}$, $\bar{R}$, $\dddot{S}$, $\dot{H}=1:3:12:22$; for bases, acid, and water, $1:3:5\frac{1}{2}$. Crystallization orthorhombic or monoclinic, usually fine fibrous or acicular.

This group is related in ratio to the Alum group, it differing only in 22 instead of 24 of water. But the real difference may be much greater, and this is rather to be inferred from the unusual ratio for the water. If 2 of the 22 of water are basic, the O. ratio for bases and acid is then $1:2$, and for bases, acid, and water, $1:2:3\frac{1}{2}$. The formulas of the species below, based on this ratio, would have the general form $(\frac{1}{4}\,(\dot{R}, \dot{H})^3+\frac{3}{4}\,\dddot{A}l)\,\dddot{S}^3+10\,\dot{H}$; or, in the new system, $S\,\Theta\vert\Theta_2\vert(\frac{1}{4}\,(H_2, R)+\frac{3}{4}\,\beta\,Al)+3\frac{1}{2}\,aq$.

77. MENDOZITE	$(\frac{1}{4}\,\dot{N}a^3+\frac{3}{4}\,\dddot{A}l)\,\dddot{S}^3+16\frac{1}{2}\,\dot{H}$	$S\,\Theta_2\vert\Theta_2\vert(\frac{1}{4}\,Na_2+\frac{3}{4}\,\beta Al)+5\frac{1}{2}\,aq$
78. PICKERINGITE	$(\frac{1}{4}\,\dot{M}g^3+\frac{3}{4}\,\dddot{A}l)\,\dddot{S}^3+16\frac{1}{2}\,\dot{H}$	$S\,\Theta_2\vert\Theta_2\vert(\frac{1}{4}\,Mg+\frac{3}{4}\,\beta Al)+5\frac{1}{2}\,aq$
79. APJOHNITE	$(\frac{1}{4}\,\dot{M}n^3+\frac{3}{4}\,\dddot{A}l)\,\dddot{S}^3+16\frac{1}{2}\,\dot{H}$	$S\,\Theta_2\vert\Theta_2\vert(\frac{1}{4}\,Mn+\frac{3}{4}\,\beta Al)+5\frac{1}{2}\,aq$
80. BOSJEMANITE	$(\frac{1}{4}\,(\dot{M}n^3, \dot{M}g)+\frac{3}{4}\,\dddot{A}l)\,\dddot{S}^3+16\frac{1}{2}\,\dot{H}$	$S\,\Theta_2\vert\Theta_2\vert(\frac{1}{4}(Mn, Mg)+\frac{3}{4}\beta Al)+5\frac{1}{2}aq$
81. HALOTRICHITE	$(\frac{1}{4}\,\dot{F}e^3+\frac{3}{4}\,\dddot{A}l)\,\dddot{S}^3+16\frac{1}{2}\,\dot{H}$	$S\,\Theta_2\vert\Theta_2\vert(\frac{1}{4}\,Fe+\frac{3}{4}\,\beta Al)+5\frac{1}{2}\,aq$

12. RŒMERITE GROUP.

682.	**Rœmerite**	$(\frac{1}{4}\dot{\mathrm{F}}\mathrm{e}^3+\frac{3}{4}\bar{\mathrm{F}}\mathrm{e})\dddot{\mathrm{S}}^3+12\dot{\mathrm{H}}$	$\mathrm{S}\,\Theta_2\vert\Theta_2\vert(\frac{1}{4}\mathrm{Fe}+\frac{3}{4}\beta\mathrm{Fe})+3$ aq

II. Sulphates, with oxygen ratio of bases and acid 1 to less than 3; not containing Copper or Uranium.

The copper and uranium hydrous sulphates are of uncertain formulas, and are therefore placed by themselves. There is also much uncertainty with regard to the true formulas of the species here included, on account of the doubtful relations of the water.

1. O. ratio for bases (no water included) and acid 2 : 5, 2 : 3, 3 : 5

683.	**Copiapite**	$\bar{\mathrm{F}}\mathrm{e}^2\dddot{\mathrm{S}}^5+12\dot{\mathrm{H}}$ (or $18\dot{\mathrm{H}}$)	$\mathrm{S}_5\,\Theta_9\vert\Theta_{12}\vert\beta\mathrm{Fe}_6+12$ aq
684.	**Raimondite**	$\bar{\mathrm{F}}\mathrm{e}^2\dddot{\mathrm{S}}^3+7\frac{1}{2}\dot{\mathrm{H}}$	$\mathrm{S}\,\Theta\vert\Theta_4\vert\beta\mathrm{Fe}_2+2\frac{1}{2}$ aq
685.	**Fibroferrite**	$\bar{\mathrm{F}}\mathrm{e}^3\dddot{\mathrm{S}}^5+27\dot{\mathrm{H}}$	$\mathrm{S}_5\,\Theta_6\vert\Theta_{18}\vert\beta\mathrm{Fe}_9+27$ aq
686.	**Apatelite**	$\bar{\mathrm{F}}\mathrm{e}^3\dddot{\mathrm{S}}^5+2\dot{\mathrm{H}}$	$\mathrm{S}_5\,\Theta_6\vert\Theta_{18}\vert\beta\mathrm{Fe}_9+2$ aq

2. O. ratio for bases (no water included) and acid 1 : 2.

687.	**Botryogen**	$(\frac{1}{4}\dot{\mathrm{F}}\mathrm{e}^3+\frac{3}{4}\bar{\mathrm{F}}\mathrm{e})\dddot{\mathrm{S}}^2+9\dot{\mathrm{H}}$	$\mathrm{S}_2\,\Theta_2\vert\Theta_6\vert(\mathrm{Fe},\beta\mathrm{Fe})_2+9$ aq

3. O. ratio of bases (water excluded) and acid 1 : 1½ to 1 : 1; but if some water be made basic, 1 : 1 for all, as in the formulas below.

688.	**Aluminite**	$\ddot{\bar{\mathrm{A}}}\mathrm{l}\,\dddot{\mathrm{S}}+9\dot{\mathrm{H}}$	$\mathrm{S}\vert\Theta_6\vert\beta\bar{\mathrm{A}}\mathrm{l}_2+9$ aq
689.	**Alunite**	$(\frac{1}{4}(\dot{\mathrm{K}},\dot{\mathrm{H}})^3+\frac{3}{4}\ddot{\bar{\mathrm{A}}}\mathrm{l})\dddot{\mathrm{S}}+\dot{\mathrm{H}}$	$\mathrm{S}\vert\Theta_6\vert(\frac{1}{4}(\mathrm{K}_2,\mathrm{H}_2)+\frac{3}{4}\beta\bar{\mathrm{A}}\mathrm{l})_2+$ aq
690.	**Löwigite**	$(\frac{1}{4}(\dot{\mathrm{K}},\dot{\mathrm{H}})^3+\frac{3}{4}\ddot{\bar{\mathrm{A}}}\mathrm{l})\dddot{\mathrm{S}}+1\frac{3}{4}\dot{\mathrm{H}}$	$\mathrm{S}\vert\Theta_6\vert(\frac{1}{4}(\mathrm{K}_2,\mathrm{H}_2)+\frac{3}{4}\beta\bar{\mathrm{A}}\mathrm{l})_2+1\frac{3}{4}$ aq
691.	**Jarosite**	$(\frac{1}{6}(\dot{\mathrm{K}},\dot{\mathrm{N}}\mathrm{a},\dot{\mathrm{H}})^3+\frac{5}{6}\bar{\mathrm{F}}\mathrm{e})\dddot{\mathrm{S}}+1\frac{1}{3}\dot{\mathrm{H}}$	$\mathrm{S}\vert\Theta_6\vert(\frac{1}{6}(\mathrm{R}_2,\mathrm{H}_2)+\frac{5}{6}\beta\bar{\mathrm{A}}\mathrm{l})_2+1\frac{1}{3}$ aq
692.	**Carphosiderite**	$(\frac{1}{3}\dot{\mathrm{H}}^3+\frac{2}{3}\bar{\mathrm{F}}\mathrm{e})\dddot{\mathrm{S}}+2\dot{\mathrm{H}}$	$\mathrm{S}\vert\Theta_6\vert(\frac{1}{3}\mathrm{H}_2+\frac{2}{3}\beta\mathrm{Fe})_2+2$ aq

The species *Copiapite*, *Raimondite*, *Fibroferrite*, *Botryogen*, may be here included, if part of the water is basic.

4. O. ratio of bases and acid 1 to less than 1.

693.	**Paraluminite**	$\ddot{\bar{\mathrm{A}}}\mathrm{l}^2\dddot{\mathrm{S}}+15\dot{\mathrm{H}}$	$\beta\bar{\mathrm{A}}\mathrm{l}_6\,\Theta_3\vert\Theta_6\vert\mathrm{S}+15$ aq
694.	**Pissophanite**	? $(\ddot{\bar{\mathrm{A}}}\mathrm{l},\bar{\mathrm{F}}\mathrm{e})^2\dddot{\mathrm{S}}+15\dot{\mathrm{H}}$	$\beta(\bar{\mathrm{A}}\mathrm{l},\mathrm{Fe})_6\,\Theta_3\vert\Theta_6\vert\mathrm{S}+15$ aq
695.	**Felsobanyite**	$\ddot{\bar{\mathrm{A}}}\mathrm{l}^2\dddot{\mathrm{S}}+10\dot{\mathrm{H}}$	$\beta\bar{\mathrm{A}}\mathrm{l}_6\,\Theta_3\vert\Theta_6\vert\mathrm{S}+10$ aq
696.	**Glockerite**	$\bar{\mathrm{F}}\mathrm{e}^2\dddot{\mathrm{S}}+6\dot{\mathrm{H}}$	$\beta\mathrm{Fe}_6\,\Theta_3\vert\Theta_6\vert\mathrm{S}+6$ aq
697.	**Lamprophanite**		

III. Sulphates, with oxygen ratio of bases and acid 1 to less than 3. Containing Copper, Lead, or Uranium.

By making part of the bases accessory hydrates, instead of basic to the acid, the formulas may be varied *ad libitum*. Only one of the possible forms is here given.

1. Containing lead or copper.

700.	**Linarite**	$\dot{\mathrm{P}}\mathrm{b}\,\dddot{\mathrm{S}}+\dot{\mathrm{C}}\mathrm{u}\,\dot{\mathrm{H}}$
701.	**Brochantite**	$\dot{\mathrm{C}}\mathrm{u}\,\dddot{\mathrm{S}}+2\frac{1}{2}\dot{\mathrm{C}}\mathrm{u}\,\dot{\mathrm{H}}$
702.	**Langite**	$\dot{\mathrm{C}}\mathrm{u}\,\dddot{\mathrm{S}}+3\dot{\mathrm{C}}\mathrm{u}\,\dot{\mathrm{H}}+\dot{\mathrm{H}}$
703.	**Cyanotrichite**	$\dot{\mathrm{C}}\mathrm{u}\,\dddot{\mathrm{S}}+(\dot{\mathrm{C}}\mathrm{u}^3,\ddot{\bar{\mathrm{A}}}\mathrm{l})\dot{\mathrm{H}}^3+12\dot{\mathrm{H}}$

2. Sulphates of Uranium.

1. *Unisulphates.*

705. JOHANNITE	$(\tfrac{2}{3}(\dot{\text{U}}^3, \ddot{\text{Ʉ}})+\tfrac{1}{3}\dot{\text{C}}\text{u}^3)\dddot{\text{S}}+1\tfrac{1}{2}\dot{\text{H}}$	$\text{S}\|\Theta_6\|(\tfrac{1}{3}\Theta\text{u}+\tfrac{2}{3}(\text{Ʉ},\beta\text{Ʉ}))_3+1\tfrac{1}{2}$ aq
706. URANOCHALCITE	$(\tfrac{1}{3}(\dot{\text{U}}^3, \ddot{\text{Ʉ}})+\tfrac{1}{3}\dot{\text{C}}\text{a}^3)\dddot{\text{S}}+\tfrac{1}{3}\dot{\text{C}}\text{u}\,\dddot{\text{S}}+9\,\dot{\text{H}}$	$\text{S}\|\Theta_6\|(\tfrac{1}{3}\Theta\text{a}+\tfrac{2}{3}(\text{Ʉ},\beta\text{Ʉ}))_3+\text{Q}-9$ aq
707. MEDJIDITE	$(?)(\tfrac{1}{2}\ddot{\text{Ʉ}}+\tfrac{1}{2}\dot{\text{C}}\text{a}^3)\dddot{\text{S}}+7\tfrac{1}{2}\dot{\text{H}}$	$\text{S}\|\Theta_6\|(\tfrac{1}{2}\Theta\text{a}+\tfrac{1}{2}\beta\text{Ʉ})_2+7\tfrac{1}{2}$ aq

2. *Subsulphates.*

708. ZIPPEITE	$(\ddot{\text{Ʉ}}, \dot{\text{C}}\text{u}^3)^3\dddot{\text{S}}^2+8\,\dot{\text{H}}$ (or $6\,\dot{\text{H}}$)	$(\Theta\text{u}, \beta\text{Ʉ})_9\,\Theta_3\|\Theta_{12}\|\text{S}_2+8$ (or 6) aq
709. VOGLIANITE	$(\dot{\text{U}}^3, \ddot{\text{Ʉ}})^2\dddot{\text{S}}+2\,\dot{\text{H}}$	$(\text{Ʉ}, \beta\text{Ʉ})_6\,\Theta_3\|\Theta_6\|\text{S}+2$ aq
710. URACONITE	$\ddot{\text{Ʉ}}^3\dddot{\text{S}}+4\tfrac{1}{2}\dot{\text{H}}$	$\beta\text{Ʉ}_6\,\Theta_6\|\Theta_6\|\text{S}+4\tfrac{1}{2}$ aq

IV. TELLURATES.

711. MONTANITE	$\ddot{\text{B}}\text{i}\,\dddot{\text{T}}\text{e}+2\,\dot{\text{H}}$	$\text{Te}\|\Theta_6\|\epsilon\text{Bi}_2+2$ aq

Appendix.—SELENATES?

712. KERSTENITE

650. MASCAGNITE. *Mascagni*, Dei Lagoni, etc., in Siena, 1779. Sel ammoniac vitriolique, Sel ammoniac secret de Glauber (fr. Solfatara near Naples), *Sage*, Min., i. 62, 1777. Ammoniaque sulfatée *Fr.* Sulphate of Ammonia. Maskagnin *Karst.*, Tab., 40, 75, 1800.

Orthorhombic. $I \wedge I=107°\ 40'$, $O \wedge 1\text{-}\bar{i}=122°\ 56'$, $a : b : c=1{\cdot}5437 : 1 : 1{\cdot}3680$. Cleavage: $i\text{-}\breve{i}$ perfect; O imperfect.

$O \wedge \tfrac{1}{2}\text{-}\bar{i}=150°\ 34'$	$\tfrac{1}{2}\text{-}\breve{i} \wedge \tfrac{1}{2}\text{-}\breve{i}$, bas., $=58°\ 52'$	$i\text{-}\dot{2} \wedge i\text{-}\dot{2}=111°\ 15'$
$O \wedge \tfrac{2}{3}\text{-}\breve{i}=125\ \ 34$	$\tfrac{2}{3}\text{-}\breve{i} \wedge \tfrac{2}{3}\text{-}\breve{i}=118\ \ 52$	$\tfrac{1}{3} \wedge \tfrac{1}{3}$, over I, $=87\ \ 26$

Usually in mealy crusts and stalactitic forms.

H.=2–2·5. G.=1·72–1·73. Lustre when crystallized, vitreous. Color yellowish-gray, lemon-yellow. Translucent. Taste pungent and bitter.

Comp.—$\text{N}\,\text{H}^4\,\text{O}\,\dddot{\text{S}}+\dot{\text{H}}$=Sulphuric acid 53·3, ammonia 34·7, water 12·0=100.

Pyr., etc.—In the closed tube yields water and is sublimed; with lime gives off ammonia vapors. Dissolves readily in water, and gives with baryta salts a precipitate insoluble in acids.

Obs.—Occurs about volcanoes, in the fissures of the lava, as at Etna, Vesuvius, and the Lipari Isles, and is also one of the products of the combustion of mineral coal.

Named after Professor Mascagni.

651. BOUSSINGAULTITE. *E. Bechi*, C. R., lviii. 583, 1864.

A sulphate of ammonia with part of this alkali replaced by magnesia. Crystals resemble those of mascagnite, but isomorphism with that species has not yet been established.

Occurs about the boric acid fumaroles of Tuscany.

652. LECONTITE. *W. J. Taylor*, Am. J. Sci., II. xxvi. 273, 1858.

Orthorhombic. In prismatic crystals, long or short. $I \wedge I$ (calc. from *i*-$\bar{2}$ ∧ *i*-$\bar{2}$)=103° 12′, *O* ∧ 1-*ī*=117° 7′; *I* ∧ *i*-$\bar{2}$=160°, *i*-$\bar{2}$ ∧ *i*-$\bar{2}$=115°, ¼-*ī* ∧ ¼-*ī* =127° 30′—128°, or over *i*-*ī*, 52°—52° 30′, Dana.

H.=2—2·5. Lustre vitreous. Colorless, when pure, and transparent. Taste saline and rather bitter. Permanent in the air.

Comp.—$\dot{R}\dddot{S}+2\dot{H}$ or $((\dot{N}a, \dot{K}), NH^4O)\dddot{S}+2\dot{H}$. Analysis by Taylor (l. c.):

$\dddot{S}$	NH^4O	$\dot{N}a$	$\dot{K}$	$\dot{H}$
44·97	12·94	17·56	2 67	19·45

With 2·30 organic residue, 0·11 inorganic id., and $\overset{\cdots}{\bar{P}}$ *trace.*

Pyr., etc.—Only partially sublimed in the closed tube, but otherwise reacts like mascagnite.

Obs.—From the cave of Las Piedras, near Comayagua, Central America, imbedded in a black mass made up of the excrement of bats. The crystals often have a coating of organic matter. The cave is worked for the nitre, which the earth of the floor near its mouth affords by lixiviation.

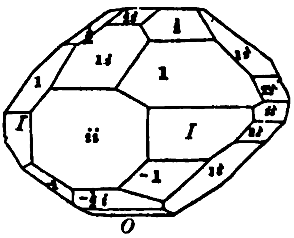
Named after Dr. John L. Le Conte.

An artificial salt of similar general formula, but having ammonia and potash as its bases, is well known (Gmelin's Ch., iii. 119).

653. MIRABILITE. Glauber Salt. Sal mirabile *Glauber* (the artificial salt at the time of its first formation). Naturliches Wundersalz, Glaubersalz, *Germ.* Glauber Salt. Sulphate of Soda. Soude sulfatée *Fr.* Mirabilite *Haid.*, Handb., 488, 1845.

Gediegen Glaubersalz (fr. Saidschitz and Sedlitz) *Reuss*, Crell's Ann., 1791, ii. 18;=Naturliches Bittersalz pt. *Lenz*, Min., i. 489, 1794;=Reussin *Karst.*, Tab., 40, 1800.

584



Monoclinic. *C*=72°. 15′, *I* ∧ *I*=86° 31, *O* ∧ 1-*ì* =130° 19′; *a* : *b* : *c*=1·1089 : 1 : 0·8962. Observed planes as in the annexed figure.

O ∧ *i*-*i*=107° 45′	1 ∧ 1, front,=93° 12′
O ∧ ½-*i*=147 34	–1 ∧ –1, front,=110 42
O ∧ 1-*i*=122 5	*i*-*i* ∧ 1-*i*=130 10
O ∧ –½-*i*=155 41	*i*-*i* ∧ ½-*i*=104 41
O ∧ 2-*ì*=113 0	

Cleavage: *i*-*i* perfect. Usually in efflorescent crusts.

H.=1·5—2. G.=1·481. Lustre vitreous. Color white. Transparent —opaque. Taste cool, then feebly saline and bitter.

Comp.—$\dot{N}a\dddot{S}+10\dot{H}$=Soda 19·3, sulphuric acid 24·8, water 55·9=100.

Analyses: 1, Rivot (Ann. d. M., V. vi. 558); 2, Moissenet (ib., xvii. 16); 3, How (Ed. N. Phil J., II. vi. 54):

	$\dddot{S}$	$\dot{N}a$	$\dot{M}g$	$\dot{C}a$	$\dot{H}$	
1. Guipuzcoa, Spain	24·8	19·5	0·5	0·3	54·5	Rivot.
2. St. Rambert, France	26·0	20·0	0·7	H Cl *tr.*	53·3	Moissenet.
3. Windsor, N. Scotia	44·54		—	—	55·46	How.

Pyr., etc.—In the closed tube much water; gives an intense yellow to the flame. Very soluble in water; the solution gives with baryta salts the reaction for sulphuric acid. Falls to powder on exposure to the air, and becomes anhydrous

Obs.—Occurs at Ischl and Hallstadt in Austria; also in Hungary, Switzerland, Italy; at Guipuzcoa in Spain, etc.; abundantly at the hot springs at Carlsbad; at Kailua, on Hawaii, Sandwich Islands, abundant in a cavern, and forming from the action of volcanic heat and gases on salt water. Effloresces with other salts on the limestone below the Genesee Falls, Rochester N. Y.; at Windsor, Nova Scotia; also near the Sweetwater River, Rocky Mountains.

The artificial salt was discovered by Glauber, a German chemist, about the middle of the seventeenth century, while he was operating with sulphuric acid and common salt; and the name *sal mirabile* was his own expression of surprise at its formation.

Taking the plane 1-*i* as 2-*i*, the axes are nearly those of pyroxene, becoming $a : b : c$=0·55445 : 1 : 0·8962.

The so-called *Reussin* is impure glauber salt, as pronounced by Reuss in 1791, after his early study of it. It occurred as a deposit of crystals and efflorescent crusts in or about the mineral springs of Saidschitz and Sedlitz, and according to Reuss was most abundant near the end of the spring. The crystals (some of which were ½ to 2 in. long) had the form of stout 6-sided prisms, with two sides smaller than the others, terminating in two rhomboidal planes—the form of glauber salt. It is stated to have become a white powder on the expulsion by heat of the crystallization-water. The analysis was made first on a *solution* of the salt, and afterward on the effloresced salt, which contained as a result of efflorescence (the usual result) no water; and hence the amount of water was not ascertained. Crystals reproduced from the solution lost more than half their weight when heated to redness; corresponding with the fact that both glauber salt and epsomite contain more than 50 p. c. of water. The analysis afforded Reuss $\dot{N}a\,\dddot{S}$ 66·04, $\dot{M}g\,\dddot{S}$ 31·55, Mg Cl 2·19, $\dot{C}a\,\dddot{S}$ 0·42; which, adding the water and excluding the Mg Cl, corresponds to 68·0 of glauber salt, 31·7 of epsomite, and 0·3 of gypsum=100.

EXANTHALOSE *Beud.* (Tr., ii. 475, 1832) is a white efflorescence, such as results from the exposure to the air of glauber salt. Beudant obtained the composition $\dot{N}a\,\dddot{S}+2\,\dot{H}$ from the analyses

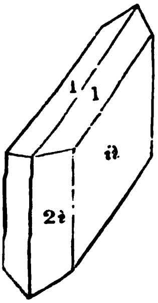
1. Vesuvius	$\dddot{S}$ 44·8	$\dot{N}a$ 35·0	$\dot{H}$ 20·2
2. Hildesheim	42·5	33·4	18·8

The Vesuvian mineral was from the lavas of 1813, according to Beudant. It was named from ἐξανθίω, *to effloresce*, and ἅλς, *salt*.

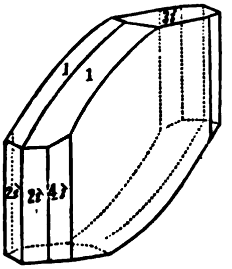
654. GYPSUM. Γύψις [=mostly *burnt Gypsum*] *Herodotus, Plato, Theophrastus.* Σεληνίτης, 'Αφροσέληνον, *Dioscorides*, v. 152, 159. Lapis specularis (principal part), Gypsum (=burnt gypsum only), *Plin.* Lapis specularis, Gypsum, σεληνίτης, *Germ.* Gips *and* Fraueneis, *Ital.* Lumen de Scaiola [Scagliola], *Agricola*, Foss., 251, Interpr., 465, 1546. Glacies Mariæ, Marienglas [=Selenite], Gips, Gypsum, Alabastrum (fine grained G.), Selenites (cryst. G.), *Wall.*, Min., 50, 1747. Marmor fugax *Linn.*, Syst., 1736. Gypsum, Terra calcarea acido vitrioli saturata, Alabaster, Selenites, *Cronst.*, Min., 18, 1758. Gips, Gyps, Fraueneis, *Wern.* Gesso *Ital.* Yeso *Span.* Sulphate of Lime, Alabaster, Plaster Stone. Chaux sulfatée, Albâtre, *Fr.* Satin Spar. Montmartrite *Delameth.*, Leçons, ii. 380, 1812.

Perhaps in part 'Αλαβαστρίτης, *Theophr.*, *Plin.*

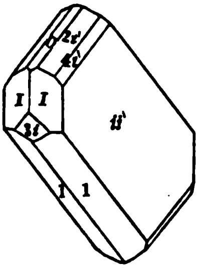
535



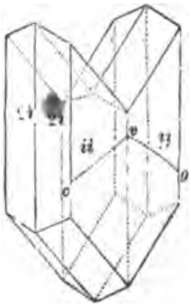
536



537



538



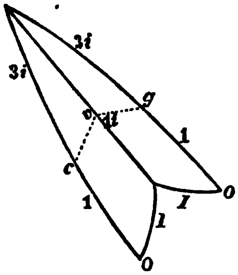
Monoclinic. C=66° 14′, if the vertical prism I (see f. 537) correspond to the cleavage prism (second cleavage), and the basal plane O to the direc-ion of the third cleavage. $I \wedge I$=138° 28′, 1-ì ∧ 1-ì=128° 31′: $a : b : c$ =0·9 : 1 : 2·4135. Observed planes: O (truncates the edge 2-ì / 2-ì) (a);

vertical, *i-ì* (*b*), *i-i* (*t*), *I* (*n*), *i*-2̀ (*x*), *i*-3̀ (*s*); clinodomes, 2-ì (*m*, or *f*), 3-ì, $\frac{3}{2}$-ì, 4-ì (*h*), $\frac{9}{2}$-ì, 5-ì, 6-ì (*k*), 7-ì, 8-ì, 9-ì; hemidomes, 1-*i* (*d*), 2-*i*, 3-*i* (*e*), $\frac{11}{2}$-ĭ; octahedral, 1 (*l*), 2 (*v*), 3 (*u*), 3-3 (*w*), 3-3̀ (*y*, or *k*).

O ∧ *i-i*=66° 14′	*O* ∧ 3-*i*=88° 8′	1 ∧ *I*=122° 17′
O ∧ 1-*i*=127 44	*O* ∧ 2-ì=145 41	1-*i* ∧ *i-i*=113 30
O ∧ 3-ì=87 58	*O* ∧ 4-ì=126 12	*i-ì* ∧ *I*=110 46
O ∧ 1=125 35	1 ∧ 1=143 42	*i-ì* ∧ 1=108 9
O ∧ *I*=67 52	2-ì ∧ 2-ì=111 42	*i-ì* ∧ 2-ì=124 19
O ∧ 2=98 46		

Cleavage: (1) *i-ì*, or clinodiagonal, eminent, affording easily smooth polished folia; (2) *I*, imperfect, fibrous, and often apparent in internal rifts or linings, making with *O* (or the edge 2-ì/2-ì) the angles 66° 14′ and 113° 46′, corresponding to the obliquity of the fundamental prism; (3) *O*, or the base, imperfect, but affording a nearly smooth surface. Twins: 1. Composition-face *O* (f. 538), occurring (A) in the form represented in f. 535, having then the reëntering angle 104° 32′, and the cross-lining of the second cleavage (or that parallel to *I*) in the directions *cv*, *vg*, meeting in the angle *cvg*=132° 28′, or twice 66° 14′; also occurring (B) in a form made up of planes 2-ì and *I* (instead of 2-ì, 1), and having a reëntering angle of 132° 28′, at the opposite end of the crystal, the cleavage lines being parallel to the sides of the reëntering angle. 2. Composition-face 1-*i*, or edge 1/1 (=*l*/*l*), reëntering angle made between edge *I*/*I* (=*n*/*n*) of each part,=123°, or double the supplement of 1-*i* on edge *I*/*I* (which equals 61° 30′); twins of this second kind often lenticular; also like f. 539 (compare with f. 537) the reëntering edges made of the planes *I* (*n*), and the outer convex edges either of planes 1 (*l*) and 3-*i* (*e*) blended together, and meeting at extremity in an angle of 25½°, or of planes 1 and 2-*i*, and having the angle at extremity 55°; the interior cleavage lines parallel to *I*, having the directions *cv*, *vg*, meeting the axis at 61½°, or one another in the angle 123°. Simple crystals often with warped as well as curved surfaces. Also foliated massive; lamellar-stellate; often granular massive; and sometimes nearly impalpable.

539



H.=1·5—2. G.=2·314—2·328, when pure crystals. Lustre of *i-ì* pearly and shining, other faces subvitreous. Massive varieties often glistening, sometimes dull earthy. Color usually white; sometimes gray, flesh-red, honey-yellow, ochre-yellow, blue; impure varieties often black, brown, red, or reddish-brown. Streak white. Transparent—opaque.

Var.—1. *Crystallized*, or *Selenite;* either in distinct crystals, or in broad folia, the folia sometimes a yard across and transparent throughout.

(*b*) An *arenaceous* variety occurs in Sussex, N. Brunswick, the crystals containing much sand which is often regularly arranged within them (O. C. Marsh)

2. *Fibrous;* coarse or fine. (*a*) *Satin spar*, when fine-fibrous a variety which has the pearly opalescence of moonstone; (*b*) *plumose*, when radiately arranged.

3. *Massive; Alabaster*, a fine-grained variety, either white or delicately shaded; *scaly-granular; earthy* or *rock-gypsum*, a dull-colored rock, often impure with clay or carbonate of lime, and sometimes with anhydrite. The *Montmartre* gypsum contains carbonate of lime, and Delame-

therie called it *Montmartrite.* A variety from Bovenden, near Göttingen, contains anhydrite (Jahrb. Min. 1856, 664).

Comp.—$\dot{Ca}\,\dddot{S}+2\,\dot{H}$=Sulphuric acid 46·5, lime 32·6, water 20·9=100. Analyses: 1, Bucholz (Gehlen's J., v. 159); 2, v. Rose (Karst. Min. Tab., 53, 1808); 3, De la Trobe (Ramm. 4th Suppl., 89); 4, 5, Jüngst (ZS. nat. Ver. Halle, viii. 482); 6, 7, W. Hampe (B. H. Ztg., xx. 267):

	$\dddot{S}$	$\dot{Ca}$	$\dot{H}$	$\dddot{Si}$	$\dddot{\overline{Al}}$	$\dddot{\overline{Fe}}$	
1. *Cryst.*	44·8	33·0	21·0	—	—	—	=98·8 Bucholz.
2. *Granular*	44·16	33·88	21·00	—	—	—	=99·04 Rose.
3. Albay, *fibrous*	44·19	29·41	20·18	6·43	0·64		=100·85 Trobe.
4. Wienrode, *compact*	45·76	31·87	19·90	2·80	0·60		=100·93 Jüngst.
5. Osterode, "	45·95	32·62	20·70	0·42	0·50		=100·19 Jüngst.
6. " *white*	46·61	32·44	20·74	0·15	—	—	=99·94 Hampe.
7. " *red*	46·50	31·99	21·56	—	0·45		=100·80 Hampe.

The siliceous variety from Albay, Luzon (Philippine islands), was of volcanic origin.

The gypsum of East River, Pictou, Nova Scotia, according to Prof. W. R. Johnson, and that of Southern Virginia, according to Prof. W. B. Rogers (Am. J. Sci., II. v. 113, 1848), contain 1 atom of water to 2 of sulphate of lime ($2\,\dot{Ca}\,\dddot{S}+\dot{H}$), the former affording $\dddot{S}$ 54·7, lime 39·4, $\dot{H}$ 5·90. The passage of anhydrite into gypsum is exemplified on a large scale in many places, as at the Canaria valley and at Box in Switzerland (Blum Pseud., p. 24; Am. J. Sci., xlviii. 69), and the compound here described may have been formed in the course of the transition; or, more probably, it is a *mixture* of gypsum and anhydrite. This compound is formed artificially only at a high temperature, or above 120° C. The incrustations in steam-boilers on the ocean consist largely of it, as shown by J. F. W. Johnston, and later by R. W. Johnson, who gave for the composition of one (Am. J. Sci., II. v. 112, 1848), having G.=2·69, and a fibrous structure, Sulphuric acid 54·25, lime 39·67, water 6·07, equivalent to 2 of $\dot{Ca}\,\dddot{S}$ to 1 of $\dot{H}$. T. L. Phipson found in one (Inventor's Institute, Dec., 1867) Sulphate of lime 65·0, magnesia 19·0, water 13·5, $\dddot{\overline{Fe}}$, $\dddot{\overline{Al}}$ 0·85, Na Cl 0·70, sand 0·45=99·50; corresponding to 1 of $\dot{Ca}\,\dddot{S}+\dot{H}$ and 1 of $\dot{Mg}\,\dot{H}$ (brucite).

Pyr., etc.—In the closed tube gives off water and becomes opaque. Fuses at 2·5—3, coloring the flame reddish-yellow. For other reactions, see ANHYDRITE, p. 621. Ignited at a temperature not exceeding 260° C., it again combines with water when moistened, and becomes firmly solid. Soluble in muriatic acid, and also in 400 to 500 parts of water.

Obs.—Gypsum often forms extensive beds in connection with various stratified rocks, especially limestones, and marlytes or clay beds. It occurs occasionally in crystalline rocks. It is also a product of volcanoes, occurring about fumaroles, or where sulphur gases are escaping, being formed from the sulphuric acid generated, and the lime afforded by the decomposing lavas—lime being contained in augite and labradorite. It is also produced by the decomposition of pyrite when lime is present; and often about sulphur springs where sulphuretted hydrogen is emitted, this gas changing, through reaction with vegetable matter, into sulphuric acid. Gypsum is also deposited on the evaporation of sea-water and brines, in which it exists in solution. Crystals may be seen to form on evaporating a drop of sea-water in the field of a microscope.

Fine specimens are found in the salt mines of Bex in Switzerland; at Hall in the Tyrol; in the sulphur mines of Sicily; in the gypsum formation near Oçana in Spain; in the clay of Shotover Hill, near Oxford; and large lenticular crystals have been met with at Montmartre, near Paris. A noted locality of alabaster occurs at Castelino, 35 m. from Leghorn, whence it is taken to Florence for the manufacture of vases, figures, etc.

This species occurs in extensive beds in several of the United States, and more particularly N. York, Ohio, Illinois, Virginia, Tennessee, and Arkansas, and is usually associated with salt springs. Also in Nova Scotia, Peru, etc.

Handsome selenite and snowy gypsum occur in *N. York*, near Lockport (occasionally f. 532) in limestone along with pearl spar and anhydrite: also near Camillus, Onondaga Co.; occasionally crystals are met with in the vicinity of Manlius. In *Maryland*, large grouped crystals on the St. Mary's, in clay; also near the mouth of the Patuxent. In *Virginia*, large beds of gypsum with rock salt, in Washington Co., 18 m. from Abingdon; also near Lynchburg. In *Ohio*, large transparent crystals have been found at Poland and Canfield, Trumbull Co. In *Tenn.*, selenite and alabaster in Davidson Co. In *Kentucky*, in Mammoth Cave, it has the forms of rosettes, or flowers, vines, and shrubbery. Abundant also W. of the Mississippi in many places, and in California.

In *N. Scotia*, in Sussex, King's Co., on Capt. McCready's farm, large single and grouped crystals, which mostly contain much symmetrically disseminated sand.

Plaster of Paris (or gypsum which has been heated and ground up) is used for making moulds, taking casts of statues, medals, etc.; for producing a hard finish on walls; also in the manufacture of artificial marble, as the scagliola tables of Leghorn, and in the glazing of porcelain.

The fibrous variety, when cut *en cabochon* and polished, resembles cat's-eye.

Gypsum is related in form to heulandite, a fact brought out in the view above taken of the crystallization (Am. J. Sci., II. xvii. 85). To the table of observed planes the lettering of Brooke and Miller for the planes is added. Plane *I* of f. 537 would be situated on f. 536, between $2\text{-}\grave{i}$ and $3\text{-}\grave{i}$ below, or the back $2\text{-}\grave{i}$ and $3\text{-}\grave{i}$ above. Kenngott obtained from an English crystal $2\text{-}\grave{i} \wedge 2\text{-}\grave{i} = 111° 14'$ (Ber. Ak. Wien, xi.).

Recent articles on cryst., B. & M.. Min., 536: Quenstedt, Min., 1855, 1863; Dufrénoy, Min., 1856; Hessenberg, Min. Not., No. ii. iv. There seems to be good reason for accepting as the true fundamental form that above adopted, since the planes of the fundamental prism *I*, and *O*, correspond in this case to directions of cleavage. Most authors make $2\text{-}\grave{i}$ the prism *I*, and $2\text{-}i$ (of rare occurrence) the plane *O*. The symbols, on this basis, with the lettering of Miller, are as follows, following the above order (Hessenberg, Min. Not., No. iv.): $i\text{-}i$ (*a*); $i\text{-}\grave{i}$ (*b*), $1\text{-}i$ (*t*), 1 (*n*); $2\text{-}\grave{2}$ (*x*), $3\text{-}\grave{3}$ (*s*); *I* (*m*, or *f* of Neumann), $i\text{-}\grave{\tfrac{3}{2}}$, $i\text{-}\grave{\tfrac{7}{4}}$, $i\text{-}\grave{2}$ (*h*), $i\text{-}\grave{\tfrac{9}{4}}$, $i\text{-}\grave{\tfrac{5}{2}}$, $i\text{-}\grave{3}$ (*k*), $i\text{-}\grave{\tfrac{7}{2}}$, $i\text{-}\grave{4}$, $i\text{-}\grave{\tfrac{9}{2}}$; $-1\text{-}i$ (*d*), *O* (*q* of Quenstedt), $\tfrac{1}{2}\text{-}i$ (*e*), $\tfrac{5}{4}\text{-}i$ (β of Hessenberg); -1 (*l*), $1\text{-}\grave{i}$ (*v*), $1\text{-}\grave{3}$ (*u*), $\tfrac{1}{2}$ (*w*); $-3\text{-}\grave{3}$ (*y*, or *k* of Neumann); $\tfrac{4}{5}\text{-}\grave{2}$ (δ of Hessenberg).

Named from γύψος, the Greek for the mineral, but more especially for the *calcined* mineral. The derivation ordinarily suggested, from γῆ, *earth*, and ἑψέω, *to cook*, corresponds with this, the most common use of the word among the Greeks. Theophrastus, after mentioning localities, speaks of the making of gypsum by burning the proper stones (among which *alabaster* is included); of making plaster or cement from it by "powdering it, pouring on water, and stirring it with wooden instruments, there being too much heat for the hand;" of the necessity of preparing it "immediately before the use of it, because it soon dries and becomes hard;" of its value for whitening the walls of houses, and of its being an excellent material for making images and ornaments.

The word γύψος in Plato and Herodotus has been sometimes translated *chalk*, but not so in the latest and best Lexicon—the recent edition of Stephanus. The sentences in Herodotus containing it, and the verb γυψόω derived from it meaning *to cover or whiten with gypsum*, are most intelligible if calcined gypsum, or preparations from it, are understood.

Powdered chalk is not likely to have been used for a whitewash; and a wash is implied instead of dry chalking. Moreover, true chalk was probably unknown to the Greeks, it being a production of more western countries; and, according to Pliny, even the Romans included under their term *Creta* (Latin for *chalk*) principally clays, and prominently the "Cimolian earth" (Cimolite, p. 457), true chalk being what Pliny calls "the inferior kind." Theophrastus speaks of a *Tymphæan gypsum* (so called by the people of Tymphæa) which was a fuller's earth of some kind. The word γύψος is, therefore, much more likely to have been applied at times to white clays than to true chalk. The ancients were acquainted with lime from the burning of limestone, and could not have called this γύψος. Plato's expression, Τὴν δε ὄψη λευκὴ γύψιν ἢ χιόνος λευκοτέραν, "Whiter than gypsum or snow," is not improved by supposing it chalk; for there is nothing whiter than calcined gypsum, or the ceilings or ornaments made from it.

Selenites (=moon-stone) of Dioscorides, which he says was also called *aphroselenon* (moon-froth), "because it was found at night while the moon was on the increase," was probably crystallized gypsum or modern selenite. His description λευκός, διαυγής, κοῦφος (=*white, transparent, light*), is good as far as it goes; and the uses of the stone which he mentions also agree better with this view than with that of its being either the modern *moonstone* or *cat's-eye*, to which it has been referred. The name is from σελήνη, *moon*, and alludes probably to the peculiar moon-like white reflections. Some aggregated crystallized masses might well have suggested the name *aphroselenon*. It is doubtful what Pliny had in view under the name *selenitis* (xxxvii. 67): it is probable, from his brevity on the subject, that he did not know the mineral.

Lapis specularis (Specular-stone) of Pliny was mostly crystallized gypsum (the rest being *mica*), he speaks of it (xxxvi. 59) as affording by burning the best of gypsum.

Ἀλαβαστρίτης (or alabaster-stone, meaning the stone out of which ointment vases of the kind called *alabastra* were made) was with Theophrastus and Pliny mainly if not wholly stalagmite, which is now often called *oriental alabaster* (see under CALCITE); and Thebes in Egypt was a famous locality. Such vases were made of other materials, and it is possible that gypsum-alabaster was one: for when polished it often resembles some clouded stalagmites. This opinion is favored—though not placed beyond question—by the statement in Theophrastus, which Pliny reiterates,* that the gypsum-stone is "very similar to," "not unlike" (meaning in the rough state, of course) *alabastrites*, which resemblance is not obvious if stalagmite is the only alabastrites. The *alabastritis* of Pliny, from Syria, said to be white spotted with various tints. may be of this kind, as Syria was noted for its gypsum-stone, according to Theophrastus and Pliny.

---

* It is not clear that Pliny is here independent authority. He appears to be citing from Theophrastus in the most of what he says about gypsum; and in one or two cases he cites blunderingly. He says, for instance, that plaster after hardening may by pounding be powdered [for use again]; whereas Theophrastus states more correctly that "*by burning* it may again and again be made fit for use."

'Αλάβαστρον (alabastron) occurs as the name of alabaster-stone in the writings of the historian Herodianus about two centuries after Christ, but without description. The *alabastrum* of Pliny, something white and froth-like, called also, as he says, *stimmi*, *stibi*, and *larbasis*, and coming from silver mines, cannot be alabaster. There is here probably some mistake on the part of Pliny.

Burnt gypsum is called Plaster-of-Paris, because the Montmartre gypsum quarries, near Paris, are, and have long been, famous for affording it.

Alt.—Gypsum occurs altered to calcite, malachite, quartz.

655. KIESERITE. Kieserit *Reichardt*, Salzbergwerk Stassfurt, 1860; B. H. Ztg., xx. 39, 1861. Martinsite *Kenngott*, Ueb., 1856–57, 22; *Ramm.*, Pogg, xcviii. 262, 1856 (not Martinsite *Karsten*, 1845).

Orthorhombic. Massive; fine granular or compact.

H.=2·5. G.=2·517, Bischof. Color white, grayish-white, to yellowish. Translucent to opaque. Friable to firm. Little soluble.

Comp.—$\dot{M}g\dddot{S}+\dot{H}$=Sulphuric acid 58·0, magnesia 29·0, water 13·0=100. Analyses: 1, Rammelsberg (Pogg., xcviii. 262); 2–4, Siewert & Leopold (Jahresb., 1860, 788); 5, Reichardt (Jahrb. Min. 1866, 343):

		$\dddot{S}$	$\dot{M}g$	$\dot{H}$
1.	Stassfurt	57·7	26·8	[15·5]=100 Ramm.
2.	"	58·98	28·51	13·47=100·96 Siewert.
3.	"	58·90	28·61	[12·49]=100 Siewert.
4.	"	57·78	28·78	14·13=100·69 Leopold.
5.	"	54·16	28·11	14·30, Cl 2·18, insol. 0·39=99·14 Reichardt.

Reichardt in his earliest analyses obtained (l. c.) $\dddot{S}$ 43·05, $\dot{M}g$ 21·66, $\dot{H}$ 34·56, which corresponds o $\dot{M}g\dddot{S}+3\dot{H}$. Anal. 2, 3, are of an opalescent, translucent, and friable variety, and 4 of a darker ellow, opaque, and much harder kind.

Pyr., etc.—In the closed tube yields water. B.B. fuses easily, and with soda on charcoal ives the sulphuric acid reaction. But little altered at 100° C. Dissolves in nitric acid, leaving small residue of impurities. Soluble slowly in water, but completely, 100 of water taking up 0·9 parts; a residue is deposited of microscopic crystals of anhydrite, or of stassfurtite.

Obs.—From the salt mine of Stassfurt, often mixed with carnallite and gypsum. F. Bischof ivides the Stassfurt salt beds vertically (Ann. Ch. Phys., IV. v. 305, and B. H. Ztg., xxiv. 1865) ito 4 regions, corresponding, he observes, to the natural order of origin from an evaporating aline: 1, or lower, the *anhydrite* region; 2, the *polyhalite*; 3, the *kieserite*; and 4, the *carnallite*. he kieserite is in beds, 9 to 12 in. thick, alternating with common salt. The whole deposit is bout 190 feet thick, and has the following as its mean percentage composition: Common salt 65, ieserite 17, carnallite 13, chlorid of magnesium (hydrated) 3, anhydrite 2=100.

Named after Mr. Kieser, President of the Academy of Jena. For the *martinsite* of Karsten, e under HALITE, p. 112.

56. POLYHALITE. Polyhalites *Strom.*, Comment. Soc. R. Götting., iv. 139. Polyhalit *Strom.*, Unters., i. 444, 1821.

Orthorhombic? Clinohedral? Descl. A prism of 115°, with acute ges truncated. Usually in compact fibrous masses.

H.=2·5—3. G.=2·7689. Lustre resinous or slightly pearly. Streak d. Color flesh- or brick-red, sometimes yellowish. Translucent—opaque. aste bitter and astringent, but very weak.

Comp.—$\dot{R}\dddot{S}+\frac{1}{2}\dot{H}$, in which $\dot{R}=\dot{K}, \dot{M}g, \dot{C}a$ in the ratio 1 : 1 : 2=Sulphate of lime 45·2, sul. gnesia 19·9, sul. potash 28·9, water 6·0=100. Analyses: 1, Stromeyer (Unters., i. 144); 2, mmelsberg (Pogg., lxviii. 512); 3, Dexter (Pogg., xciii. 1); 4, Behnke (ib.); 5, C. A. Joy aug. Dissert., 49, Pogg., xciii. 1); 6, 7, v. Hauer (Ber. Ak. Wien, xi. 385); 8, G. Jenzsch (Pogg., ii. 175); 9, Dexter (l. c.); 10, Bischof (Ann. Ch. Phys., IV. v. 312); 11, Reichardt (Jahrb. Min. 6. 345):

	$\dot{Ca}\dddot{S}$	$\dot{Mg}\dddot{S}$	$\dot{Na}\dddot{S}$	$\dot{K}\dddot{S}$	NaCl	$\ddot{\bar{Fe}}$	$\dot{H}$
1. Ischl	44·74	20·03	——	27·70	0·19	0·34	5·95=98·94 Strom.
2. Aussee	45·43	20·59	——	28·10	0·11	0·33	5·24=99·80 Ramm.
3. "	45 62	18·97	0·61	28·39	0·31	0·24	6·02, $\ddot{Si}$ 0·32, $\dot{Mg}$ 0·49=100·97 Dexter
4. Hallein, *red*	42·29	18·27	2·60	27·09	1·38	——	6·10, $\ddot{Si}$ 0·27, $\ddot{\bar{Fe}}\dddot{S}$ 1·35=99·35 Behnke
5. Gmunden	42·78	19·05	0·75	28·11	1·75	$\dot{Fe}\dddot{S}$ 0·36	6·41=99·21 Joy.
6. Hallstatt	56·41	11·04	——	14·81	12·16	——	5·58=100 v. Hauer.
7. Ebensee	61·18	13·53	——	19 12	0·23	0·41	6·05=100·52 v. Hauer.
8. Vic, *red*	44·11	19 78	1·69	25·87	0·24	1·01	6·16, $\ddot{Si}$ 0·11, $\ddot{\bar{Al}}$ 0·39, $\dot{Mg}$ 0·02=99 38 Jenzsch.
9. " *gray*	44·72	19·08	——	27·77	0·44	0·59	7·40=100 Dexter.
10. Stassfurt	42·64	19·76	——	27 90	3·49	——	5·75=99·54 Bischof.
11. "	43·44	20·56	——	26·22	——	——	7 47, Mg Cl 0·58=98·27 Reichardt.

From analysis 9, 6·23 p. c. of clay have been removed, and part of the 7·40 p. c. of water belongs with it.

Berthier's analyses of the Vic polyhalite (Ann. d. M., x. 260) were incorrect. The loc. Gmunden (anal. 5) should be either Ischl or Aussee, according to Rammelsberg, who says the mineral does not occur near Gmunden (Min. Ch., 288, 1862). Joy says in a letter to the author dated Oct., 1865, that it was brought to G. Rose's laboratory so labelled.

Pyr., etc.—In the closed tube gives water. B.B. fuses at 1·5, colors the flame yellow. On charcoal fuses to a reddish globule, which in R.F. becomes white, and on cooling has a saline hepatic taste; with soda like glauberite. With fluor does not give a clear bead. Partially soluble in water, leaving a residue of sulphate of lime, which dissolves in a large amount of water.

Obs.—Occurs at the mines of Ischl, Ebensee, Aussee, Hallstatt, and Hallein in Austria, with common salt, gypsum, and anhydrite; at Berchtesgaden in Bavaria; at Vic in Lorraine.

The name Polyhalite is derived from πολύς, *many*, and ἅλς, *salt*, in allusion to the number of salts in the constitution of the mineral.

For remarks on the position of the polyhalite at Stassfurt see KIESERITE, p. 641.

657. MAMANITE *A. Goebel* (Bull Ac. St. Petersb., ix. 16, 1865). Like polyhalite in aspect and characters, but has the $\dot{K}$, $\dot{Mg}$, $\dot{Ca}$ in the ratio 1 : 2 : 3. Color white; lustre silky; structure foliated fibrous. In nodules as large as the fist, at the salt mine of Maman in Persia, with carnallite, and also investing or intersecting nodules of carnallite.

658. PICROMERITE. Picromeride *Scacchi*, Mem. Incend. Vesuv. 1855, 191. Pikromerit *Ramm.*, Min. Ch., 281, 1860. Kainit *Zincken*, B. H. Ztg., xxiv. 79, 1865. Schönit *E. Reichardt*, Jahrb. Min. 1865, 602, 1866, 340.

Monoclinic. $C=75° 12'$, $I \wedge I=109° 50'$, $O \wedge 1\text{-}i=154° 39'$, $O \wedge 2\text{-}i=116° 41'$. In crystals and crystalline crusts.

H.=2·5. Color white.

Comp. - $\dot{K}\dddot{S}+\dot{Mg}\dddot{S}+6\dot{H}$, or $(\frac{1}{2}\dot{K}+\frac{1}{2}\dot{Mg})\dddot{S}+3\dot{H}$=Sulphuric acid 39·8, magnesia 9·9, potash 23·5, water 26·8=100. Analyses: H. Reichardt (l. c.):

	$\dddot{S}$	$\dot{Mg}$	$\dot{K}$	$\dot{H}$	Cl
1. Stassfurt	38·52	11·56	22 82	[26·29]	0·81=100.
2. "	39·74	10·40	23·28	26·87	0·28=100·57.

Reichardt's analyses were made on his *schönite*, a salt obtained by him by separating the chlorid of magnesium in what is called kainite by means of alcohol.

Pyr., etc.—Loses 11 p. c. water at 100° C., and all the rest by heating to 133° C., Reichardt. According to Graham, the artificial salt loses its water wholly at 132°.

Obs.—Found at Vesuvius among the salts produced at the eruption in 1855, in crystals along with crystals of cyanochroite, an isomorphous species in which copper replaces the magnesia. Also occurs at the Stassfurt salt mine, along with kieserite and carnallite. It is often mixed, at Stassfurt, with chlorids and other salts. Alcohol dissolves out chlorid of magnesium.

Kainite of Zincken, from the same locality at Stassfurt, is nothing but the impure picromerite just alluded to, as shown by Reichardt. It has been analyzed by Graf (B. H. Ztg., xxiv. 288); E. and H. Reichardt, Hossæus, and Theile (Jahrb. Min. 1866, 337); Philip (ZS. G., xvii. 649); and the chlorine in the results varies from 14·5 to 36·7 p. c. Nearly all the chlorine is removed as chlorid of magnesium on treating the mineral with alcohol. Forms granular masses which vary in color from colorless to grayish, yellowish, and reddish, and has G.=2·131—2·147, but varying to 2·184. It sometimes contains also common salt. Named *picromerite* in allusion to the magnesia present; and Kainite (properly *Cænite*) from *καινός, recent.*

659. BLŒDITE. Blœdit *John*, Unters., 1811. Astrakanit *G. Rose*, Reis. Ural, ii. 270, 271, 1842.

In imperfect crystals. Also massive.

Color whitish, orange, reddish. Translucent. Very soluble.

Var.—The original *blœdite* from Ischl, analyzed by John, was massive, somewhat fibrous, flesh-red to brick-red in color, and splintery in fracture. The *astrakanite*, from near Astrakan, was in whitish crystals.

Comp.—$\dot{R}\dddot{S}+2\dot{H}$, with $\dot{R}=\frac{1}{2}\dot{M}g+\frac{1}{2}\dot{N}a$=Sulphate of soda 42·6, sulphate of magnesia 35·9, water 21·5=100. Analyses: 1, John (l. c.); 2, v. Hauer (Jahrb. G. Reichs., 605, 1856); 3, Göbel (Rose's Reis. Ural, l. c.); 4, Hayes (Proc. N. H. Bost., v. 391):

	$\dot{N}a\dddot{S}$	$\dot{M}g\dddot{S}$	Na Cl	Mg Cl	$\dot{H}$
1. Ischl, *rdh.*	33·34	36·66	0·33	—	22·00, $\dot{M}n\dddot{S}$ 0·33, $\bar{F}e\dddot{S}$ 0·34=98·00 John.
2. " *orange*	41·02	36·36	0·50	—	21·50=99·38 Hauer.
3. Astrakan	41·73	35·81	—	0·34	21·95=99·83[a] Göbel.
4. Mendoza	45·74	33·31	1·16	—	19·60, sand, etc. 0·19=100 Hayes.
5. "	45·82	33·19	1·79	—	18·84, sand, etc. 0·36=100 Hayes.

[a] 1·75 clay and sand removed.

Another sample afforded Hayes $\dot{N}a\dddot{S}$ 48·00, $\dot{M}g\dddot{S}$ 34·20, Na Cl 1·21, $\dot{H}$ 16·42, $\ddot{S}i$, etc. 0·17=100. Dried at 90° F. the water was reduced to 15·20 p. c. The less amount of water in Hayes's analyses than in the others may have been due to the degree of drying.

Pyr., etc.—Heated loses water rapidly; at a red heat fuses quietly to a transparent globule, which is white on cooling. Somewhat deliquescent in a moderately moist atmosphere.

Obs.—From the salt mines of Ischl; the salt lakes near Astrakan, east of the mouth of the Volga (anal. 3); the soil of the country near Mendoza, between San Luis de la Punta and the foot of the Andes, especially east of San Juan, occurring in imperfect crystals at the junction of two layers of common salt, one to two feet below the surface.

Named after the chemist and mineralogist Blöde.

660. LŒWEITE. Löweit *Haid.*, Abh. Ges. Wiss. Prag, V. iv. 1846; *Haid.*, Ber. Fr. Nat., ii. 266, 1847.

Tetragonal. Massive. Cleavage octahedrons have approximately the angles 111° 44′ and 105° 2′, giving for the vertical axis the value 1·304. Cleavage: basal, distinct; *I*, imperfect; 1, or the octahedral, in traces.

H.=2·5—3·0. G.=2·376. Lustre vitreous. Color yellowish-white to honey-yellow, also reddish. Fracture conchoidal, with the aspect somewhat of fire-opal. Taste weak. Optically uniaxial; refraction positive, for the ordinary ray 1·491, extraord. 1·494.

Comp.—$\dot{R}\dddot{S}+1\frac{1}{4}\dot{H}$, with $\dot{R}=\frac{1}{2}\dot{M}g+\frac{1}{2}\dot{N}a$=Sulphate of soda 46·3, sulphate of magnesia 39·1, water 14·7. Analyses: 1, Karafiat (l. c.); 2, v. Hauer (Jahrb. G. Reichs., 1856, 605):

	$\dddot{S}$	$\dot{M}g$	$\dot{N}a$	$\dot{H}$
1.	52·35	12·78	18·97	14·45, $\bar{F}e$, $\bar{A}l$ 0·66=99·21 Karafiat.
2.	52·53	14·31	18·58	14·80=100·22 Hauer.

Obs.—In pure crystalline masses an inch thick, involved with foliated anhydrite, at the Ischl salt mine, Austria.

661. EPSOMITE. Epsom Salt. Sal nativum catharticum *A. Hermann*, De Salo nativo cathartico in fodinis Hungariæ recens invento, Posonii, 1721. Sal neutrum acidulare, Sal

Anglicanum, *Wall.*, Min., 184, 1747. Id., Sel d'Epsom *Fr. Trl.* Wall., i. 339, 1753. Halotrichum *Scopoli*, De Hydrarg. Idriense Tent.. Venet., 1761 (Klap. Beitr., iii. 104), Princip. Min.. 1772 Magnesia vitriolata (Sal Anglicus, Epsomensis, Seidlizensis, Seydschütensis, amarus, etc.) *Bergm.* Sciagr., 1782. Bittersalz *Wern.* Haarsalz pt. Epsomite *Beud.*, Tr., 445, 1824.

Orthorhombic, and generally hemihedral in the octahedral modifications. $I \wedge I = 90°\ 34'$, $O \wedge 1\text{-}\bar{\imath} = 150°\ 2'$; $a : b : c = 0{\cdot}5766 : 1 : 1{\cdot}01$. $1\text{-}\breve{\imath} \wedge 1\text{-}\breve{\imath}$, basal, $=59°\ 27'$, $1\text{-}\bar{\imath} \wedge 1\text{-}\bar{\imath}$, basal, $=59°\ 56'$. Cleavage: brachydiagonal, perfect. Also in botryoidal masses and delicately fibrous crusts.

H.=2·25. G.=1·751; 1·685, artificial salt, Schiff. Lustre vitreous—earthy. Streak and color white. Transparent—translucent. Taste bitter and saline.

Comp.—$\dot{\mathrm{Mg}}\,\dddot{\bar{\mathrm{S}}} + 7\,\dot{\mathrm{H}}$, when pure=Magnesia 16·3, sulphuric acid 32·5, water 51·2=100. Analyses: 1–4, Stromeyer (Gel. Anz. Gött., 1833, Pogg., xxxi. 137, Schw. J., lxix. 255); 5, Bouis (Rev. Sci. Industr., xiv. 300); 6, Dufrénoy (Tr., ii. 323):

	$\dddot{\bar{\mathrm{S}}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Mn}}$	$\dot{\mathrm{H}}$
1. S. Africa	32·26	14·58	—	3·61	49·24=99·69 Stromeyer.
2. Idria, "*Haarsalz*"	32·30	16·39	0·23	—	50·93=99·85 Stromeyer.
3. Catalonia	31·90	16·49	—	—	51·20=99·59 Stromeyer.
4. Neusohl, *rose-red*	31·37	15·31	0·09	0·34	51·70, $\dot{\mathrm{C}}$u 0·38, $\dot{\mathrm{C}}$o 0·69=99·88 Stromeyer.
5. Fitou, France	34·37	17·31	—	—	48·32=100 Bouis.
6. " "	34·07	16·20	—	—	47·20, $\dot{\mathrm{C}}$a 2·10=99·57 Dufrénoy.

Pyr., etc.—Liquifies in its water of crystallization. Gives much water in the closed tube at a high temperature; the water is acid. B.B. on charcoal fuses at first, and finally yields an infusible alkaline mass, which, with cobalt solution, gives a pink color on ignition. Very soluble in water, and has a very bitter taste.

Obs.—Common in mineral waters, and as a delicate fibrous or capillary efflorescence on rocks in the galleries of mines, and elsewhere. In the former state it exists at Epsom, England, and at Sedlitz and Saidschutz in Bohemia. At Idria in Carniola it occurs in silky fibres, and is hence called *hairsalt* by the workmen. Also obtained at the gypsum quarries of Montmartre, near Paris; in Fitou, Dept. of the Aude, France; in Aragon and Catalonia in Spain; in the Cordillera of St. Juan in Chili; and in a grotto in Southern Africa, where it forms a layer 1½ in. thick. Also found at Vesuvius, at the eruptions of 1850 and 1855.

The floors of the limestone caves of Ky., Tenn., and Ind., are in many instances covered with epsomite, in minute crystals, mingled with the earth. In the Mammoth Cave, Ky., it adheres to the roof in loose masses like snowballs. At the Alum Cave, in Sevier, Tenn., on the headwaters of the West Fork of Little Pigeon River, masses of nearly pure epsomite, almost a cubic foot in volume, have been obtained (Safford's Rep., 119). It effloresces from the calcareous sandstone, 10 m. from Cocymans, on the east face of the Helderberg, N. Y. Said to occur also over the California plains, east of San Diego (Am. J. Sci., II. vi. 389). Also effloresces from a pyritiferous serpentine in Marmora, Canada West; and on dolomites of the Clinton formation (Silurian) in sheltered places between Niagara Falls and Lake Huron, as at Dundas, where layers occur 1 in. thick.

Sulphate of magnesia is dimorphous. According to Haidinger and Mitscherlich, the above described form is produced when crystallization takes place below 15° C. (60° F.), but a monoclinic form between 25° C. and 30° C.

662. TAURISCITE. Tauriszit *G. H. O. Volger*, Jahrb. Min. 1855, 152.

Orthorhombic. Angles those of epsomite. Occurring planes: I, $i\text{-}\breve{\imath}$, $i\text{-}\bar{\imath}$, $i\text{-}\breve{2}$; $1\text{-}\breve{\imath}$, $1\text{-}\bar{\imath}$; 1, $2\text{-}\breve{2}$, $2\text{-}\bar{2}$. Crystals acicular.

Lustre and other physical characters those of copperas.

Comp.—Stated to be that of copperas.

Obs.—From Windgälle in the Canton Uri (Pagus Tauriscorum of the Romans), Switzerland, associated with copperas and alum. The crystal is a rhombic prism with pyramidal terminations.

662A. Tecticite *Breith.* (Graulit *Glocker*, Syn., 1847). A clove-brown mineral, easily soluble in water and attracting moisture readily, occurring in small pyramidal and acicular crystals supposed to be orthorhombic, and also massive. Probably a hydrous sulphate of sesquioxyd of iron; but composition not ascertained. H.=1·5—2.

From Graul, near Schwarzenberg, in Saxony, and Bräunsdorf in the Erzgebirge. Named from τηκτικός, in allusion to the deliquescence; but changed to *graulite* by Glocker, because the Greek signifies liquifying *actively*, and not *passively* as in deliquescence.

663. FAUSERITE. Fauserit *Breith.*, B. H. Ztg., xxiv. 301, 1865.

Orthorhombic. $I \wedge I = 91° 18'$. Cleavage: i-$\check{i}$ distinct; I in traces or none; O rather distinct. Crystals grouped in stalactitic forms.

H.=2—2½. G.=1·888. Lustre vitreous. Color reddish- and yellowish-white to colorless. Translucent to transparent. Taste astringent, bitter.

Comp.—$\dot{M}g\,\bar{S}+2\,\dot{M}n\,\dddot{\bar{S}}+15\,\dot{H}=(\frac{1}{3}\,\dot{M}g+\frac{2}{3}\,\dot{M}n)\,\dddot{\bar{S}}+5\,\dot{H}$=Sulphuric acid 34·7, protox. manganese 20·5, magnesia 5·8, water 39·0=100. Analyses: 1, 2, Mollnár (l. c.):

$\dddot{\bar{S}}$	$\dot{M}n$	$\dot{M}g$	$\dot{H}$
34·49	19·61	5·15	42·66, $\ddot{\bar{A}}l$, $\bar{F}e$ *trace*
33·78	20·05	5·63	40·54.

Obs.—From Herrengrund in Hungary. Named after Mr. Fauser.

COPPERAS GROUP.

The species here included are the ordinary vitriols. They are identical in general formula with the species of the Epsomite group, and are regarded as the same compound essentially under oblique crystallization. The copper sulphate diverges from the others in crystallization, and contains but 5 of water; but species containing copper in many other groups exhibit a like divergence from the rest in crystalline form.

SYNONYMY BEFORE 1750. Χάλκανθον, Χαλκῖτις, Μελαντηρία, Σῶρυ, Μίσυ, *Dioscor.*, v. 114–118. [*Chalcanthum* (from χαλκός, *brass*, and ἄνθος, *flower*) is vitriol of any kind; Spain is given as a locality; *Chalcitis*, a disintegrating pyrites, iron or copper, impregnated with the same, as a result of its alteration; *Melanteria* (fr. μέλαν, *ink*), a salt-like chalcanthus, or earth containing it; *Soru*, a black earth or stone impregnated with some vitriol; *Misu*, a yellowish vitriolic stone, perhaps partly copiapite, and partly yellow ochre impregnated with vitriol of some kind.*]

Atramentum sutorium=Chalcanthum, Chalcites, Sory, Misy, *Plin.*, xxxiv. 29-32; evidently in part from Dioscorides. [The description of *Chalcanthum* gives prominence to *blue* vitriol, while its use as shoemaker's ink (which Atr. sutorium signifies) implies the presence of *green* (or iron) vitriol, the material still used for blackening leather; *Chalcites* and *sory* are the same as above; *Misy* is yellow and pulverulent, like the mineral now called copiapite.]

Atramentum sutorium=Melanteria=Chalcanthum, Chalcites, Sory, Misy, *Agric.*, Foss., 212-214, 1546; Kupferwasser *id.*, Interpr., 463, 1546. [The first three of these names are synonyms for any vitriol or all; and include (as partly also in Dioscorides) capillary or wool-like, plumose, stalactitic, and salt-like kinds, besides *Lapis atramenti;* Agricola mentions the varieties *Atramentum sutorium candidum* (=λευκοιον *Gr.*), which is white or zinc vitriol; *A. s. viride*, which is green

---

[*] In interpreting these ancient names it has to be borne in mind that there are three sources of obscurity, besides that of imperfect description:

1. That the earthy or stony mass containing the essential ingredient comes into the description.
2. That Pyrites (including pyrite, marcasite and pyrrhotine) is brassy enough to be confounded with chalcopyrite. the ore of copper or brass (χαλκός); and, in fact, Dioscorides says that pyrites yields χαλκός, although in the next line asserting that it strikes fire with a steel, a characteristic distinguishing it from copper pyrites. Moreover, Agricola describes all the vitriols under his *Atramenta sutoria*, and makes *Kupferwasser* of the Germans (meaning *copper water*) a common synonym for them; as has been true of *Copperas* in English and *Couperose* in French.
3. That iron and copper pyrites often occur together, and the vitriolic results of their alteration are consequently variously mixed in nature.

vitriol; *A. s. cœruleum*, which is blue vitriol; *Sory*, a gray or blackish stone, often nodular (glebæ rotundæ), impregnated with any vitriol; *Misy*, a yellow efflorescent or mealy vitriol (*Copiapite*). Goslar in the Harz is the principal locality cited by Agricola. *Chalcites* is said to be between sory and misy in texture, and *rubra et æris colore*; perhaps a red ochre (a frequent result of the alteration of pyrites) containing copperas and some unaltered pyrites.

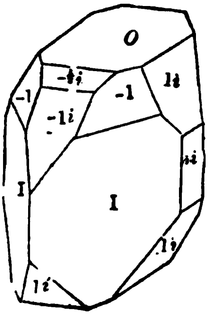
Atramentum viride, a quibusdam *Vitreolum* vocatur, *Albertus Magnus*, De Min., Libr. v., c. 3, 1270. Vitriolum *Agric.*, ib., 218. [So named from *vitrium*, *glass*, in allusion to the glassy appearance of the crystals of vitriols; Agricola speaks in connection with his explanation of the word, of "A. candidum translucidum instar Crystalli."]

Atramentum *Gesner*, Foss., 13, 1565; divided into A. album durum Goslarianum [or Zinc vitriol], A. viride [or Iron vitriol], A. cœruleum Cyprium pulcherrimum [or Blue vitriol], etc. Melanteria, Sory, Misy, *Gesner*, ib., 15, 16.

Vitriolum *Wallerius*, Min., 155, 1747, and *Cronstedt*, Min., 113, 1758: a genus including the species V. Cupri (=V. Cypri, V. Veneris); 2, V. viride (=V. ferri, V. martis); 3, V. album, vel Zinci (from Goslar); besides 4, V. mixtum (a mere mixture); 5, 6, Terra vitriolica and Lapis atramentarius (earth or stone impregnated with vitriol of some kind), and including Lapis atramentarius flavus, or *Misy*.

664. MELANTERITE. Μελαντηρία, Χαλκάνθον, etc., *Dioscor.* Chalcanthum, Atramentum sutorium, etc., *Plin.* Melanteria, Atramentum sutorium viride, *Agric.* Vitriolum pt. *Albertus Magnus.* Atramentum viride *Gesner.* Vitriolum viride, V. ferri, V. martis, *Wallerius.* Green Vitriol. Copperas. Sulphate of Iron. Fer sulfaté *Fr.* Melantérie *Beud.*, Tr., ii. 482, 1832.

540



Monoclinic. $C=75° 40'$; $I \wedge I=82° 21'$, $O \wedge 1\text{-}i=123° 44'$; $a:b:c=1{\cdot}310:1:0{\cdot}8474$.

$O \wedge i\text{-}i=104° 20'$ $O \wedge -1\text{-}i=136° 18$
$O \wedge I=80\ 37$ $O \wedge 1\text{-}i=123\ 44$
$O \wedge -\tfrac{1}{3}\text{-}i=159\ 6$ $-1 \wedge -1=101\ 32$

Cleavage: *O* perfect, *I* less so. Often in capillary, fibrous, stalactitic, and concretionary forms. Generally massive and pulverulent.

H.=2. G.=1·832. Lustre vitreous. Color, various shades of green, passing into white; becoming yellowish on exposure. Streak uncolored. Subtransparent—translucent. Taste sweetish, astringent, and metallic. Fracture conchoidal. Brittle.

Comp.—$\dot{Fe}\,\dddot{S}+7\,\dot{H}$=Sulphuric acid 28·8, protoxyd of iron 25·9, water 45·3=100.

Pyr., etc.—In the closed tube yields water, and after a time sulphurous and sulphuric acids. On charcoal turns at first brown, then red, and finally black, becoming magnetic. With the fluxes reacts for iron. Soluble in twice its weight of water, and the solution is blackened by a tincture of nut galls. Exposed to the air becomes covered with a yellow powder, which is the sulphate of the sesquioxyd of iron.

Obs.—This salt usually proceeds from the decomposition of pyrite or marcasite, which readily afford it, if occasionally moistened while exposed to the atmosphere. Occurs near Goslar in the Harz; Bodenmais in Bavaria; Fahlun, Sweden; at Hurlet, near Paisley; and in many mines in Europe and on the other continents. Usually accompanies pyrite in the U. States, occurring as an efflorescence; at Copperas Mt., a few miles E. of Bainbridge, Ohio, it is associated with alum and pyrite. It is employed in dyeing and tanning, and in the manufacture of ink and Prussian blue.

665. PISANITE. *F. Pisani*, C. R., xlviii. 807. Pisanit *Kenng.*, Ueb. 1859, 10, 1860.

In concretionary and stalactitic forms.

Lustre vitreous. Color bright blue. Becomes ochreous externally.

Comp.—$(\dot{Fe},\dot{Cu})\dddot{S}+7\dot{H}$; or a copperas with three-fifths of the iron replaced by copper. Analysis by Pisani (l. c.):

$\dddot{\mathrm{S}}$ 29·90 $\dot{\mathrm{F}}\mathrm{e}$ 10·98 $\dot{\mathrm{C}}\mathrm{u}$ 15·56 $\dot{\mathrm{H}}$ 43·56

Pyr., etc.—B.B. gives with the fluxes reactions for copper. Otherwise like melanterite.

Obs.—Occurs with chalcopyrite at a copper mine in the interior of Turkey. The interior of the mineral has sometimes druses of minute crystals.

666. GOSLARITE. Atramentum sutorium, candidum, potissimum reperitur Goselariæ, translucidum, crystalli instar, *Agric.*, Foss., 213, 1546. A. album fossile durum Goslarianum *Gesner*, Foss., 13, 1565. Vitriolum Zinci album nativum, Galizensten, Hvit Viktril, *Wall.*, 157, 1747. Zinc Vitriol, White Vitriol, White Copperas, Sulphate of Zinc. Zinc sulfatée, Couperose blanche, *Fr.* Gallizinite *Beud.*, Tr., 446, 1824. Goslarit *Haid*, Handb., 490, 1847.

Orthorhombic. $I \wedge I = 90°\ 42'$; $O \wedge 1\text{-}\bar{i} = 150°\ 10'$; $a : b : c = 0·5735 : 1 : 1·0123$. Observed planes: I, $i\text{-}\bar{i}$, $i\text{-}\breve{i}$, $i\text{-}\breve{2}$, $1\text{-}\bar{i}$, $1\text{-}\breve{i}$, 1, $2\text{-}\breve{2}$. $1\text{-}\bar{i} \wedge 1\text{-}\bar{i}$, top, $= 120°\ 20'$, $1\text{-}\breve{i} \wedge 1\text{-}\breve{i}$, top, $= 120°\ 3'$, $O \wedge 1 = 140°\ 57'$, $1 \wedge 1$, mac., $= 127°\ 27'$, $1 \wedge 1$, brach., $= 126°\ 45'$. Cleavage: $i\text{-}\breve{i}$ perfect.

H.=2–2·5. G.=2·036; 1·9–2·1; 1·953, artificial crystals, Schill. Lustre vitreous. Color white, reddish, bluish. Transparent—translucent. Brittle. Taste astringent, metallic, and nauseous.

Comp.—$\dot{\mathrm{Z}}\mathrm{n}\,\dddot{\mathrm{S}} + 7\,\dot{\mathrm{H}}$ = Sulphuric acid 27·9, oxyd of zinc 28·2, water 43·9=100. Beudant obtained for a specimen from Schemnitz (Tr., ii. 481) $\dddot{\mathrm{S}}$ 29·8, $\dot{\mathrm{Z}}\mathrm{n}$ 28·5, $\dot{\mathrm{M}}\mathrm{n}$ 0·7, $\dddot{\bar{\mathrm{F}}}\mathrm{e}$ 0·4, $\dot{\mathrm{H}}$ 40·8=100·2, which corresponds to 6 $\dot{\mathrm{H}}$. Klaproth obtained (Beitr., v. 193) $\dddot{\mathrm{S}}$ 22·0, $\dot{\mathrm{Z}}\mathrm{n}$ 27·5, $\dot{\mathrm{M}}\mathrm{n}$ 0·5, $\dot{\mathrm{H}}$ 50·0=100.

Pyr., etc.—Yields water. On charcoal with soda gives a zinc coating, and a sulphid which tarnishes silver. Easily soluble in water.

Obs.—This salt is formed by the decomposition of blende, and is found in the passages of mines. It occurs at the Rammelsberg mine near Goslar, in the Harz; at Schemnitz in Hungary; at Fahlun in Sweden; and at Holywell in Wales. It is not of common occurrence.

It is manufactured for the arts, and is very extensively employed in medicine and dyeing. White vitriol, as the term is used in the arts, is the sulphate of zinc in a granular state, like loaf sugar, produced by melting and agitation while cooling.

The name *Gallitzenite*, which has priority, was given the mineral by Beudant from a popular German name *Galitzenstein*. But although so called in Germany, zinc vitriol is not a stone from Galicia (Poland), as the word implies, while it is eminently a product of the mines of Goslar in the Harz. Haidinger's name *Goslarite* is therefore adopted for the species.

667. BIEBERITE. Cobalt Vitriol *Sage*, J. de Phys., xxxix. 58, 1791. Kobaltvitriol *Kopp*, Gehlen's J., II. vi. 157, 1808. Red Vitriol. Sulphate of Cobalt. Rhodhalose *Beud.*, Tr., ii. 481, 1832. Bieberit *Haid.*, Handb., 489, 1845.

Monoclinic. Usually in stalactites and crusts, investing other minerals.

G.=1·924, artificial crystals, Schill. Lustre vitreous. Color flesh- and rose-red. Subtransparent—translucent. Friable. Taste astringent.

Comp.—$\dot{\mathrm{C}}\mathrm{o}\,\dddot{\mathrm{S}} + 7\,\dot{\mathrm{H}}$ = Sulphuric acid 28·4, oxyd of cobalt 25·5, water 46·1=100. Analyses 1, J. H. Kopp (Gehlen's J., II. vi. 157); 2, Winkelblech (Ann. d. Pharm., xiii. 265); 3, Beudant (l. c.); 4, 5, Schnabel (Ramm. 4th Suppl., 118):

	$\dddot{\mathrm{S}}$	$\dot{\mathrm{C}}\mathrm{o}$	$\dot{\mathrm{H}}$
1. Bieber	19·74	38·71	41·55=100 Kopp.
2. "	29·05	19·91	46·83, $\dot{\mathrm{M}}\mathrm{g}$ 3·86=99·65 Winkelblech.
3. "	30·2	28·7	41·2, $\dddot{\bar{\mathrm{F}}}\mathrm{e}$ 0·9 Beudant.
4. Siegen	28·81	23·30	45·22, $\dot{\mathrm{C}}\mathrm{a}$ 0·43, $\dot{\mathrm{M}}\mathrm{g}$ 0·88, Cl 0·09, insol. 1·14=100·12 Schn.
5. "	20·84	16·50	38·13, $\dot{\mathrm{C}}\mathrm{a}$, $\dot{\mathrm{M}}\mathrm{g}$ *tr.*, Cl 0·05 insol. 24·04=100 Schn.

Kopp's analysis corresponds to $\dot{\mathrm{C}}\mathrm{o}^2\,\dddot{\mathrm{S}} + 8\,\dot{\mathrm{H}}$; but the existence of such a compound is very doubtful. The artificially prepared cobalt vitriol has the composition above given.

Pyr., etc.—In a matrass yields water, and when strongly heated, sulphurous acid. Communicates a blue color to glass of borax.

Obs.—In the rubbish of old mines at Bieber, near Hanau; at Leogang in Saltzburg; at Tres Puntos, near Copiapo, Chili.

Beudant's name *Rhodhalose* is not an admissible derivative from 'ροδόεις, *rose-colored*, and ἅλς, *salt*, and is unmineralogical in its termination; it should have been *Rhodohalite*. Instead of making it right (in which case it would be no longer Beudant's name), it appears better to adopt the name applied by Haidinger, derived from the longest known locality.

668. MORENOSITE. Nickel-Viktril, Vitriolum ferrum & niccolum continens ("of a deep green color, with Kupfernickel, in Cobalt mines") *Cronst.* (the discov. of the metal Nickel), Min., 114, 1758. Niccolum vitriolatum (interdum e mineris sulphuratis fatiscentibus genitum) *Bergm.*, Sciagr., 50, 1782. Sulfato de niquel (fr. Galicia) *D. A. Casares*, 1849, A. M. Alcibar, in Revista Minera, Madrid, 305, 1850. Sulfato de nickel, Morenosita, *Casares*, ib., 176, March, 1851. Nickel Vitriol *T. S. Hunt*, this Min., 679, 1850, Logan's G. Rep. Can., 1863. Pyromeline *v. Kob.*, Gel. Anz. Münch., xxxv. 215, 1852, J. pr. Ch., lviii. 44.

In acicular crystals and thin prisms. Also fibrous; and as an efflorescence.

H.=2—2·25. G.=2·004, Fulda. Lustre vitreous. Color apple-green to greenish-white. Streak white, faintly greenish. Soluble; taste metallic astringent.

Comp.—$\dot{N}i\,\dddot{S}+7\dot{H}$=Sulphuric acid 28·5, oxyd of nickel 26·7, water 44·8=100. Analyses: 1, 2, Fulda and Körner (Ann. Ch. Pharm., cxxxi. 217):

	$\dddot{S}$	$\dot{N}i$	$\dot{H}$	$\overset{..}{\bar{A}}s$
1. Riechelsdorf	28·54	26·76	44·43	0·27=100 Fulda.
2. "	28·42	26·59	44·83	0·24=100·08 Körner.

In the mineral from Galicia, on which the species was instituted, the nickel vitriol, according to Casares (l. c.), was mixed with a little sulphate of copper and iron; while that of Canada, according to Hunt, appeared to be pure nickel vitriol.

Pyr., etc.—B.B. in tube gives water, strongly acid, swells up, and hardens, becoming yellow and opaque. On charcoal glows strongly and evolves sulphurous acid. With borax and phosphorus salt gives a distinct nickel reaction. The Riechelsdorf mineral colors the outer flame blue, from the presence of arsenic.

Obs.—A result of the alteration of nickel ores. Occurs near Cape Hortegal, in Galicia, Spain, on magnetite, with which some millerite is mixed; at Riechelsdorf, in Hesse; as an earthy crust, mountain-green in color, with native bismuth and arsenical nickel, at the Friedens mine near Lichtenberg in Bayreuth (pyromeline). Also in acicular crystals and crusts at Wallace mine, Lake Huron, upon a sulphuret of nickel and iron; at the Gap nickel mine, Lancaster Co., Pennsylvania.

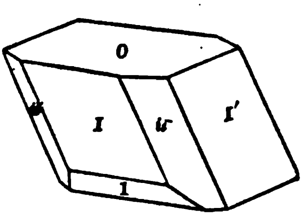
Named by Casares after Mr. Moreno, of Spain. A. M. Alcibar states that Prof. Casares sent a communication on this mineral to the Société de Pharmacie of Paris in 1849, which was not published.

669. CHALCANTHITE. Χάλκανθον, Chalcanthum pt., *Dioscor.*, *Plin.*, Atramentum cœruleum *Agric.*, *Gesner.* Vitriolum Cupri=V. Cypri=V. Veneris, *Wall.*. *Cronst.* Sulphate of Copper, Blue Vitriol, Copper Vitriol. Kupfervitriol *Germ.* Couperose bleue, Cuivre sulfaté, *Fr.* Vitriolo di Rame *Ital.* Cyanose *Beud.*, Tr., ii. 486, 1832. Chalkanthit *v. Kobell*, Tafeln, 31, 1853.

Triclinic. $O \wedge I=109° \; 32'$, $O \wedge I'=127° \; 40'$, $I \wedge I'=123° \; 10$, $O \wedge 1=125° \; 38'$, $I \wedge 1=126° \; 10'$, $O \wedge i\text{-}\bar{\imath}=120° \; 50'$, $O \wedge i\text{-}\breve{\imath}=103° \; 27'$ and 76° 33′. Cleavage: *I* imperfect, *I′* very imperfect. Occurs also amorphous, stalactitic, reniform.

H.=2·5. G.=2·213. Lustre vitreous. Color Berlin-blue to sky-blue, of different shades; sometimes a little greenish. Streak uncolored. Subtransparent—translucent. Taste metallic and nauseous. Somewhat brittle.

541



Comp.—$\dot{\text{Cu}}\,\dddot{\text{S}}+5\,\dot{\text{H}}$=Sulphuric acid 32·1, oxyd of copper 31·8, water 36·1=100. Often mixed with melanterite. Bluish crystals from mud at the Cronebane copper mine of Wicklow contain, according to Mr. Mallet, 34·2 of sulphate of iron to 65·7 of sulphate of copper.

Pyr., etc.—In the closed tube yields water, and at a higher temperature sulphuric acid. B.B. with soda on charcoal yields metallic copper. With the fluxes reacts for copper. Soluble in water; a drop of the solution placed on a surface of iron coats it with metallic copper.

Obs.—Blue vitriol is found in waters issuing from mines, and in connection with rocks containing chalcopyrite, by the alteration of which it is formed. Some of its foreign localities are the Rammelsberg mine near Goslar in the Harz; Fahlun in Sweden; at Parys mine, Anglesey; at various mines in Co. of Wicklow; formerly in crystals an inch long at Ting Tang mine in Gwennap; also Rio Tinto mine, Spain. The waters of the Rio Tinto mine have yielded annually 1,800 cwt. of copper, consuming 2,400 cwt. of iron. At Wicklow about 500 tons of iron were laid in the pits at one time, and in about 12 months the bars were dissolved, and each ton of iron yielded 1½ to 2 tons of a reddish mud which was *cement* copper, containing for every ton 16 cwt. of pure copper. It has been observed at Vesuvius among the products of the eruption of 1855.

Found at the Hiwassee copper mine, also in large quantities at the Isabella and other mines, in Polk Co., Tennessee, 30 m. from Cleveland; at the Canton mine, Georgia; at Copiapo, Chili, with stypticite.

When purified it is employed in dyeing operations, and in the printing of cotton and linen, and for various other purposes in the arts. It is manufactured mostly from old sheathing, copper trimmings, and refinery scales.

On the ancient *chalcanthum* see p. 645. Beudant's name *cyanose* (with *cyanosite* derived from it, from κυανος) is rejected like other names in which the terminal *s* of the Greek is retained. Moreover *chalcanthite*, meaning *flowers of copper*, is old and good.

670. CYANOCHROITE. Cianocroma *Scacchi*, Mem. Vesuv., 191, 1855.

Monoclinic. $C=75°\ 30'=O\wedge i\text{-}i$, $I\wedge I=108°\ 12'$, $O\wedge 1\text{-}\breve{\imath}=153°\ 56'$, $O\wedge 1\text{-}i=141°\ 47'$, $O\wedge 2\text{-}i=116°\ 49'$; also plane $2\text{-}\breve{2}$. Occurs as a crust, and crystals obtained by solution and evaporation. Color clear blue.

Comp.—According to Scacchi, a hydrous sulphate of potash and copper; $(\frac{1}{2}\dot{\text{Cu}}+\frac{1}{2}\dot{\text{K}})\dddot{\text{S}}+3\,\dot{\text{H}}$.

Obs.—From the saline crusts formed on the lavas during the eruption of Vesuvius in 1855.

Named in allusion to the color from κυάνος, *blue*, and χρόα, *color*. Scacchi's name has been changed to the above, in order to secure the termination *ite* and avoid ambiguity (the mineral containing no chrome).

---

671. ALUNOGEN. Hydro-trisulfate d'alumine *Beud.*, Tr., 449, 1824. Davite (?) *Mill.*, Quart. J., 1828. Alunogene *Beud.*, Tr., ii. 488, 1832. Solfatarite pt. *Shep.*, Min., 188, 1835. Keramohalit *Glocker*, Grundr., 689, 1839. Saldanite *Huot*, Min., ii. 451, 1841. Stypterit *Glocker*, Syn., 297, 1847. Halotrichit pt. *Hausm.*, Handb., ii. 1174, 1847 (not Halotrichit *Glocker*). Schwefelsaure Thonerde. Sulphate of Alumina.

Monoclinic, Jurasky. In six-sided tables with two angles of 92° and four of 134°. Usually in delicate fibrous masses or crusts; also massive.

H.=1·5—2. G.=1·6—1·8. Lustre vitreous—silky. Color white, or tinged with yellow or red. Subtranslucent—subtransparent. Taste like that of common alum.

Comp.—$\dddot{\bar{\text{A}}}\text{l}\,\dddot{\text{S}}^3+18\,\dot{\text{H}}$=Alumina 15·4, sulphuric acid 36·0, water 48·6=100. **Analyses:** 1, 2 Boussingault (Ann. Ch. Phys., xxx. 109); 3, Herapath (Ch. Gaz., 1846); 4, Hartwall (Jahresb., x 178); 5, H. Rose (Pogg., xxvii 317); 6–9, Rammelsberg (Pogg., xliii. 130, 399); 10, J. Jurasky (Ast. Bl. f. Lit., 1847); 11, L. Barth (Ber. Ak. Wien, xxiv. 289):

	$\dddot{\text{S}}$	$\dddot{\bar{\text{A}}}\text{l}$	$\dot{\text{H}}$	$\dddot{\bar{\text{F}}}\text{e}$	$\dot{\text{M}}\text{g}$	$\dot{\text{C}}\text{a}$	$\ddot{\text{S}}\text{i}$
1. Rio Saldana	36·40	16·00	46·60	0·004	0·004	0·002	——=99·01 Bouss.
2. Pasto	35·68	14·98	49·34	——	——	——	——=100·00 Bouss.
3. Adelaide	35·63	17·09	46·70	——	——	——	——, $\dot{\text{C}}\text{u}$ 0·04, insol. 0·50 Herapath.
4. Milo	40·81	14·98	40·94	——	0·85	——	1·13, $\dot{\text{N}}\text{a}$ 1·13, $\dot{\text{K}}$ 0·26, H Cl 0·40=100 Hart.
5. Copiapo	36·97	14·63	44·64	2·58	0·14	——	1·37=100·33 Rose.
6. Kolosoruk	35·82	15·57	48·61	——	——	——	——=100 Ramm.
7. Friesdorf	37·38	14·87	45·16	——	——	0·15	——, $\dot{\text{K}}$ 0·22, $\dot{\text{F}}\text{e}$ 2·46=100·24 R.
8. Potschappel	35·71	12·78	47·02	——	0·27	0·64	——, $\dot{\text{K}}$ 0·32, $\dot{\text{F}}\text{e}$ 0·67, $\dddot{\bar{\text{M}}}\text{n}$ 1·02 R.
9. Freienwalde	35·64	11·23	48·84*	——	1·91	0·45	0·43, $\dot{\text{F}}\text{e}$ 0·72, $\dot{\text{K}}$ 0·47, $\dot{\text{M}}\text{n}$ 0·31=100 Ramm.
10. Königsberg	36·75	14·30	44·60	2·15	——	——	——, insol. 2·01=99·81 Jurasky
11. Puster V., Tyrol	36·0	15·8	48·4	——	——	——	——=100·2 Barth.

* And loss.

Beudant obtained in his analysis of a specimen from Guadaloupe, the first made of the species (Tr., 449, 1832), $\dddot{\text{S}}$ 39·94, $\dddot{\bar{\text{A}}}\text{l}$ 16·76, $\dot{\text{H}}$ 36·44, potash alum 4·58, green vitriol 1 94, which gives 12 $\dot{\text{H}}$ instead of 18 $\dot{\text{H}}$. The other analyses agree well in the latter, and the difference is probably an error.

Davite N. Mill (Brandes Q. J., xxv. 382, 1828) from a hot spring at Chiwachi, a day's journey from Bogota, afforded him $\dddot{\text{S}}$ 28·8, $\dddot{\bar{\text{A}}}\text{l}$ 15·0, $\dot{\text{H}}$ 51·8, $\dddot{\bar{\text{F}}}\text{e}$ 1·2, with earthy matters 3·2=100. Requires investigation. Anal. 10 is of the *keramohalite* of Jurasky, from near Königsberg.

Pyr., etc.—Yields water, and at a higher temperature sulphuric acid, in the closed tube. Gives a fine blue with cobalt solution. Soluble in water.

Obs.—This species, a hydrous sulphate of alumina, results both from volcanic action, and the decomposition of pyrites in coal districts and alum shales, and occurs at the localities above mentioned, besides many others The Pasto mineral was from the crater of a volcano. It has been observed by Scacchi at Vesuvius; at Königsberg, Hungary, it occurs in thick druses with iron vitriol. It is found as an efflorescence in numerous places in the United States. A white fibrous alunogen (?) occurs abundantly at Smoky Mtn., Jackson Co., N. C., where, it is said, tons may be obtained.

This species was made known by Beudant, and by him first named *Alunogen.* The word is a cross between French and Greek, and therefore objectionable; but not worse than some others of minerals that are accepted. Should *davite* turn out to be the same thing, this name would have the precedence in time; but still it could not claim recognition on the basis of an analysis proved to be so greatly in error.

672. COQUIMBITE. Neutrales schwefelsaures Eisenoxyd *G. Rose*, Pogg., xxvii. 309, 1833. White Copperas. Coquimbit *Breith.*, Handb., 100, 1841.

Hexagonal. Prisms usually with the terminal edges deeply replaced. $O \wedge 1=151°$, $I \wedge 1=119°$, $1 \wedge 1=128° \ 8'$. Cleavage: *I*, imperfect. Also in fine granular masses.

H.=2–2·5. G.=2–2·1. Color white, yellowish, brownish, sometimes with a pale violet tint. Taste astringent.

Comp.—$\dddot{\bar{\text{F}}}\text{e}\,\dddot{\text{S}}^3+9\,\dot{\text{H}}$=Sulphuric acid 42·7, sesquioxyd of iron 28·5, water 28·8=100. **Analyses:** 1, 2, H. Rose (l. c.):

	$\dddot{\text{S}}$	$\dddot{\bar{\text{F}}}\text{e}$	$\dddot{\bar{\text{A}}}\text{l}$	$\dot{\text{C}}\text{a}$	$\dot{\text{M}}\text{g}$	$\ddot{\text{S}}\text{i}$	$\dot{\text{H}}$
1. *Crystalline*	43·55	24·11	0·92	0·73	0·32	0·31	30·10=100·04 Rose.
2. *Granular*	43·55	25·21	0·78	0·14	0·21	0·37	29·98=100·24 Rose.

Pyr., etc.—B.B. resembles melanterite. Wholly soluble in cold water; if the solution be heated, sesquioxyd of iron is copiously precipitated. Dilute muriatic acid dissolves all except the silica.

Obs.—Forms a bed in a feldspathic or trachytic rock, in the province of Coquimbo, about half a day's journey from Copiapo. The bed of salt is on the increase, and is probably derived from decomposing sulphids. Pits 20 ft. deep have been formed in it by the people of the country. Occurs also in Bolivia near Calama, constituting the greater part of a large hill.

Observed by Scacchi about fumaroles after the eruption of Vesuvius in 1855, partly in a brownish friable crust, which, by solution and evaporation, afforded yellow *hexagonal* crystals; also as a yellowish crust, in many parts tinged green, compact in texture, with the lustre of a surface of fracture very bright.

Grailich states (Ber. Ak. Wien, xxviii. 272, 1858) that a specimen of coquimbite from Copiapo in the museum at Vienna has the optical characters of his rœmerite, and therefore cannot be hexagonal, and he suggests that the two minerals may be identical.

A related ochre-yellow mineral from Algodonbai in Bolivia, afforded v. Bibra (J. pr. Ch., xcvi. 206) $\ddot{S}$ 30·28, $\bar{F}e$ 43·89, $\dot{C}a$ 4·21, $\dot{H}$ 21·20, $\dot{C}u\,\ddot{\bar{P}}$ *tr.*=99·53; which, if the lime be separated as gypsum (10·21 p. c.), becomes $\ddot{S}$ 50·34, $\bar{F}e$ 27·80, $\dot{H}$ 21·86=100. It is partly soluble in water, but the solution contains no iron.

ALUM AND HALOTRICHITE GROUPS.

Groups of Tersulphates having the ratio of base and acid, and also of $\dot{R}$, $\bar{R}$, 1 : 3; all very soluble, and having more or less the astringent taste of common alum. H.=2–2·5. G.=1·56–2. The Alums have 24 $\dot{H}$ to 4 $\ddot{S}$, and are isometric; the Halotrichites have 22 $\dot{H}$ instead of 24 $\dot{H}$, and are not isometric, being either orthorhombic or monoclinic.

The species here included are not easily distinguishable by the taste or external characters, and hence early authors on minerals include all under one or two names. The old synonymy and the history of the species are therefore more conveniently given here than under the several subdivisions of the group.

Στυπτηρία *Gr.* Alumen *Plin.* [embracing vitriols as well as the alums]. Σχιστὴ στυπτηρία *Dioscor.* [embracing the fibrous or feathery kinds, Σχιστὴ being from σχίζω, *I cut*, and alluding to the easy subdivision into fibres]. Τριχῖτις *Dioscor.* [fr. θρίξ, *hair*, it embracing capillary kinds]. Alumen fossile, *Germ.* Alaun, *Gesner*, Foss., 1565 [vitriols being excl., and comprising the var. A. candidum Neapolitanum (fr. Naples), A. capillare, ib., A. Placodes (latas crustas habens), ib., etc.]. Alun, Alumen [including var. α solidum, β crystallisatum, γ plumosum, or Fjäder-Alun], *Wall.*, Min., 161, 1747. Alun, Argilla acido vitrioli imbuta, *Cronst.*, 115, 1758. Argilla vitriolata [= Sulphate of Alumine] *Bergm.*, Sciagr., 1782. Alaun, Haarsalz, Federalaun [all as one species, or if two, without right distinctions], *Wern., and other Min. before* 1800. Alumine sulfatée alkaline *H.*, Tr., ii. 278, 1801 [citing Vauquelin's anal. of potash-alum, but including all alums].

In 1795 Klaproth proved (Beitr., i. 311), and in 1792 Breislak (Essais Min. sur la Solfatara, etc.), that some alum (that of Miseno and the Solfatara, near Naples) was *potash-alum.* In 1802 Klaproth showed (Beitr., iii. 102) that the *Federalaun* of Freyenwald was *iron-alum.* Beudant ascertained that there was a native alum-like mineral which had the constitution attributed last century to true alum—that is, was a simple *sulphate of alumina*, without an alkali or other protoxyd (Tr., 449, 1824). Grüner, in 1821 (Gilb. Ann., lxix. 218), made known a native *ammonia-alum;* Thomson, in 1828 (Ann. Lyc. N. Y., iii. 19, 1828), a native *soda-alum;* A. A. Hayes, in 1845 (Am. J. Sci., xlvii. 360), a *magnesia-alum.*

673. TSCHERMIGITE. Ammonia Alum. Ammoniakalaun, Ammonalaun, *Germ.* Ammonalun *Beud.*, ii. 497, 1832. Tschermigit *v. Kobell*, Tafeln Bestimm., 1853.

In octahedrons and fibrous.

H.=1–2. G.=1·50. Lustre vitreous. Color white. Transparent to translucent.

Comp.—$NH^4O\ddot{\bar{S}}+\bar{A}l\,\ddot{\bar{S}}^3+24\,\dot{H}=(\frac{1}{4}\,(NH^4O)^3+\frac{3}{4}\,\bar{A}l)\,\ddot{\bar{S}}^3+18\,\dot{H}$=Sulphate of ammonia 14·6, sulphate of alumina 37·8, water 47·6=100.

Analyses: 1, Pfaff (Handb. An. Ch., ii. 47); 2, Lampadius (Gilb. Ann., lxx. 182, lxxiv. 183); 3 Stromeyer (Pogg., xxxi. 137):

	$\dddot{S}$	$\bar{A}l$	NH^4O	$\dot{H}$	$\dot{M}g$
1. Tschermig	36·00	12·14	6·58	45·00	0·28=100 Pfaff.
2. "	38·58	12·34	4·12	44·96.	——=100 Lampadius.
3. "	36·065	11·602	3·721	48·390	0·115=99·893 Stromeyer.

Pyr., etc.—In the closed tube yields water and sulphate of ammonia; B.B. sublimes; on charcoal gives a coating of sulphate of ammonia, and leaves a residue which gives a fine blue with cobalt solution; with soda gives ammonia fumes, and the reaction for sulphuric acid.

Obs.—From Tschermig, Bohemia. This salt is manufactured from the waste of gas works, and used extensively in place of potash alum.

674. KALINITE. Potash Alum. Native Alum. Kalialaun, Kalinischer Alum, Kalinischer Alumsulphat, *Germ.* Kalinite *Dana.*

Isometric. Usually fibrous or massive, or in mealy or solid crusts.

H.=2–2·5. G.=1·75. Lustre vitreous. Color white. Transparent to translucent.

Comp.—$\dot{K}\dddot{S}+\bar{A}l\dddot{S}^3+24\dot{H}=(\frac{1}{4}\dot{K}^3+\frac{3}{4}\bar{A}l)\dddot{S}^3+18\dot{H}$=Sulphate of potash 18·4, sulphate of alumina 36·2, water 45·5=100.

Pyr., etc.—B.B. fuses in its water of crystallization, and froths, forming a spongy mass; with cobalt solution an intense blue; on charcoal gives a hepatic mass. Soluble in from 16 to 20 times its weight of cold water, and in little more than its weight of boiling water.

Obs.—Effloresces on argillaceous minerals, and more particularly alum slate. Whitby in Yorkshire is a noted locality, also Hurlet and Campsie near Glasgow. Also obtained at the volcanoes of the Lipari isles and Sicily. Cape Sable, Maryland, affords large quantities of alum annually. In the caves of the Unaka Mts., Eastern Tennessee, especially at Sevier, masses a cubic foot in size may be obtained; also in the "Black Slate" of Middle Tennessee; and in caves along the valleys and gorges of the streams in De Kalb, Coffee, and Franklin Cos., Tenn. (Safford).

675. VOLTAITE. Voltaite *A. Scacchi*, Ac. Sci. Nap., 1840.

Isometric. In octahedrons, cubes, dodecahedrons, and combinations of these forms.

Lustre resinous. Color dull oil-green, greenish-black, brown, or black. Streak grayish-green. Opaque.

Comp.—$\dot{F}e\dddot{S}+\bar{F}e\dddot{S}^3+24\dot{H}$, Scacchi,=$\dot{F}e\dddot{S}$ 15·4, $\bar{F}e\dddot{S}^3$ 40·6, $\dot{H}$ 44·0=100; but not from a complete analysis. Dufrénoy's analysis (Ann. d. M., III. ix. 165) is not correct according to Scacchi (Mem. G. Camp. Napoli, 89, 1849).

Abich has obtained an artificial salt of similar characters, which has the formula $(\frac{3}{4}(\dot{F}e,\dot{K})^3+\frac{1}{4}\bar{F}e)\dddot{S}^3+4\dot{H}$, and the composition:

$\dddot{S}$ 48·32 $\bar{A}l$ 2·20 $\bar{F}e$ 17·65 $\dot{F}e$ 11·60 $\dot{N}a$ 6·25 $\dot{K}$ 0·4 $\dot{H}$ 15·94

a little of the iron being replaced by aluminum. It is supposed that voltaite corresponds to it essentially in composition.

Paulinyi has found crystals of a similar compound at Kremnitz. They afford the formula (Tschermak, Anz. Ak. Wien, 1867, 218) $(\frac{2}{3}(\dot{F}e,\dot{K})^3+\frac{1}{3}\bar{F}e)\dddot{S}^3+4\frac{1}{3}\dot{H}$, with $\dot{F}e:\dot{K}=4:1$, and a little aluminum replacing iron.

Pyr., etc.—Soluble in water with difficulty, and at the same time decomposes.

Obs.—This species was first observed at the Solfatara near Naples, by Breislak (1792). It has been found by F. Ulrich at the Rammelsberg mine near Goslar. The last contains protoxyd of manganese, as well as of iron.

676. **Blakeite** *Dana*, Min., 1850. J. H. Blake has described an iron-sulphate from Coquimbo, which he refers to coquimbite; but it occurs in regular octahedrons, and assumed the same form on solution and recrystallization. He obtained in an analysis $\dddot{S}$ 41·37, $\bar{F}e$ 26·79, $\bar{A}l$ 1·05, $\dot{M}g$ 0·30, $\dddot{S}i$ 0·82, $\dot{H}$ 29·40=99·68. Requires further investigation.

677. **MENDOZITE.** Soda Alum. Natronalaun, Natrumalaun, *Germ.* Natronalun *Huot*, ii. 448, 1841. Solfatarite pt. *Shep.*, Min., ii. 187, 1835 (not in Min. of 1857). Mendozite *Dana.*

In white fibrous masses.

H.=3, and G.=1·88, Thomson. Externally white or pulverulent. Some resemblance to fibrous gypsum, but harder.

Comp.—$\dot{N}a\,\dddot{S}+\dddot{\bar{A}}l\,\dddot{S}^3+22\,\dot{\bar{H}}$=Sulphate of soda 16·1, sulphate of alumina 39·0, water 44·9=100; or, Sulphuric acid 36·3, alumina 11·7, soda 7·1, water 44·9=100. Analysis by Thomson (Ann. Lyc. N. Y., 1828):

St. Juan near Mendoza $\dddot{S}$ 37·70 $\dddot{\bar{A}}l$ 12·00 $\dot{N}a$ 7·96 $\dot{\bar{H}}$ 41·96=99·62.

Pyr., etc.—Resembles ordinary alum.

Obs.—Occurs near Mendoza, east of the Andes.

Thomson found for the composition of a soda alum from Southern Peru which he called Subsesquisulphate of Alumina (Phil. Mag., III. xxii. 188), $\dddot{S}$ 32·95, $\dddot{\bar{A}}l$ 22·55, $\dot{N}a$ and $\dddot{S}$ 6·50, $\dot{\bar{H}}$ 39·20 =101·20. G.=1·584.

Shepard states in Am. J. Sci., xvi. 203, 1829, that the alum of the island of Milo is a soda alum related to Thomson's; but in vol. xxii. 387, ib., he admits a doubt, on the ground of Hartwall's analysis of a Milo alum, which makes it *Alunogen* (q. v.). Shepard's name solfatarite (which he has since rejected) was based upon its occurring in solfataras, and not in the Naples solfatara, to which no allusion is made in his edition of 1835; and under it he gave three analyses of alunogen, with the one of *soda-alum* by Thomson. The Mendoza mineral is not from a solfatara.

678. **PICKERINGITE.** *Hayes*, Am. J. Sci., xlvi. 360, 1844. Magnesia Alum *ib.* Magnesialaun, Talkerde-Alaun, *Germ.*

Monoclinic? In fine acicular crystals; long fibrous masses; and in efflorescences.

H.=1. Lustre silky. Color white, yellowish. Becomes pulverulent and white on exposure. Taste bitter—astringent.

Comp.—$\dot{M}g\,\dddot{S}+\dddot{\bar{A}}l\,\dddot{S}^3+22\,\dot{\bar{H}}$=Sulphuric acid 37·3, alumina 12·0, magnesia 4·6, water 46·1. Analyses: 1, A. A. Hayes (l. c.); 2, How (J. Ch. Soc., II. i. 200):

	$\dddot{S}$	$\dddot{\bar{A}}l$	$\dot{F}e, \dot{M}n$	$\dot{M}g$	$\dot{C}a$	$\dot{K}$	$\dot{\bar{H}}$
1. Iquique	36·32	12·18	0·43	4·68	0·13	——	45·45, H Cl 0·60=99·74 Hayes.
2. Newport, N. S.	36·33	10·64	0·58	4·79	——	0·23	45·06, $\dot{C}o$ 0·06, $\dot{N}i$ 0·14, slate 0·72=99·57 H.

In two other trials How found for $\dddot{S}$ 36·36, 36·59, and for $\dot{\bar{H}}$ 46·16, 46·07.

Pyr., etc.—In the matrass yields water, and acts like other alums. Tastes like ordinary alum.

Obs.—From near Iquique, in Peru; also from N. Scotia, in Newport, on the bank of the Meander, as an efflorescence on the slate or shale (Silurian) of a sheltered cliff, where it results from the action on the shale of decomposing pyrite—and probably a kind containing traces of cobalt and nickel. How observes that the fibres in this mineral are oblique in crystallization, and that it contains only 22 $\dot{\bar{H}}$; and that it is therefore not a true alum.

679. **APJOHNITE.** Manganese Alum *Apjohn*, Phil. Mag., xii. 103, 1838. Manganalaun. Apjohnit *Glocker*, Syn., 298, 1847.

In fibrous or asbestiform masses, white, and with a silky lustre.

Comp.—$\dot{M}n\,\dddot{S}+\dddot{\bar{A}}l\,\dddot{S}^3+24\,\dot{\bar{H}}$=Sulphate of manganese 16·3, sulphate of potash 37·0. water 46·7=100. How suggests the formula $\dot{M}n\,\dddot{S}+\dddot{\bar{A}}l\,\dddot{S}^3+22\,\dot{\bar{H}}$, which would correspond to 44·54 p. c. of water and 35·96 $\dddot{S}$, supposing some loss of the sulphuric acid in the heating to determine the water.

Analysis: Apjohn (Phil. Mag., l. c.):

$\dddot{S}$ 32·79 $\dddot{\bar{A}}l$ 10·65 $\dddot{\bar{M}}n$ 7·33 (=$\dot{M}n$ 6·60) $\dot{\bar{H}}$ 48·15 $\dot{M}g\,\dddot{S}$ 1·08=100.

Pyr.—Nearly the same as for ordinary alum, but gives with fluxes a reaction for manganese.
Obs.—From Lagoa Bay in South Africa.

680. BOSJEMANITE. Manganese Alum pt., Mangano-magnesian Alum. Bosjemanite *Dana*.

Monoclinic? In silky acicular or capillary crystallizations; and as crusts and efflorescences. Taste like that of ordinary alum, but less strong.

Comp.—$(\dot{\mathrm{M}}\mathrm{n}, \dot{\mathrm{M}}\mathrm{g})\dddot{\mathrm{S}}+\dddot{\bar{\mathrm{A}}}\mathrm{l}\,\dddot{\mathrm{S}}^3+22\,\dot{\mathrm{H}}$ (How)=if $\dot{\mathrm{M}}\mathrm{n} : \dot{\mathrm{M}}\mathrm{g}=1:2$, Sulphuric acid 36·82, alumina 11·83, protoxyd of manganese 2·73, magnesia 3·06, water 45·56=100. Analyses: 1, Stromeyer (Pogg., xxxi. 137); 2, J. L. Smith (Am. J. Sci., II. xviii. 379); 3, E. Schweizer (Kenng. Uebers., 1859, 12):

	$\dddot{\mathrm{S}}$	$\dddot{\bar{\mathrm{A}}}\mathrm{l}$	$\dot{\mathrm{F}}\mathrm{e}$	$\dot{\mathrm{M}}\mathrm{n}$	$\dot{\mathrm{M}}\mathrm{g}$	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\mathrm{K}}$	$\dot{\mathrm{H}}$
1. Bosjeman R., Afr.	36·77	11·52	——	2·17	3·69	——	——	45·74, KCl 0·20=100 S.
2. Utah	35·85	10·40	0·15	2·12	5·94	——	0·20	46·00=100·66 Smith.
3. Maderan Vall.	35·96	10·55	1·06	2·51	3·74	0·27	0·58	44·26, $\dot{\mathrm{C}}\mathrm{u}$ 0·22, insol. 1·12=100.

In the last there was some ammonia with the water.
Pyr., etc.—As under apjohnite.
Obs.—It covers the floor of a cave near Bosjeman river in Southern Africa, to a depth of six inches; the roof is a reddish quartzose conglomerate, containing magnesia and pyrites; it rests on a bed of epsomite, 1½ inches thick; also found in Maderan valley in Canton Uri, Switzerland (called *keramohalite* by Schweizer); and at Alum Point near Salt Lake, in Utah. This Utah mineral was made a manganesian alum by Dr. Gale (Am. J. Sci., II. xv. 434, 1853).

681. HALOTRICHITE. Federalaun von Freyenwalde (with anal. showing it to be an iron alum) *Klapr.*, Beitr., iii. 102, 1802. Eisenalaun *Germ.* Iron Alum. Halotrichit *Glocker*, Grundr., 691, 1839. Hversalt *Forchhammer*, Jahresb., xxiii. 263, 1843. Halotrichine *Scacchi*, Mem. Geol. Camp. Nap., 84, 1849.

Silky fibrous. Yellowish-white. Taste inky-astringent. Becomes dull and pulverulent on exposure.

Comp.—$\dot{\mathrm{F}}\mathrm{e}\,\dddot{\mathrm{S}}+\dddot{\bar{\mathrm{A}}}\mathrm{l}\,\dddot{\mathrm{S}}^3+22\,\dot{\mathrm{H}}$=Sulphuric acid 35·9, alumina 11·5, protoxyd of iron 8·1, water 44·5=100.
In the *Hversalt* of Forchhammer (l. c.) a small part of the alumina is replaced by sesquioxyd of iron, and of the protoxyd of iron by magnesia. Scacchi's *Halotrichine* (l. c.) may belong here; he writes for the formula $\dot{\mathrm{F}}\mathrm{e}\,\dddot{\mathrm{S}}+\frac{1}{3}\dddot{\bar{\mathrm{A}}}\mathrm{l}\,\dddot{\mathrm{S}}^3+18\,\dot{\mathrm{H}}$. If part of the iron is sesquioxyd it is like the hversalt.
Analyses: 1, Berthier (Ann. d. Mines, v. 257); 2, Rammelsberg (Pogg., xliii. 399); 3, B. Silliman, Jr. (this Min., 226, 1850); 4, Arppe (An. Finske Min., 1857); 5, Phillips (Ann. Ch. Phys., xxiii. 322); 6, Forchhammer (l. c.); 7, Scacchi (l. c.):

	$\dddot{\mathrm{S}}$	$\dddot{\bar{\mathrm{A}}}\mathrm{l}$	$\dot{\mathrm{F}}\mathrm{e}$	$\dot{\mathrm{M}}\mathrm{g}$	$\dot{\mathrm{H}}$
1. ———?	34·4	8·8	12·0	0·8	44·0=100 Berth.
2. Mörsfeld	36·03	10·91	9·37	0·23	43·03, $\dot{\mathrm{K}}$ 0·43=100 Ramm.
3. Oroomiah	33·81	10·62	9·15	——	41·61, $\dddot{\mathrm{S}}\mathrm{i}$ 3·34, $\ddot{\bar{\mathrm{F}}}\mathrm{e}$ 1·05=99·58 S.
4. Finland	34·71	18·33	6·23	——	44·20=98·47 Arppe.
5. Hurlet	30·9	5·2	20·7	——	43·2=100 Phillips.
6. *Hversalt*	35·16	11·22	4·57	2·19	45·63, $\ddot{\bar{\mathrm{F}}}\mathrm{e}$ 1·23=100 Forchhammer.
7. *Halotrichine*	34·12	9·76	10·20	——	45·92=100 Scacchi.

Klaproth obtained for the "Feather alum" of Freyenwalde, Sulphuric acid and water 77, alumina 15·25, protoxyd of iron 7·50, potash 0·25=100.
Pyr., etc.—Fuses in its own crystallization-water, cracks open, and if strongly heated gives off sulphurous acid, leaving a brown residue; with the fluxes reacts for iron, and with soda on charcoal gives an hepatic mass.
Obs.—Occurs at Bodenmais and at Mörsfeld in Rhenish Bavaria. Also at Oroomiah, Persia, where the inhabitants use it for making ink of a fine quality; at Hurlet and Campsie near Glasgow; at Bjorkbackagard in Finland (anal. 4). Probably at Rossville, Richmond Co., N. Y. (Beck)

The *Hversalt* of Forchhammer is an allied alum from Iceland. *Halotrichine* is a silky alum from the Solfatara near Naples.

The name *Halotrichite* is from ἅλς, *salt*, and θρίξ, *hair*.

Berg-butter (*Beurre de Montagne*) is an impure alum or copperas efflorescence, of a butter-like consistence, oozing from some alum slates. A yellowish kind from Wetzelstein, near Saalfeld, afforded R. Brandes (Schw. J., xxxix. 417) $\dddot{S}$ 34·82, $\dddot{\overline{Al}}$ 7·00, $\dot{Fe}$ 9·97, $\dot{Mg}$ 0·80, $\dot{Na}$ 0·72, ammonia 1·75, $\dot{H}$ 43·50=99·00. Another, from the original locality at Irtisch in the Altai, gave Klaproth (Beitr., vi. 344) $\dddot{S}$ 31·0, $\dddot{\overline{Al}}$ 2·5, $\dot{Fe}$ 6·0, $\dot{Mn}$ 0·25, $\dot{Mg}$ 6·25, $\dot{Ca}$ 4·5, $\dot{Na}$ 0·25, $\dot{H}$ 49·25.

682. RŒMERITE. Rœmerit *Grailich*, Ber. Ak. Wien, xxviii. 272, 1858.

Monoclinic. $C=78°\ 59'$, $I \wedge I$, front, $=101°\ 24'$, $O \wedge I=98°\ 30'$ and $81°\ 30'$, $O \wedge i\text{-}\breve{i}=101°\ 1'$, $O \wedge i\text{-}\grave{i}=90°$, $I \wedge i\text{-}\grave{i}=129°\ 18'$, Grailich. Cleavage: clinodiagonal perfect. Coarse granular, the grains partly crystallized.

H.=2·75. G.=2·15—2·18; mean of results 2·174. Lustre between greasy and vitreous. Color rust-brown to yellow. Translucent. Taste saline, astringent, vitriolic.

Comp.—O. ratio for $\dot{R}$, $\dddot{\overline{R}}$, $\dddot{S}$, $\dot{H}$=nearly 1 : 3 : 12 : 12; $\dot{R}\dddot{S}+\dddot{\overline{Fe}}\dddot{S}^3+12\dot{H}$. Mean of two analyses by Tschermak (l. c.):

	$\dddot{S}$	$\dddot{\overline{Fe}}$	$\dot{Fe}$	$\dot{Zn}$	$\dot{Mn}$	$\dot{Ca}$	$\dot{Mg}$	$\dot{H}$	insol.
(⅔)	41·54	20·63	6·26	1·97	*tr.*	0·58	*tr.*	28·00	0·50=99·48.

Pyr., etc.—Probably the same as for copiapite. Reactions of iron and zinc.
Obs.—From the Rammelsberg mine near Goslar, along with copiapite.

---

683. COPIAPITE. Μισυ *Diosc.* Misy (fr. Cyprus, etc.) *Plin.*, xxxiv. 31. Misy, *Germ.* Gelb Atrament (fr. Harz, etc.), *Agric.*, Nat. Foss., 218, 457, Interpr., 466, 1546. Misy, Gul Atrament Sten, Lapis atramentarius flavus, *Wall.*, Min., 159, 1747. Misy (fr. Harz) *Hausm.*, Handb., 1061, 1813, 1203, 1847. Gelbeisenerz *Breith.*, Char., 97, 238, 1823, 228, 1832. Yellow Copperas. Copiapite (fr. Copiapo), Basisches Schwefelsaures Eisenoxyd, *H. Rose*, Pogg., xxvii. 309, 314, 1833. Xanthosiderit pt. *Glocker*, Syn., 65, 1847.

Hexagonal? Loose aggregation of crystalline scales, or granular massive, the scales rhombic or hexagonal tables. Cleavage: basal, perfect. Incrusting.

H.=1·5. G.=2·14, Borcher. Lustre pearly. Color sulphur-yellow, citron-yellow. Translucent.

Comp.—$\dddot{\overline{Fe}}^2\dddot{S}^5+18\dot{H}$, Rose; $\dddot{\overline{Fe}}^2\dddot{S}^5+12\dot{H}$, Ramm.=Sulphuric acid 42·7, sesquioxyd of iron 34·2, water 23·1=100. Analyses: 1, H. Rose (Pogg., xxvii. 309); 1A, same, excluding 18·45 epsomite, 0·19 gypsum, and the silica, as impurities (Ramm. Min. Ch., 275); 2–4, Borcher, and Ahrend & Ullrich (B. H. Ztg., 1854); 5, 6, List (Ann. Ch. Pharm., lxxiv. 239):

	$\dddot{S}$	$\dddot{\overline{Fe}}$	$\dddot{\overline{Al}}$	$\dot{Mg}$	$\dot{Ca}$	$\dot{H}$
1. Copiapo	39·60	26·11	1·95	2·64	0·06	29·67, $\dddot{Si}$ 1·37=101·40 Rose
1A. "	41·59	33·59	——	——	——	24·82 Rose.
2. Goslar, *cryst.*	38·00	24·24	$\dot{Zn}$ 5·80	——	——	30·06=98·10 Borcher.
3. " "	39·44	28·00	" 2·00	——	——	30·64=100·08 A. & U.
4. " *earthy*	38·07	26·03	" 2·30	$\dot{Mn}$ 1·26	——	30·50=98·22 A. & U.
5. " *cryst.*	42·92	30·07	" 2·49	2·81	$\dot{K}$ 0·32	21·39=100 List.
6. " "	43·21	30·37	——	——	——	*und.* List.

Pyr., etc.—Yields water, and at a higher temperature sulphuric acid. On charcoal becomes magnetic, and with soda affords the reaction for sulphuric acid. With the fluxes reactions for iron. In water insoluble.

Obs.—Common as a result of the decomposition of pyrite at the Rammelsberg mine, near Goslar in the Harz, and elsewhere.

This species is the yellow copperas long called misy, and it might well bear now the name *Misylite*. The description of Dioscorides is unsatisfactory. But that of Pliny, not over 25 years later, is good, and is as likely to represent the true *μισυ* of the Greeks; and that of Agricola is excellent, and was taken from Goslar specimens.

684. RAIMONDITE. Raimondit *Breith.*, B. H. Ztg., xxv. 149, 1866.

Hexagonal. In thin six-sided tables with removed basal edges, scale-like. Cleavage: basal, perfect.

H.=3–3·25. G.=3·190–3·222. Lustre pearly. Color between honey- and ochre-yellow. Streak ochre-yellow. Opaque.

Comp.—O. ratio $\overline{\text{Fe}}$, $\dddot{\text{S}}$, $\dot{\text{H}}$=6 : 9 : 7; $\overline{\text{Fe}}^2\dddot{\text{S}}^3+7\dot{\text{H}}$=Sulphuric acid 35·0, sesquioxyd of iron 46·6, water 18·4=100.

Analysis: 1, Rube (l. c.):

	$\dddot{\text{S}}$	$\overline{\text{Fe}}$	$\dot{\text{H}}$
1. Ehrenfriedersdorf	36·08	46·52	17·40=100.

Pyr., etc.—Probably the same as for copiapite. In water insoluble.

Obs.—From the tin mines of Ehrenfriedersdorf, in scales on cassiterite.

684A. PASTREITE *Norman* (Bergemann, Verh. nat. Ver. Bonn, 1866, 17), may be of the above species, if part of the iron is present as limonite. According to Bergemann, it occurs amorphous or reniform, of a yellow color, at Paillières, near Alais, Dept. of Gard, with cerussite, limonite, calcite, gypsum, fibroferrite; B B. infusible; in muriatic acid easily soluble. The analyses gave (l. c.):

	$\dddot{\text{S}}$	$\dddot{\text{Si}}$	$\overline{\dddot{\text{As}}}$	$\overline{\text{Fe}}$	$\dot{\text{Pb}}$	$\dot{\text{H}}$
1. *Yellow*	30·47	2·40	1·86	46·50	1·25	16·04, $\overline{\dddot{\text{Al}}}$, $\dot{\text{Mn}}$, $\dot{\text{Ca}}$ 0 89=99·41.
2. *Yellowish-brown*	30·55	—	2·05	52·80	—	13·95, $\overline{\dddot{\text{Al}}}$, $\dot{\text{Ca}}$, sand 0·63=99·98.

Received by Dr. Bergemann from Dr. Normann, of Marseilles, who named it after President Pastré, of that city. It approaches jarosite (p. 660), except in the absence of alkalies.

685. FIBROFERRITE. *H. Rose*, Pogg., xxvii. 309, 1833. Fibroferrite *Prideaux*, Phil. Mag., III. 397, 1841. Stypticit *Hausm.*, Handb., ii. 1202, 1847. Copiapite *J. L. Smith*, Am. J. Sci., II. xviii. 375.

Delicately fibrous.

H.=1·5–2. G.=1·84, Smith. Lustre silky, pearly. Color pale yellow, or nearly white. Translucent.

Comp.—$\overline{\text{Fe}}^3\dddot{\text{S}}^5+27\dot{\text{H}}$, Ramm.=Sulphuric acid 29·30, sesq. iron 35·15, water 35·55=100

Analyses: 1, H. Rose (l. c.); 2, 3, J. L. Smith (l. c.); 4, E Tobler (Ann. Ch. Pharm., xcvi. 383) 5, Prideaux (l. c.); 6, F. Field (Q. J. Ch. Soc., xiv. 156); 7, Pisani (C. R., lix. 94):

	$\dddot{\text{S}}$	$\overline{\text{Fe}}$	$\dot{\text{Mg}}$	$\dot{\text{Ca}}$	$\dot{\text{H}}$
1. Copiapo, *fib.*	31·73	28·11	0·59	1·91	36·56, $\dddot{\text{Si}}$ 1·48=100·53 Rose.
2. " "	30·25	31·75	—	—	38·20, insol. 0·54=100·75 Smith.
3. " "	30·42	30·98	—	—	*undet.* Smith.
4. " "	31·49	31·69	—	—	36·82=100 Tobler.
5. " "	28·9	34·4	—	—	36·7=100 Prideaux.
6. Chili, "	31·94	31·89	—	—	35·90=99·73 Field.
7. Paillières	29·72	33·40	—	*tr.*	36·88=100 Pisani.

Pyr., etc.—Same as for copiapite.

Obs.—From Copiapo, Chili, in delicately fibrous masses, associated with coquimbite; also from the mines of Paillières, in Gard, France.

The name alludes to the fibrous structure. There is no reason to doubt the identity of Prideaux's *fibroferrite* of 1841 with the mineral analyzed by Rose, Smith, and others, and which Hausmann named stypticite in 1847.

686. APATELITE. *Meillet*, Ann. d. M., IV. iii. 308, 1841.

In small friable nodules or balls. Color clear yellow. Resembles copiapite.

Comp.—$\mathrm{\overline{F}e}^2\,\dddot{\mathrm{S}}^3 + 2\,\dot{\mathrm{H}}$. Analysis by Meillet (l. c.):

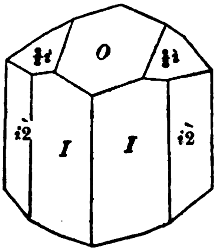
$\dddot{\mathrm{S}}$ 42·90 $\mathrm{\overline{F}e}$ 53·30 $\dot{\mathrm{H}}$ 3·96=100·16.

Occurs at Meudon and Auteuil, disseminated in an argillaceous bed connected with the plastic clay.

687. BOTRYOGEN. Rother Eisen-Vitriol *Berz.*, Afh., iv. 307, 1815. Red Iron Vitriol. Fer sulfaté rouge *Fr.* Botryogen *Haid.*, Pogg., xii. 491, 1828. Neoplase pt. *Beud.*, Tr., ii. 483, 1832. Botryt *Glock.*, Syn., 300, 1847.

Monoclinic. $C=62°\ 26'$, $I \wedge I=119°\ 56'$, $O \wedge 1\text{-}\grave{i}=152°\ 1\tfrac{1}{2}'$; $a:b:c=0{\cdot}9188:1:1{\cdot}5334$. Observed planes as in the figure, with also $1\text{-}i$ (on acute solid angle of base), 1 (on acute edge of base), and $i\text{-}\grave{i}$. $O \wedge I=113°\ 37'$, $O \wedge 1\text{-}i=125°\ 31'$, $O \wedge 1=121°\ 4'$, $I \wedge i\text{-}\grave{2}=160°\ 54'$, $i\text{-}\grave{2} \wedge i\text{-}\grave{2}=98°\ 16'$, $\tfrac{2}{3}\text{-}\grave{i} \wedge \tfrac{2}{3}\text{-}\grave{i}=141°$, $O \wedge \tfrac{2}{3}\text{-}\grave{i}=160°\ 30'$; I and $i\text{-}\grave{2}$ vertically striated. Cleavage parallel to I. Crystals usually small. Often in reniform and botryoidal shapes, consisting of globules with a crystalline surface.

542



H.=2—2·5. G.=2·039. Lustre vitreous. Color deep hyacinth-red; massive varieties sometimes ochre-yellow; streak ochre-yellow, a little shining. Translucent. Taste slightly astringent.

Comp.—? $\dot{\mathrm{F}}\mathrm{e}^3\,\dddot{\mathrm{S}}^2 + 3\,\mathrm{\overline{F}e}\,\dddot{\mathrm{S}}^2 + 36\,\dot{\mathrm{H}}$, Berz., $=(\tfrac{1}{4}\,\dot{\mathrm{F}}\mathrm{e}^3 + \tfrac{3}{4}\,\mathrm{\overline{F}e})\,\dddot{\mathrm{S}}^2 + 9\,\dot{\mathrm{H}}$=Sulphate of protoxyd of iron 19·0, id. of sesquioxyd 48·3, water 32·7=100. Analyses: Gahn & Berzelius (l. c.):

	$\dddot{\mathrm{S}}$	$\mathrm{\overline{F}e}$	$\dot{\mathrm{M}}\mathrm{g}$	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\mathrm{H}}$
1.	36·53	26·50	5·69	2·76	
2.	37·87	24·77	8·95	0·91	
3.		25·45	6·92		30·90

from which he deduces, without having determined directly the protoxyd of iron:

	$\dot{\mathrm{F}}\mathrm{e}\,\dddot{\mathrm{S}}$	$\dot{\mathrm{F}}\mathrm{e}\,\mathrm{\overline{F}e}\,\dddot{\mathrm{S}}$	$\dot{\mathrm{M}}\mathrm{g}\,\dddot{\mathrm{S}}$	$\dot{\mathrm{C}}\mathrm{a}\,\dddot{\mathrm{S}}$	$\dot{\mathrm{H}}$ and loss.
1.	6·77	35·85	26·88	2·22	28·28=100.
2.	6·85	39·92	17·10	6·71	31·42=100.
3.	48·3		20·8	—	30·9=100.

The sulphates of magnesia and lime are rejected as impurity, but with how much propriety is uncertain.

Pyr., etc.—B.B. intumesces and gives off water, producing a reddish-yellow earth. On charcoal becomes magnetic; with soda gives a hepatic mass. Remains unaltered if kept dry, but in a moist atmosphere it becomes covered with a dirty yellowish powder. Partly soluble in boiling water, leaving an ochreous residue.

Obs.—Occurs at the copper mine of Fahlun, in Sweden, coating gypsum or pyrite.

Named from βότρυς, *a bunch of grapes*, and γεννάω, *I make*. This last part of the name is bad, and is well thrown aside by Glocker, who makes it *botryte; botryite* would be more correct.

---

688. ALUMINITE. Reine Thonerde (fr. Halle) *Wern.*, Ueb. Cronstedt, 176, 1780. Native Argill *Kirwan*, Min., i. 175. Aluminit *C. C. Haberle*, Der Mineralreich, etc., 1807; *Karst.*, Tab, 48, 1808. Hallite *Delameth.*, Min., ii. 1812. Websterite *Levy*, in Brooke, 1823. Hydrosulphate d'alumine, Websterite, *Beud.*, Tr., 449, 1824.

Reniform, massive; impalpable.

H.=1–2. G.=1·66. Lustre dull, earthy. Color white. Opaque. Fracture earthy. Adheres to the tongue; meagre to the touch.

Comp.—$\ddot{\bar{\text{A}}}\text{l}\,\dddot{\text{S}}+9\,\dot{\text{H}}$=Alumina 29·8, sulphuric acid 23·2, water 47·0=100. Analyses: 1, Stromeyer (Unters., 99); 2, Schmid (J. pr. Ch., xxxii. 495); 3, 4, Stromeyer (l. c.); 5, Dufrénoy (Min., ii. 1845, 366); 6, Dumas (ib.):

	$\dddot{\text{S}}$	$\ddot{\bar{\text{A}}}\text{l}$	$\dot{\text{H}}$
1. Halle	23·365	29·263	46·372=100 Stromeyer.
2. "	23·25	29·23	46·34, $\dot{\text{C}}$a 1·18=100 Schmid.
3. Morl, near Halle	23·68	30·98	45·34=100 Stromeyer.
4. Newhaven	28·37	29·87	46·76=100 Stromeyer.
5. Lunel Vieil	23·45	29·72	46·80=99·97 Dufrénoy
6. Auteuil	23	30	47=100 Dumas.

Pyr., **etc.**—In the closed tube gives much water, which, at a high temperature, becomes acid from the evolution of sulphurous and sulphuric acids. B.B. infusible. With cobalt solution a fine blue color. With soda on charcoal a hepatic mass. Soluble in acids.

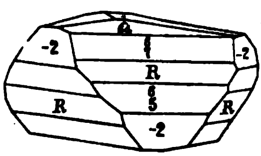
Obs.—Occurs in connection with beds of clay in the Tertiary and Post-tertiary formations.

First found in 1730 in the Garden of the Pædagogium at Halle; afterward suspected to be an artificial product, from a manufactory near by; subsequently found elsewhere in the plastic clay of the region, and proved to be native. Since discovered by Mr. Webster at Newhaven. Sussex, in reniform and botryoidal concretions, imbedded in ferruginous clay, which rests on the chalk strata; also under similar circumstances at Epernay, in Lunel Vieil, and Auteuil, in France.

689. ALUNITE. Alumen de Tolpha, quod primum fossum est in Italia, Pii 2di Pontificis temporibus (Piccolomini, 1458–1464), *Gesner*, Foss., 13, 1565. Romersk Alunsten *Wall.*, Min., 163, 1747. Alaunstein (fr. Tolfa) *Wern.*, Bergm. J., 376, 1789. Alumstone. Aluminilite *Delameth.*, T. T., ii. 113, 1797. Alun de Rome pt. *H.*, Tr., 1801. Pierre alumineuse de la Tolfa *Fr.* Alunite *Beud.*, 449, 1824. Alaun-Spath *Breith.*, Char., 1823.

Rhombohedral. $R \wedge R=89° 10'$, $O \wedge R=124° 40'$, Breith.; $a=1·2523$. Observed planes: R, O, and the rhombohedrons $\frac{6}{7}$, $\frac{1}{64}$, $-\frac{6}{5}$, and -2, Breith.

543



$O \wedge 2=109° 4'$ $O \wedge \frac{1}{64}=178° 42'$

$O \wedge \frac{6}{5}=119\ 57$ $\frac{6}{5} \wedge \frac{6}{5}=82\ 26$

$O \wedge \frac{6}{7}=128\ 55$ $2 \wedge 2=70\ 8$

Cleavage: basal nearly perfect; R indistinct. Also massive, having a fibrous, granular, or impalpable texture.

H.=3·5–4. G.=2·58–2·752. Lustre of R vitreous, basal plane somewhat pearly. Color white, sometimes grayish or reddish. Streak white. Transparent—subtranslucent. Fracture flat conchoidal, uneven; of massive varieties splintery; and sometimes earthy. Brittle.

Comp., Var.—(*a*) Crystallized. (*b*) Fibrous, concretionary. (*c*) Massive, and moderately tender. (*d*) Hard, mainly from disseminated silica, which impurity sometimes amounts to 60 p. c. (*e*) Cavernous.

O. ratio for $\dot{R}$, $\dddot{\bar{R}}$, $\dddot{S}$, $\dot{H}$=1 : 9 : 12 : 6. Formula, as usually written, $\dot{K}\dddot{S}+3\dddot{\bar{A}}l\dddot{S}+6\dot{H}$; or, making one-third of the water basic, $(\dot{K}, \dot{H})^3\dddot{S}+3\dddot{\bar{A}}l\dddot{S}+4\dot{H}$=Sulphuric acid 38·53, alumina 37·13, potash 11·34, water 13·00=100. But A. Mitscherlich, in view of the results of its decomposition after heating (J. pr. Ch., lxxxiii. 465), it affording alum, which water will remove, and hydrated alumina, holds that the formula should be $\dot{K}\dddot{S}+\dddot{\bar{A}}l\dddot{S}^3+2\dddot{\bar{A}}l\dot{H}^3$, making it a compound of anhydrous alum and gibbsite.

Analyses: 1, Cordier (Ann. d. M., v. 203); 2, Mitscherlich (J. pr. Ch., lxxxiii. 464); 3, Rammelsberg (l. c.); 4, Mitscherlich (l. c., and ZS. G., xiv 254); 5, Berthier (l. c.); 6, C. Descotils (Ann. d. M., i. 319); 7, Sauvage (ib., IV. x. 85); 8, Cordier (ib., iv. 205); 9, Fridau (Ann. Ch. Pharm., lxxvi. 106):

	$\dddot{S}$	$\dddot{\bar{A}}l$	$\dot{C}a$	$\dot{N}a$	$\dot{K}$	$\dot{H}$
1. Tolfa, *cryst.*	35·50	39·65	—	—	10·02	[14·83]=100 Cordier.
2. " "	38·63	36·83	0·70	1·84	8·99	12·68, $\dot{B}a$ 0·29=99·96 Mitsch.
3. Muzsai, Hung. (½)	39·54	37·13	—	—	10·67	12·66=100 Ramm.
4. " "	36·93	39·01	0·49	—	10·67	[12·71], $\dot{B}a$ 0·19 Mitsch.
5. Bereghszasz, Hung.	39·42	37·95	—	—	10·66	11·97=100 Berthier.
6. Tuscany	35·6	40·0	—	—	13·8	10·6=100 Descotils.
7. Milo	38·27	37·04	—	—	11·60	13·09=100 Sauvage.
8. Mt. Dore	39·1	46·5	—	—	8·5	5·9=100 Cordier.
9. Styria	35·3	40·8	—	—	8·5	15·4=100 Fridau.

From analysis 3, $\dddot{S}i$ 26·88 is excluded as impurity; from 5, $\dddot{S}i$ 26·5, $\dddot{\bar{F}}e$ 4·0, are excluded; from 7, $\dddot{S}i$ 19·0; from 8, $\dddot{S}i$ 28·40, $\dddot{\bar{F}}e$ 1·44. No. 11, by Fridau, as published in full, is $\dddot{S}i$ 50·71, $\dddot{S}$ 16·50, $\dddot{\bar{A}}l$ 19·06, $\dddot{\bar{F}}e$ 1·13, $\dot{K}$ 3·97, $\dot{H}$ 7·23, $\dot{C}a$ 0·56, $\dot{M}g$ 0·41, $\dot{K}$, $\dddot{S}i$ 0·81, $\dot{M}g\dddot{S}$ 0·09, Mg Cl 0·03=100.

For analysis of impure A. from Pic de Sancy, by J. Gautier-Lacroze, see C. R., lvii. 862.

Pyr., etc.—B.B. decrepitates, and is infusible. In the closed tube yields water, sometimes also sulphate of ammonia, and at a higher temperature sulphurous and sulphuric acids. Heated with cobalt solution affords a fine blue color. With soda and charcoal infusible, but yields a hepatic mass. Soluble in sulphuric acid.

Obs.—Forms seams in trachytic and allied rocks, where it has been formed as a result of the alteration of the rock by means of sulphurous vapors.

Met with at Tolfa, near Civita Vecchia, in the neighborhood of Rome, in crystals; at Montioni in Tuscany; at Muzsai and Bereghszasz in Hungary; on Milo, Argentiera, and Nevis, Grecian Archipelago; and at Mt. Dore, France.

The compact varieties from Hungary are so hard as to admit of being used for millstones. Alum is obtained from it by repeatedly roasting and lixiviating, and finally crystallizing by evaporation.

This species was first observed at Tolfa, near Rome, in the 15th century, by J. de Castro, a Genoese, who had been engaged in the manufacture of alum, from an alum-stone or "Rock-alum" found near Edessa in Syria. It was named *Aluminilite* by Delametherie in 1797, a long name well changed to *Alunite* by Beudant in 1824.

690. LÖWIGITE. Alaunstein *Römer*, ZS. G., viii. 246, 1856. Löwigit *A. Mitscherlich*, J. pr. Ch., lxxxiii. 474, 1861.

In rounded masses, similar to compact alunite.

H.=3–4. G.=2·58. Lustre feeble. Color pale straw-yellow. Slightly subtranslucent. Fracture perfectly conchoidal.

Comp.—O. ratio 1 : 9 : 12 : 9=$\dot{K}\dddot{S}+3\dddot{\bar{A}}l\dddot{S}+9\dot{H}$=Sulphuric acid 36·2, alumina 34·8, potash 10·7, water 18·3=100; or alunite with 9 $\dot{H}$ in place of 6 $\dot{H}$. Analyses: 1, Löwig (ZS. G., viii. 247); 2, 3, A. Mitscherlich (l. c.); 4, Rammelsberg (Min. Ch., 289); 5, Berthier (Ann. d. M., IV. ii. 459):

	$\dddot{S}$	$\dddot{\bar{A}}l$	$\dddot{\bar{F}}e$	$\dot{M}g$	$\dot{C}a$	$\dot{N}a$	$\dot{K}$	$\dot{H}$
1. Silesia	34·84	33·37	—	—	—	—	10·10	[18·32], org., $\dddot{S}i$ 3·37=100 Löwig.
2. "	34·81	34·95	0·68	0·55	0·28	0·39	9·30	[17·88], $\dot{B}a$ 0·44, org., $\dddot{S}i$ 0·73=100 M

	$\dddot{S}$	$\dddot{\overline{Al}}$	$\dot{K}$	$\dot{H}$
3. Tolfa	37·86	36·01	9·63	16·50=100[a] Mitscherlich.
4. " *cryst.*	36·94	34·02	10·38	16·72, $\dddot{Si}$ 1·94=100 Rammelsberg.
5. " "	37·67	34·69	10·58	17·06=100 Berthier.

[a] 0·07 organic substance, 8·21 silica, and 28·59 earthy matters removed.

Pyr., etc.—B.B. nearly like alunite. The water is expelled at a lower temperature than in alunite; and the compound resulting after heating, instead of containing a mixture affording alum and insoluble hydrated alumina, affords to water sulphate of potash and subsulphate of alumina. Mitscherlich hence writes for it the above formula, instead of one like his for alunite. Partially soluble in muriatic acid, while alunite is not at all so.

Obs.—Found in a coal bed at Tabrze in Upper Silesia, in compact lumps, having the lustre, color, and texture of the Solenhofen lithographic stone, but blackish externally from a coaly crust; also with alunite at Tolfa.

According to Rammelsberg's analysis, part at least of the crystallized alunite has the composition of löwigite.

691. JAROSITE. Gelbeisenerz *Ramm.*, Pogg., xliii. 132, 1838. Misy *Haid.*, Handb., 512, 1845. Vitriolgelb, Gelbeisenerz, *Hausm.*, Handb., 1205, 1847 [not Gelbeisenerz fr. Harz *Breith.*, Char., 1832]. Jarosit *Breith.*, B. H. Ztg., 1852. Moronolite *Shep.*, Suppl. Append. Min., p. iv. 1857.

Rhombohedral. $R \wedge R = 88° 58'$; $O \wedge R = 124° 32'$; $a = 1·2584$. Cleavage: basal. Also fibrous, and granular massive. Also in nodules, or as an incrustation with a tuberose or coralloidal surface.

H.=2·5–3·5. G. of crystallized 3·24–3·26; of nodular 2·6–2·9. Lustre a little shining to dull. Color ochre-yellow; streak yellow, shining. Opaque.

Var., Comp.—(1) *Crystallized; Jarosite*, which occurs also fibrous and granular; G.=3·256, fr. Spain; 3·244, fr. Maryland, Breith. (2) *Concretionary*, the ordinary form of the Norway and Bohemian mineral, and the *moronolite* of Orange Co., N. Y.; G.=2·62 (moronolite)—2·79.

O. ratio for $\dot{R}$, $\dddot{\overline{R}}$, $\dddot{S}$, $\dot{H}$=1 : 12 : 15 : 9, Ramm.; $(\dot{K}, \dot{Na})\,\dddot{S} + 4\,\dddot{\overline{Fe}}\,\dddot{S} + 9\,\dot{H}$, Ramm. For jarosite, Ferber deduces 1 : 15 : 18 : 10, differing mainly in a little less of alkali. Richter's analysis of it was imperfect. It is isomorphous with alunite, which would suggest the ratio 1 : 9 : 12 : 6, which also differs mainly in the proportion of protoxyd. Analyses: 1, Rammelsberg (l. c.); 2, Scheerer (Pogg., xlv. 188); 3, J. H. Ferber (B. H. Ztg., xxiii. 10); 4, Tyler (Am. J. Sci., II. xli. 212):

	$\dddot{S}$	$\dddot{\overline{Fe}}$	$\dot{Na}$	$\dot{K}$	$\dot{H}$
1. Kolosoruk, *Gelbeis.*	32·11	46·73	——	7·88	13·56, $\dot{Ca}$ 0·64=100·92 Rammelsberg.
2. Modum, "	32·45	49·63	5·20	——	13·11=100·39 Scheerer.
3. Spain, *Jarosite*	31·76	49·24	0·80	5·90	11·35, $\dddot{\overline{Al}}$ 1·25=100·33 Ferber.
4.[a] Monroe, N. Y., *Moron.*	34·17	46·89	3·81		13·18, $\dddot{\overline{Al}}$ 0·83, $\dot{Ca}$ 1·10=99·98 Tyler.

[a] Result after subtracting 1·53 "hygr. water" and 11·17 insol.

Pyr., etc.—Nearly as for coquimbite.

Obs.—The original of this species was from Luschitz, between Kolosoruk and Bilin, Bohemia, in brown coal; and later from Modum, Norway, in alum slate.

The jarosite was from Barranco Jaroso, in the Sierra Almagrera, Spain, on limonite; also, according to Breithaupt (B. H. Ztg., xxv. 149), from Maryland, of granular form, with quartz and a magnetite altered to hematite; Mexico; Saxony, Thekla mine, near Hauptmanngrün in Voigtland, in small crystals on turgite (hydrohematite) and limonite; Erzgebirge, near Schwarzenberg, at the Frisch Glück mine. It is isomorphous with beudantite.

Moronolite is from Monroe, N. Y., where it occurs on gneiss. It contains less alkali than is required for the formula. Named *moronolite* from *μωρον*, *mulberry*, alluding to a resemblance to the mulberry calculus.

Erusibite Shepard (Rep. Mt. Pisgah Copper Mine, N. Haven, 1859; Am. J. Sci., II. xxviii. 129, 1859) is a "rusty insoluble ferric sulphate" of undetermined nature. His *copperasine* (ib.) is announced as a "hydrous cuprous and ferric sulphate," from the same place. His *leucanterite* (ib.) is an efflorescence on the copperasine. These are names without descriptions.

692. CARPHOSIDERITE. Karphosiderit *Breith.*, Schw. J., l. 314, 1827.

In reniform masses, and incrustations.

H.=4—4·5. G.=2·49—2·5, Breith.; 2·728, Pisani. Lustre resinous Color pale and deep straw-yellow. Streak yellowish. Feel greasy.

Comp.—O. ratio for $\bar{R}$, $\dddot{S}$, $\dot{H}$=1 : 1·28 : 1·08; if a fourth of the water is basic $(\frac{3}{4}\bar{F}e+\frac{1}{4}\dot{H}^3)$ $\dddot{S}+2\dot{H}$=Sulphuric acid 31·4, sesquioxyd of iron 50·2, water 18·4=100. Analyses: 1, Pisani (C. R., lviii. 242, J. pr. Ch., xcii. 376); 2, same, after removing impurities:

	$\dddot{S}$	$\bar{F}e$	$\dot{\bar{M}}n$	$\dot{H}$	Sand	Gypsum
1.	25·52	40·00	*tr.*	10·67	14·78	9·03=100.
2.	31·82	49·88	——	18·30	——	——=100.

Supposed by Harkort (l. c.), after blowpipe trials, to be a hydrous phosphate; but shown by Pisani's analysis of an original specimen to be a sulphate.

Pyr., etc.—B.B. nearly like copiapite. Insoluble in water.

Obs.—Occurs in fissures in mica slate, and was first distinguished by Breithaupt among some specimens which he says were from Labrador. Pisani's specimens were from the Kölburg collection in Paris, and were labelled Greenland, most probably the true locality.

The name alludes to the color, and is from κάρφος, *straw*, σίδηρος, *iron*.

---

693. PARALUMINITE. Paraluminit *Steinberg*, J. pr. Ch., xxxii. 495, 1844.

Massive, and like aluminite. White to pale yellow.

Comp.—$\bar{A}l^2\dddot{S}+15\dot{H}$=Sulphuric acid 14·4, alumina 37·0, water 48·6=100.

Analyses: 1–6, Schmid, Martens, Marchand, Wolff, Backs (J. pr. Ch., xxxii. xxxiii.); 7, Dieck (ZS. nat. Ver. Halle, xiii. 265); 8, Berthier (Mem., 1839, 288):

	$\dddot{S}$	$\bar{A}l$	$\dot{H}$
1. South of Halle	14·54	36·17	49·03=99·74 Schmid.
2. " "	14·04	35·96	50·00=100 Martens.
3. " "	17·0	36·0	47·2=100·2 Marchand.
4. " "	12·44	38·81	47·07, $\dot{C}a\ddot{C}$ 1·68=100 Wolff.
5. " "	12·22	37·71	49·18, $\dot{C}a\ddot{C}$ 1·00=100·11 Backs.
6. " "	11 45	39·50	48·80=99·75 Marchand.
7. " "	15·56	36·54	46·89=98·99 Dieck.
8. Huelgoet	13·37	43·00	43·63=100 Berthier.

Another analysis of the mineral from Presslers mountain, near Halle, afforded Geist (ZS. Nat. Ver. Halle, xiii. 268) $\dddot{S}$ 22·18, $\bar{A}l$ 39·86, $\dot{H}$ 34·91 by loss, $\ddot{S}i$ 1·92, $\bar{F}e$ 0·40, $\dot{C}a$ 0·50, $\dot{M}g$ 0·03. For a similar mineral from Bernon, near Epernay, France, Lassaigne obtained (Ann. Ch. Phys., xxix. 98) $\dddot{S}$ 20·06, $\bar{A}l$ 39·70, $\dot{H}$ 39·94, gypsum 0·30=100.

Pyr., etc.—Nearly as for aluminite.

Obs.—Similar in its modes of occurrence to aluminite. Found in Presslers mountain (anal. 7) and elsewhere, near Halle, and Huelgoet in Brittany.

694. PISSOPHANITE. Pissophan *Breith.*, Char., 101, 1832. Garnsdorfite.

Amorphous, or stalactitic, somewhat pitch-like in appearance.

H.=1·5. G.=1·93—1·98. Lustre vitreous. Color pistachio-, asparagus-, or olive-green. Transparent. Very fragile. Fracture conchoidal.

Comp.—Erdmann (Schw. J., lxii. 104) obtained:

	$\dddot{S}$	$\dddot{\overline{Al}}$	$\dddot{\overline{Fe}}$	$\dot{H}$		
1. *Green*	12·70	35·15	9·74	41·69,	gangue and loss	0·72=100.
2. "	12·49	35·30	9·80	41·70	"	0·71=100.
3. *Yellow*	11·90	6·80	40·06	40·13	"	1·11=100.

Probably not a simple mineral. Perhaps Nos. 1 and 2, $\dddot{\overline{R}}^2\dddot{S}+15\dot{H}$, and No. 3, $\dddot{\overline{R}}^2\dddot{S}+15\dot{H}$ The relation in the former is more exactly $\dddot{\overline{R}}^5\dddot{S}^3+30\dot{H}$.

Pyr., etc.—For the most part insoluble in water. Easily soluble in muriatic acid. B.B becomes black. In a glass tube gives alkaline water.

Obs.—Occurs at Garnsdorf, near Saalfeld, and at Reichenbach, Saxony, on alum slate.

Named from πισσα, *pitch*, and φανός, *appearance*.

695. FELSOBANYITE. Felsöbanyt *Haid.*, Ber. Ak. Wien, 1852, xii. 183, 1854.

Orthorhombic. Massive, and in concretions, grouped or single, consisting of scales, which are hexagonal, and have two angles of 112°. Cleavage perfect. Optically biaxial.

H.=1·5. G.=2·33. Lustre of cleavage-face pearly. Color snow-white, surface often yellowish. Translucent to subtransparent.

Comp.—$\dddot{\overline{Al}}^2\dddot{S}+10\dot{H}$=Sulphuric acid 17·2, alumina 44·1, water 38·7=100. Analysis: v. Hauer (Ber. Ak. Wien, xii. 188):

(½) $\dddot{S}$ 16·47 $\dddot{\overline{Al}}$ 45·53 $\dot{H}$ 37·27=99·27 Hauer.

Pyr., etc.—Nearly as for aluminite.

Obs.—From Kapnik near Felsöbanya in Hungary, the concretions sometimes grouped on barite.

696. GLOCKERITE. Vitriolocker *Berz.*, Afh., v. 157, 1816. Fer sous-sulfaté terreux *Berz.*, N. Min. Syst., 1819. Vitriol Ochre. Pittizite *Beud*, Tr., 447, 1824. Glockerit *Naum.*, Min 254, 1855.

Massive, sparry or earthy. Stalactitic.

Lustre resinous or earthy. Color brown to ochre-yellow, also brownish black to pitch-black; dull green. Streak ochre-yellow to brown. Opaque to subtranslucent. Fracture shining to earthy.

Comp., Var.—$\dddot{\overline{Fe}}^2\dddot{S}+6\dot{H}$, Berzelius, for a brown to ochre-yellow variety, occurring with botryogen at Fahlun, containing according to him, Sulphuric acid 15·9, sesquioxyd of iron 62·4, water 21·7=100.

The same for a stalactitic variety from Obergrund, near Zuckmantel, the stalactites of which are sometimes 2 feet long, brown to pitch-black, yellowish-brown, and dark green in color, with yellowish-brown to ochre-yellow streak, shining lustre to earthy, and insoluble in water. It is the *Glockerite* of Naumann, who cites Hochstetter's analysis, $\dddot{S}$ 15·19, $\dddot{\overline{Fe}}$ 64·34, $\dot{H}$ 20·7, agreeing closely with that by Berzelius.

Jordan obtained for a compact and earthy vitriol ochre from Rammelsberg mine near Goslar (J pr. Ch., ix. 95), and Scheerer for another from Modum, Norway (Pogg., xlv. 188):

	$\dddot{S}$	$\dddot{\overline{Fe}}$	$\dot{H}$
1. Goslar, *compact*	13·59	63·85	18·46, $\dot{Zn}$ 1·23, $\dot{Cu}$ 0·87, gangue 2·00=100 Jordan.
2. " *earthy*	9·80	68·75	15·52, $\dot{Zn}$ 1·29 $\dot{Cu}$ 0·50, gangue 4·14=100 Jordan.
3. Modum, *brown*	6·00	80·78	13·57=100 Scheerer.

Pyr., etc.—Nearly as for copiapite.

Obs.—A result of the alteration of pyrite or marcasite.

Glockerite was named after the mineralogist E. F. Glocker. Pitticite is the name of pitchy iron ore, q. v.

697. LAMPROPHANITE. Lamprophan *Igelström*, Œfv. Ak. Stockh., 1866, 93.

In thin cleavable folia.

H.=3. G.=3·07. Lustre pearly. Color and streak white.

Comp.—An analysis afforded Igelström (l. c.):

$\dddot{S}$	$\dot{P}b$	$\dot{M}n$	$\dot{M}g$	$\dot{C}a$	$\dot{N}a$, $\dot{K}$	$\dot{H}$
11·17	28·09	7·90	5·26	24·65	14·02	8·35=99·35.

Pyr., etc.—Yields water. With soda on charcoal yields metallic lead and a hepatic mass Not wholly soluble in acids.

Obs.—From Longban in Wermland, Sweden. Named in allusion to the lustre from λαμπρός, *shining*.

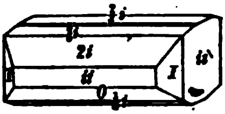
---

700. LINARITE. Linarite *Brooke*, Ann. Phil., II. iv. 117, 1822. Cupreous Sulphate of Lead, Cupreous Anglesite. Bleilasur, Kupferbleispath, *Germ.*

Monoclinic. $C=77°\ 27'$; $I \wedge I$, over *i-i*,$=61°\ 36'$, $O \wedge$ 1-*ì*$=141°\ 5'$, $a:b:c=0{\cdot}48134:1:0{\cdot}5819$. Observed planes: *O*; vertical, *i-i*, *I*, *i-ì*, *i*-2; hemidomes, $\frac{1}{8}$-*i*, $\frac{2}{3}$-*i*, $\frac{5}{6}$-*i*, 1-*i*, $\frac{4}{3}$-*i*, 2-*i*, $\frac{5}{2}$-*i*, 7-*i*; –1-*i*; clinodomes, 1-*ì*, $\frac{1}{2}$-*ì*; hemipyramids, 2, 2-2, $\frac{8}{3}$-$\frac{4}{3}$, $\frac{8}{7}$-8. Fig. 544. Plane *i-ì* often wanting.

$O \wedge$ *i-i*$=102°\ 33'$	$O \wedge$ *i-ì*$=90°$
$O \wedge$ 1-*i*$=152\ \ 19$	$O \wedge \frac{1}{2}$-*ì*$=158\ \ 1$
$O \wedge$ –1-*i*$=156\ \ 57\frac{1}{2}$	*i-i* $\wedge$ 1-*i*$=105\ \ 8$
$O \wedge \frac{2}{3}$-*i*$=161\ \ 23\frac{1}{2}$	*i-i* $\wedge$ –1-*i*$=125\ \ 35\frac{1}{2}$
$O \wedge$ 2-*i*$=130\ \ 5$	*i-i* $\wedge$ 2-*i*$=127\ \ 22$
$O \wedge \frac{1}{8}$-*i*$=176\ \ 36$	*i*-2 $\wedge$ *i*-2, ov. *i-i*,$=100\ \ 1$
$O \wedge \frac{5}{6}$-*i*$=156\ \ 48$	$I \wedge$ 2-2$=137\ \ 1$
$O \wedge I=96\ \ 23$	$I \wedge 2=159\ \ 9$

544



Twins: composition-face *i-i* common; $O \wedge O'=154°\ 54'$. Cleavage: *i-i* very perfect; *O* less so.

H.=2·5. G.=5·3–5·45. Lustre vitreous or adamantine. Color deep azure-blue. Streak pale blue. Translucent. Fracture conchoidal. Brittle.

Comp.—O. ratio for $\dot{C}u$, $\dot{P}b$, $\dddot{S}$, $\dot{H}=1:1:3:1$, whence $\dot{P}b\,\dddot{S}+\dot{C}u\,\dot{H}$; or, if $\dot{H}$ be basic, for base and acid $1:1=(\frac{1}{3}\dot{C}u+\frac{1}{3}\dot{P}b+\frac{1}{3}\dot{H})^3\dddot{S}$. It seems to be an objection to the first formula that there is no near isomorphism with any sulphate of lead, while there is with cyanosite or sulphate of copper.

Analyses: 1, Brooke (l. c.); 2, Thomson (Phil. Mag., III. xvii. 402); 3, v. Kobell (J. pr. Ch., lxxxiii. 454):

	$\dot{P}b\dddot{S}$	$\dot{C}u$	$\dot{H}$
1. Wanlockhead	75·4	18·0	4·7=98·1 Brooke.
2. “	74·8	19·7	5·5=100 Thomson; G.=5·2137.
3. Kadainski	76·41	17·43	6·16, Cl *tr.*=100 Kobell.

Pyr., etc.—In the closed tube yields water and loses its blue color. B.B. on charcoal fuses easily to a pearl, and in R.F. is reduced to a metallic globule which by continued treatment coats the coal with oxyd of lead, and if fused boric acid is added yields a pure globule of copper. With soda gives the reaction for sulphuric acid. Decomposed with nitric acid, leaving a white residue of sulphate of lead.

Obs.—Formerly found at Leadhills. Occurs at Roughten Gill, Red Gill, and near Keswick, in Cumberland, in crystals sometimes an inch long; near Schneeberg, rare; in Dillenburg, at the mines Aurora and Thomas; Nassau on the Lahn; at Retzbanya; at the Kadainski mine in

Nertschinsk; and in the vicinity of Beresof in the Ural; and supposed formerly to be found at Linares in Spain, whence the name.

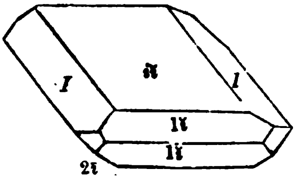
Alt.—Linarite occurs altered to cerussite, a change like that of anglesite to cerussite.

For recent obs. on cryst., B. & M., Min.; Greg & Lettsom, Min., 395, 1858; Kokscharof, Min. Russl., iv. 139, v. 106; Hessenberg, Min. Not., No. vii., from whom the above angles are taken; K. Peters, Ber. Ak. Wien, xliv. 168.

701. BROCHANTITE. Brochantite (fr. Katharinenb.) *Levy*, Ann. Phil., II. viii. 241, 1824 Konigine (fr. Russia) *Levy*, ib., xi. 194, 1826. Brongnartine (fr. Mexico) *Huot*, Min., i. 331, 1841. Krisuvigit (fr. Iceland) *Forchhammer*, Skand. Nat. Stockh., 1842, Arsb. 1843, 192 Warringtonite (fr. Cornwall) *Maskelyne*, Ch. News, x. 263, 1864, Phil. Mag., IV. xxix. 475.

Orthorhombic. $I \wedge I = 104° 32'$, $O \wedge 2\text{-}\bar{i} = 147° 49'$; $a : b : c = 0·31471 : 1 : 1·2923$. Observed planes: vertical, I, $i\text{-}\breve{i}$, $i\text{-}\breve{2}$; domes, $1\text{-}\breve{i}$, $2\text{-}\bar{i}$. Fig. 545; also prisms made of I and $i\text{-}\breve{2}$, and dome $1\text{-}\breve{i}$ without $i\text{-}\breve{i}$, the form resembling f. 542, p. 657, excepting the absence of O, this plane not having been observed.

545



$i\text{-}\breve{2} \wedge i\text{-}\breve{2}$, ov. $i\text{-}\breve{i}, = 114° 16'$
$1\text{-}\breve{i} \wedge 1\text{-}\breve{i} = 152\ 37$
$2\text{-}\bar{i} \wedge 2\text{-}\bar{i}$, ov. $O, = 115\ 38$
$i\text{-}\breve{i} \wedge i\text{-}\breve{2} = 147\ 8$
$i\text{-}\breve{i} \wedge I = 127\ 44$
$i\text{-}\breve{i} \wedge 1\text{-}\breve{i} = 103\ 41$

Also in groups of acicular crystals and drusy crusts. Cleavage: $i\text{-}\breve{i}$ very perfect; I in traces. Also massive; reniform with a columnar structure.

H.=3·5—4. G.=3·78—3·87, Magnus; 3·9069, G. Rose. Lustre vitreous; a little pearly on the cleavage-face $i\text{-}\breve{i}$. Color emerald-green, blackish-green. Streak paler green. Transparent—translucent.

Var.—1. *Ordinary Brochantite.* The analyses vary considerably, as shown below. The crystals are vertically striated.

2. *Warringtonite.* Essentially brochantite in composition, but occurring in non-striated crystals in form like a doubly curving wedge, of paler green color than ordinary brochantite, with G.= 3·39—3·47, and H.=3—3·5.

Comp.—O. ratio for $\dot{C}u$, $\dddot{S}$, $\dot{H}$=7 : 6 : 5; $\dot{C}u\,\dddot{S} + 2\tfrac{1}{2}\,\dot{C}u\,\dot{H}$; or perhaps $2\,\dot{C}u^3\,\dddot{S} + \dot{C}u\,\dot{H} + 4\,\dot{H}$; =Sulphuric acid 19·9, protoxyd of copper 69·0, water 11·1=100. Some analyses correspond to the O. ratio 4 : 3 : 3; and Field's to 4 : 3 : 4, the ratio of langite. Analyses: 1, 2, Magnus (Pogg., xiv. 141); 3, Forchhammer (J. pr. Ch., xxx. 396); 4, Berthier (Ann. Ch. Phys., l. 360); 5, H. Risse (Pogg., cv. 614); 6, Pisani (C. R., lix. 912); 7, Warrington (J. Ch. Soc., II. iii. 85); 8, Maskelyne (Phil. Mag., IV. xxix. 475); 9, Tschermak (Ber. Ak. Wien, li. 131); 10, Field (Phil. Mag., IV. xxiv. 123); 11, v. Kobell (Ber. Ak. München, 1865, ii. 70); 12, Domeyko (Ann. d. M., VI. v. 460):

	$\dddot{S}$	$\dot{C}u$	$\dot{Z}n$	$\dot{P}b$	$\dot{H}$
1. Retzbanya	17·132	62·626	8·181	0·030	11·887=99·856 Magnus.
2. "	17·426	66·935	8·145	1·048	11·917=100·471 Magnus.
3. *Krisuvigite*	18·88	67·75	——	——	12·81=99·44 Forchhammer.
4. Mexico	16·6	66·2	——	——	17·2=100 Berthier.
5. Nassau	19·0	67·8	——	——	13·2, Cl *tr.*=100 Risse.
6. Cornwall	17·2	68·8	1·0[a]	——	13·2, $\dot{C}a$ 0·8=101 Pisani.
7. " *Warr.*	18·93	68·27	——	——	12·22[b], insol. 0·58=100 Warrington.
8. " "	16·73	68·24	——	——	14·64=99·61 Maskelyne.
9. N. S. Wales	19·4	69·1	——	——	11·5=100 Tschermak.
10. Chili	16·59	66·94	——	——	16·47=100 Field; G.=3·81.
11. "	19·71	68·87	——	——	[11·42]=100 Kobell.
12. "	15·8	68·5	——	——	13·5, gangue 2·4=100·2 Domeyko

[a] With Fe^2O^3. [b] 1·04 per cent. water lost below 260° C.

The Mexican corresponds to $\dot{C}u^4\,\dddot{S}+4\,\dot{H}$, and is the *Brongnartine* of Huot.

Rivot found in crystals of brochantite of a fine green color, which afforded a slight efforvescence with acids, $\dddot{S}$ 19·4, $\dot{C}u$ 62·9, $\dot{H}$ 13·5, with $\ddot{C}$ 1·2, $\dot{H}$ 1·2=98·2. The mineral had undergone partial alteration as shown by the 6·2 p. c. of carbonate of copper present (Ann. d. M., V. iii. 740).

Pyr., etc.—Yields water, and at a higher temperature sulphuric acid, in the closed tube, and becomes black. B.B. fuses, and on charcoal affords metallic copper. With soda gives the reaction for sulphuric acid.

Obs.—Occurs in small but well defined crystals, with malachite and native copper, at Gumeschevsk and Nischne-Tagilsk in the Ural; the Königine (or *Königite*) was from Gumeschevsk; in small brilliant crystals with malachite in a quartzose rock near Roughten Gill in Cumberland; in Cornwall (in part *warringtonite*), and sometimes with crystals of brochantite on the so-called warringtonite; at Retzbanya; in Nassau, with chalcopyrite; in small beds at Krisuvig in Iceland (*krisuvigite*); in Mexico (*brongnartine*); in Chili at Andacollo (anal. 10); in Australia (brought from Sidney, N.S.W., anal. 9).

Named after Brochant de Villiers.

On cryst., G. Rose, Reis. Ural, i. 267; Kokscharof, Min. Russl., iii. 260. The above angles are from Kokscharof. G. Rose found $I \wedge I$=104° 10', and $1\text{-}\breve{i} \wedge 1\text{-}\breve{i}$=151° 52'. Fig. 545 is from Levy. Kokscharof's figures have not the plane $2\text{-}\bar{i}$, and several are without $i\text{-}\breve{i}$.

Artif.—Formed in a bright green powder by Field (Phil. Mag., IV. xxiv. 123) by adding to a strong solution of sulphate of copper a small quantity of caustic potash, boiling, filtering, and washing till all the sulphate of copper is removed; analysis after drying at 100° C. afforded $\dddot{S}$ 16·98, $\dot{C}u$ 67·51, $\dot{H}$ [15·51]=100, giving the O. ratio 4 : 3 : 4. See further under LANGITE.

702. LANGITE. A new British mineral *N. S. Maskelyne*, Phil. Mag., IV. xxvii. 306, 1864.
Langite *Maskelyne*, Pisani, C. R., lix. 633, 1864, Maskelyne, Phil. Mag., IV. xxix. 473, 1865.
Devilline *Pisani*, C. R., 813, 1864=Lyellite *Maskelyne*, Ch. News, x. 263, 1864.

Orthorhombic. $I \wedge I$=123° 44'; $O \wedge 1\text{-}\bar{i}$=147° 36'; $a : b : c$=0·6346 : 1 : 1·8702. $I \wedge i\text{-}\bar{i}$=118° 8', $O \wedge 2\text{-}\breve{i}$=128° 14'. Cleavage: apparently O and $i\text{-}\breve{i}$. Crystals small and short; simple forms not observed. Twins: composition-face I, and forms like those of aragonite. Also in fibro-lamellar and concretionary crusts, with earthy surface.

H.=2·5—3. G.=3·48—3·50, Maskelyne. Lustre of crystals vitreous; of crusts somewhat silky. Color fine blue to greenish-blue; through $i\text{-}\bar{i}$ blue; through $i\text{-}\breve{i}$ greenish-blue; through O paler greenish-blue. Translucent.

Comp.—O. ratio for $\dot{R}$, $\dddot{S}$, $\dot{H}$=4 : 3 : 4, Pisani; 4 : 3 : 5, Maskelyne. The former gives the formula $\dot{C}u\,\dddot{S}+3\,\dot{C}u\,\dot{H}+\dot{H}$=Sulphuric acid 17·0, oxyd of copper 67·7, water 15·3=100. The latter corresponds to Sulphuric acid 16·4, oxyd of copper 65·1, water 18·5=100. The ratio 4 : 3 : 4 gives also the formula $\dot{C}u^3\,\dddot{S}+\dot{C}u\,\dot{H}+3\,\dot{H}$.

Analyses: 1, Maskelyne (l. c.); 2, Pisani (l. c.); 3–5, A. H. Church and R. Warrington (J. Ch. Soc., II. iii. 87); 6, Tschermak (Ber. Ak. Wien, li. i. 127):

		$\dddot{S}$	$\dot{C}u$	$\dot{C}a$	$\dot{H}$
1.	Cornwall	16·42	65·82	——	18·32=100·56 Maskelyne.
2.	"	16·77	65·92	0·83	16·19, $\dot{M}g$ 0·29=100 Pisani.
3.	"	16·79	67·48	——	15·73=100 Church.
4.	"	16·72	67·31	——	16·25=100·28 Warrington.
5.	"	16·88	67·88	——	15·53=100·29 Warrington.
6.	"	16·2	68·1	0·5	[15·2]=100 Tschermak.

The *devilline* (or *lyellite*), which includes the incrusting variety, is, as Tschermak has shown (l. c.), langite mixed with gypsum, which is apparent in scales. His analysis above was made on the devilline after separating 18 p. c. of gypsum; and he stated that Pisani's analysis of the same (l. c.) indicates the presence of 24 p. c. For an analysis of the *lyellite* by Church see J. Ch. Soc., II. iii. 83.

Pyr., etc.—B.B. on charcoal yields water, acid fumes, and metallic copper. Heated it passes through (1) a bright green color, losing 1 equivalent of water, and then having the O. ratio (4 : 3 : 4) of some brochantite; (2) various tints of olive-green; and (3) becomes black. It has finally a strongly acid reaction.

Obs.—Found in argillaceous schist (killas) in Cornwall, in minute twinned crystals; also as a blue crust, partly earthy. It is associated sometimes with connellite.

Named *langite* after Dr. V. v. Lang, formerly of the British Museum.

The analyses of so-called brochantite by Berthier of a Mexican specimen, and Field of a Chilian, as well as of the artificial mineral, have the same composition assigned by Pisani and Church to the *langite;* and there is yet some uncertainty as to the true limits between the two species. The specimens had the *green* color of brochantite.

703. CYANOTRICHITE. Kupfersammeterz, Kupfersammterz, *Wern.*, Karsten's Tab., 62, 1808. Velvet Copper Ore *Jameson*, Min., iii. 153, 1816. Sammeterz *Breith.*, Char., 168, 1823, 320, 1832. Cuivre velouté *Fr.* Cyanotrichit *Glocker*, Grundr., 587, 1839. Lettsomite *Percy*, Phil. Mag., xxxvi. 103, 1850.

Occurs in druses of short capillary crystals, and having an appearance like velvet; sometimes in spherical globules.

Color clear smalt-blue, sometimes passing into sky-blue. Lustre pearly.

Comp.—O. ratio for $\dot{\mathrm{Cu}}$, $\ddot{\bar{\mathrm{R}}}$, $\dddot{\mathrm{S}}$, $\dot{\mathrm{H}}$, from mean of analyses, 9·03 : 5·48 : 8·85 : 20·50. Taking it at 9 : 6 : 9 : 21, the formula may be $3\,\dot{\mathrm{C}}\mathrm{u}^3\,\dddot{\mathrm{S}}+2\,\ddot{\bar{\mathrm{A}}}\mathrm{l}\,\dot{\mathrm{H}}^3+15\,\dot{\mathrm{H}}$; or $3\,\dot{\mathrm{C}}\mathrm{u}\,\dddot{\mathrm{S}}+2\,\dot{\mathrm{C}}\mathrm{u}^3\,\dot{\mathrm{H}}^3+2\,\ddot{\bar{\mathrm{A}}}\mathrm{l}\,\dot{\mathrm{H}}^3+9\,\dot{\mathrm{H}}=3\,\dot{\mathrm{C}}\mathrm{u}\,\dddot{\mathrm{S}}+4\,(\tfrac{1}{2}\,\dot{\mathrm{C}}\mathrm{u}^3+\tfrac{1}{2}\,\ddot{\bar{\mathrm{A}}}\mathrm{l})\,\dot{\mathrm{H}}^3+9\,\dot{\mathrm{H}}$. Needs further investigation. Analyses: J. Percy (l. c.):

$\dddot{\mathrm{S}}$	$\ddot{\bar{\mathrm{A}}}\mathrm{l}$	$\ddot{\bar{\mathrm{F}}}\mathrm{e}$	$\dot{\mathrm{C}}\mathrm{u}$	$\dot{\mathrm{H}}$
15·39	11·70		43·16	23·06=98·80.
14·12	11·06	1·18	46·59	23·06, insol. 2·55=98·36.

Obs.—Occurs sparingly at Moldawa in the Bannat, coating the cavities of an earthy hydrated oxyd of iron, along with a white amorphous sulphate of alumina.

Named *Cyanotrichite* from κύανος, *blue*, and θρίξ, *hair;* and *Lettsomite* after the English mineralogist, W. G. Lettsom.

704. **WOODWARDITE** *Church*, Ch. News, xiii. 85, 113, 1866, J. Chem. Soc., II. iv. 130. Probably an impure uncrystallized variety of the above, mixed with hydrate of alumina. Occurs in Cornwall, in minute botryoidal concretions, of a rich turquois-blue to greenish-blue color, translucent to almost transparent; G.=2·38. Analyses: 1–3, Church and Warrington (l. c.); 4, Pisani (C. R., lxv. 1142):

		$\dddot{\mathrm{S}}$	$\ddot{\bar{\mathrm{A}}}\mathrm{l}$	$\dot{\mathrm{C}}\mathrm{u}$	$\dot{\mathrm{H}}$
1.	Cornwall	13·95	17·97	48·34	18·48=98·74 Church.
2.	"	13·04	18·64	48·67	[19·65]=100 Warrington.
3.	"	12·54	17·93	46·80	[22·73]=100 Warrington.
4.	"	11·7	13;4	46·8	[26·9], $\ddot{\mathrm{S}}\mathrm{i}$ 1·2=100 Pisani.

Church and Warrington also found traces of silica, lime, magnesia, and phosphoric acid, which were undetermined. The mean of the first 3 analyses affords the O. ratio for $\dot{\mathrm{C}}\mathrm{u}$, $\ddot{\bar{\mathrm{A}}}\mathrm{l}$, $\dddot{\mathrm{S}}$, $\dot{\mathrm{H}}$=11 : 9·6 : 9 : 23; equivalent to $3\,\dot{\mathrm{C}}\mathrm{u}^3\,\dddot{\mathrm{S}}$, $2\,\dot{\mathrm{C}}\mathrm{u}\,\dot{\mathrm{H}}$, $3\,\ddot{\bar{\mathrm{A}}}\mathrm{l}\,\dot{\mathrm{H}}^3$, $12\,\dot{\mathrm{H}}$; or $3\,\dot{\mathrm{C}}\mathrm{u}\,\dddot{\mathrm{S}}$, $8\,\dot{\mathrm{C}}\mathrm{u}\,\dot{\mathrm{H}}$, $3\,\ddot{\bar{\mathrm{A}}}\mathrm{l}\,\dot{\mathrm{H}}^3$, $6\,\dot{\mathrm{H}}$. No. 4, by Pisani, gives about 12 : 9 for the $\dot{\mathrm{C}}\mathrm{u}$ and $\dot{\mathrm{H}}$, the ratio in langite, and he makes the mineral impure *langite.* He analyzed (l. c.) another similar material from Cornwall (received from Mr. Talling), of a clear green color, and obtained $\dddot{\mathrm{S}}$ 4·7, $\ddot{\bar{\mathrm{A}}}\mathrm{l}$ 33·8, $\dot{\mathrm{C}}\mathrm{u}$ 17·4, $\dot{\mathrm{H}}$ 38·7, $\ddot{\mathrm{S}}\mathrm{i}$ 6·7=100·5; showing a mixture of the copper sulphate with a hydrous silicate of alumina as well as hydrate; and this he considers as proving that woodwardite is only a mixture.

The mineral is soluble with scarcely any residue in diluted acids. Named after Dr. S. P. Woodward.

705. JOHANNITE. Uranvitriol *John*, Ch. Unters., V. 254, 1821. Johannit *Haid.*, Abhandl., böhm. Ges. Prag, 1830. Sulphate of Uranium. Sulfate vert d'urane *Beud.*

Monoclinic. $C=85°\ 40'$, $I \wedge I=69°$. Crystals flattened, and from one to three lines in length; arranged in concentric druses or reniform masses.

H.=2–2·5. G.=3·19. Lustre vitreous. Color beautiful emerald-green, sometimes passing into apple-green. Streak paler. Transparent—

translucent; sometimes opaque. Soluble in water. Taste bitter, rather than astringent.

Comp.—O. ratio for bases and acid 1 : 1, whence the formula $(\dot{U}^3, \dddot{Ʉ})\dddot{S}+\frac{1}{2}\dot{C}u^3\dddot{S}+1\frac{1}{2}\dot{Ħ}$. or $(\frac{2}{3}(\dot{U}^3,\dddot{Ʉ})+\frac{1}{3}\dot{C}u^3)\dddot{S}+1\frac{1}{2}\dot{Ħ}=$, if the uranium be all sesquioxyd, Sulphuric acid 20·8, oxyd of uranium 66·1, oxyd of copper 6·9, water 6·2=100. Analysis by Lindacker (mean of two trials, Vogl's Min. Joach., 1857):

$\dddot{S}$ 20·02 $\dot{U}, \dddot{Ʉ}$ 67·72 $\dot{C}u$ 5·99 $\dot{F}e$ 0·20 $\dot{Ħ}$ 5·59=99·52.

Pyr., etc.—In a glass tube at a low heat does not change; highly heated gives off water and sulphurous acid, and becomes brown and finally black. B.B. on charcoal gives sulphur fumes and a scoria of black color and dull green streak. With salt of phosphorus reacts for copper and uranium. Somewhat soluble in water. Solution precipitated chestnut-brown by prussiate of potash, yellowish-green by alkalies, and in brown flocks by an infusion of nutgalls.

Obs.—Discovered by John near Joachimsthal in Bohemia, after whom the species is named. Found also at Johanngeorgenstadt. Reported from the Middletown feldspar quarry by Shepard.

---

706. URANOCHALCITE. Urangrün *Hartmann.* Uranochalzit *Breith.*, Handb., 173, 1841.

In small nodular crusts and velvety druses, consisting of acicular crystals.

H.=2—2½. Color fine grass-green to apple-green; streak apple-green.

Comp.—$(\frac{2}{3}(\dot{U}^3, \dddot{Ʉ})+\frac{1}{3}\dot{C}a^3)\dddot{S}+\frac{1}{3}\dot{C}u\dddot{S}+9\dot{Ħ}=$, if the uranium be taken as all sesquioxyd, Sulphuric acid 21·1, oxyd of uranium 33·5, oxyd of copper 7·0, lime 9·8, water 28·5=100. Analysis Lindacker (Vogl's Min. Joach., 1857):

	$\dddot{S}$	$\dot{U}\,\dddot{Ʉ}$	$\dot{F}e$	$\dot{C}u$	$\dot{C}a$	$\dot{Ħ}$
($\frac{2}{3}$)	20·03	36·14	0·14	6·55	10·10	27·16=100·12.

Obs.—From Joachimsthal in Bohemia.

707. MEDJIDITE. *J. L. Smith*, Am. J. Sci., II. v. 337, 1848. Sulphate of Uranium & Lime.

Massive, with an imperfectly crystalline structure.

H.=2·5. Lustre vitreous in the fracture. Color dark amber. Transparent.

Comp.—Perhaps $\dddot{Ʉ}\dddot{S}+\dot{C}a\dddot{S}+15\dot{Ħ}$, according to some qualitative trials by Smith; but as probably $\dddot{Ʉ}\dddot{S}+\dot{C}a^3\dddot{S}+15\dot{Ħ}=(\frac{1}{2}\dddot{Ʉ}+\frac{1}{2}\dot{C}a^3)\dddot{S}+7\frac{1}{2}\dot{Ħ}$, and thus approaching uranochalcite.

Pyr., etc.—In a matrass easily yields water. At redness blackens, being converted into oxyd of uranium and sulphate of lime. With salt of phosphorus a green bead. Dissolves readily in dilute muriatic acid.

Obs.—Occurs near Adrianople, Turkey, on pitchblende, associated with liebigite, in some places with crystals of sulphate of lime; also at Joachimsthal, with liebigite on uranium ore. Externally often dull from loss of water.

It was named after the Turkish sultan Abdul Medjid.

708. ZIPPEITE. Basisches schwefelsaures Uranoxyd (verwitterter Uran-Vitriol) *J. F. John*, Unters., v. 1821, Jahrb. Min. 1845, 299. Uranblüthe *Zippe*, Verh. Ges. Böhm. Prag, 1824. Zippeit *Haid.*, Handb., 510, 1845.

In delicate needles; acicular rosettes; warty crusts.

H.=3. Color fine sulphur-yellow, lemon-yellow, orange-yellow.

Comp.—Hydrous sulphate of sesquioxyd of uranium, with or without oxyd of copper, and lemon- to orange-yellow when without. Analyses by Lindacker (Vogl's Min. Joach.):

	$\dddot{S}$	$\bar{U}$	$\bar{F}e$	$\dot{C}u$	$\dot{C}a$	$\dot{H}$
1. *With no Copper*	13·06	67·86	0·17	—	0·61	17·69=99·39.
2. *Copper var.*	17·36	62·04	—	5·21	—	15·23=99·84.

Formula of the former $\bar{U}^3\dddot{S}^2+12\dot{H}$, Vogl; of the latter, $\bar{U}^3\dddot{S}^2+6\dot{H}$, with 16 p. c. copper vitriol as impurity, Ramm.; or $(\dot{C}u^3, \bar{U})^3\dddot{S}^2+8\dot{H}$, in which O. ratio of $\dot{C}u$, $\bar{U}=1:12$.

Pyr., etc.—In the closed tube water, and at a higher temperature sulphuric acid. With salt of phosphorus gives a yellowish-green glass in O.F., becoming emerald-green in R.F.

Obs.—From Joachimsthal.

Named after the mineralogist Prof. Zippe. John's *basic sulphate* is a *yellow* mineral, and may be either the preceding, or what Vogl calls *Uranochre.*

709. VOGLIANITE. Basic Sulphate of Uranium *Vogl*, Min. Joach., 1857. Voglianite *Dana.*

In soft globular, and nodular, earthy coatings.

Color pistachio- to verdigris-green; streak pale green or apple-green.

Comp.—$4(\dot{U}^3, \bar{U})^3\dddot{S}+(\dot{C}a, \dot{C}u)\dddot{S}+10\dot{H}$, or, regarding the sulphate of copper and lime as impurity, $(\dot{U}^3, \bar{U})^3\dddot{S}+2\dot{H}$. Analyses by Lindacker (Min. Joach.):

	$\dddot{S}$	$\dot{U}\bar{U}$	$\bar{F}e$	$\dot{C}u$	$\dot{C}a$	$\dot{H}$
1. *Lime var.*	12·34	79·50	0·12	—	1·66	5·49=99·11.
2. *Copper var.*	12·13	79·69	0·36	2·24	0·05	5·25=99·72.

Obs.—From Joachimsthal in Bohemia.

710. URACONITE. Uranochre *Vogl*, Min. Joach. ? Uraconise *Beud.*, Tr., ii. 672, 1832. Uraconite *Dana.*

Amorphous, earthy, or scaly, and of a fine lemon-yellow color, or orange.

Comp.—Analyses by Lindacker (l. c.):

	$\dddot{S}$	$\bar{U}$	$\bar{F}e$	$\dot{C}u$	$\dot{C}a$	$\dot{H}$
1. *Yellow*	7·12	70·94	0·41	0·24	—	20·88=99·58.
2. *Orange*	10·16	66·05	0·86	—	2·62	20·06=99·76.

Formula deduced by Vogl for 1, $\bar{U}^3\dddot{S}+14\dot{H}$; for 2, $\frac{1}{2}\dot{C}a\dddot{S}+\bar{U}^3\dddot{S}+14\dot{H}$.

Obs.—From Joachimsthal, with other uranium ores. Uraconise of Beudant was described as a yellow pulverulent ore; its composition is unknown.

---

711. MONTANITE. *F. A. Genth*, Private contribution, Jan. 19, 1868.

Incrusting; without distinct crystalline structure.

Soft and earthy. Lustre dull to waxy. Color yellowish to white. Opaque.

Comp.—$\ddot{\bar{B}}i\,\dddot{T}e+2\dot{H}$=Telluric acid 26·1, oxyd of bismuth 68·6, water 5·3=100. Analysis: Genth (l. c.):

Montana $\dddot{T}e$ 26·83 $\ddot{\bar{B}}i$ 66·78 $\bar{F}e$ 0·56 $\dot{P}b$ 0·39 $\dot{H}$ 5·94=100.

Pyr., etc.—Yields water in a tube when heated. B.B. gives the reactions of bismuth and tellurium. Soluble in dilute muriatic acid.

Obs.—Incrusts tetradymite, from whose alteration it had been formed, at Highland, in Montana. The waxy lustre is observed when the incrustation has separated from the scales of tetradymite.

712. KERSTENITE. Selenbleispath *Kersten*, Pogg., xlvi. 277. 1839. Selenigsaures Bleioxyd *Germ.* Selenite of Lead. Selenate of Lead. Kerstenite *Dana.*

In small spheres and botryoidal masses. Cleavage distinct in one direction. H.=3—4. Lustre greasy—vitreous. Color sulphur-yellow. Streak uncolored. Brittle. Fracture fibrous. According to Kersten, it consists of selenous acid and oxyd of lead, with a small proportion of copper. On coal it fuses readily to a black slag, giving off a strong selenium odor, and is finally reduced to a metallic globule. With borax it fuses and forms a yellowish-green pearl, which is of the same color on cooling. With soda on charcoal metallic lead is obtained. Occurs with selenid of antimony and lead, malachite, etc., at the Friederichsglück mine, near Hilburghausen, and at Eisfeld. May it be a *selenate*, or is it only a mixture?

---

7. CARBONATES.

The carbonates have a hardness not exceeding 5, and consequently will not, when pure, strike fire with a steel. The anhydrous come under the common general formula, RO, CO^2, but present three types of crystallization, a rhombohedral, with $R \wedge R$ near 105°; an orthorhombic, with $I \wedge I$ near 120°; and a monoclinic, with $I \wedge I$ near 105°. They constitute therefore a case of pleomorphism, while all, still, are approximately isomorphous. These anhydrous species have a vitreous to subpearly lustre, and are typically *spars*. The hydrous carbonates vary much in crystallization, and in some cases have a strongly pearly lustre. All effervesce in hot acids, and part of them in cold.

I. ANHYDROUS CARBONATES.

ARRANGEMENT OF THE SPECIES.

I. CALCITE GROUP. Rhombohedral; $R \wedge R = 105°—108°$.

715. CALCITE	$\dot{\mathrm{C}}\mathrm{a}\,\ddot{\mathrm{C}}$	$\text{Ɵ}\,\Theta\vert\Theta_2\vert\text{Ɵa}$
716. DOLOMITE	$(\frac{1}{2}\dot{\mathrm{C}}\mathrm{a}+\frac{1}{2}\dot{\mathrm{M}}\mathrm{g})\,\ddot{\mathrm{C}}$	$\text{Ɵ}\,\Theta\vert\Theta_2\vert(\frac{1}{2}\text{Ɵa}+\frac{1}{2}\not{\mathrm{M}}\mathrm{g})$
717. ANKERITE	$(\frac{1}{2}\dot{\mathrm{C}}\mathrm{a}+\frac{1}{2}(\dot{\mathrm{M}}\mathrm{g}, \dot{\mathrm{F}}\mathrm{e}, \dot{\mathrm{M}}\mathrm{n}))\,\ddot{\mathrm{C}}$	$\text{Ɵ}\,\Theta\vert\Theta_2\vert(\frac{1}{2}\text{Ɵa}+\frac{1}{2}(\not{\mathrm{M}}\mathrm{g}, \not{\mathrm{F}}\mathrm{e}, \not{\mathrm{M}}\mathrm{n}))$
718. MAGNESITE	$\dot{\mathrm{M}}\mathrm{g}\,\ddot{\mathrm{C}}$	$\text{Ɵ}\,\Theta\vert\Theta_2\vert\not{\mathrm{M}}\mathrm{g}$
719. MESITITE	$(\frac{2}{3}\dot{\mathrm{M}}\mathrm{g}+\frac{1}{3}\dot{\mathrm{F}}\mathrm{e})\,\ddot{\mathrm{C}}$	$\text{Ɵ}\,\Theta\vert\Theta_2\vert(\frac{2}{3}\not{\mathrm{M}}\mathrm{g}+\frac{1}{3}\not{\mathrm{F}}\mathrm{e})$
720. PISTOMESITE	$(\frac{1}{2}\dot{\mathrm{M}}\mathrm{g}+\frac{1}{2}\dot{\mathrm{F}}\mathrm{e})\,\ddot{\mathrm{C}}$	$\text{Ɵ}\,\Theta\vert\Theta_2\vert(\frac{1}{2}\not{\mathrm{M}}\mathrm{g}+\frac{1}{2}\not{\mathrm{F}}\mathrm{e})$
721. SIDERITE	$\dot{\mathrm{F}}\mathrm{e}\,\ddot{\mathrm{C}}$	$\text{Ɵ}\,\Theta\vert\Theta_2\vert\not{\mathrm{F}}\mathrm{e}$
722. RHODOCHROSITE	$\dot{\mathrm{M}}\mathrm{n}\,\ddot{\mathrm{C}}$	$\text{Ɵ}\,\Theta\vert\Theta_2\vert\not{\mathrm{M}}\mathrm{n}$
723. SMITHSONITE	$\dot{\mathrm{Z}}\mathrm{n}\,\ddot{\mathrm{C}}$	$\text{Ɵ}\,\Theta\vert\Theta_2\vert\not{\mathrm{Z}}\mathrm{n}$

II. ARAGONITE GROUP. Orthorhombic. $I \wedge I = 115°—119°$.

724. ARAGONITE	$\dot{\mathrm{C}}\mathrm{a}\,\ddot{\mathrm{C}}$	$\text{Ɵ}\,\Theta\vert\Theta_2\vert\text{Ɵa}$
725. MANGANOCALCITE	$(\frac{2}{3}\dot{\mathrm{M}}\mathrm{n}+\frac{1}{3}(\dot{\mathrm{C}}\mathrm{a}, \dot{\mathrm{M}}\mathrm{g}))\,\ddot{\mathrm{C}}$	$\text{Ɵ}\,\Theta\vert\Theta_2\vert(\frac{2}{3}\not{\mathrm{M}}\mathrm{n}+\frac{1}{3}(\text{Ɵa}, \not{\mathrm{M}}\mathrm{g}))$
726. WITHERITE	$\dot{\mathrm{B}}\mathrm{a}\,\ddot{\mathrm{C}}$	$\text{Ɵ}\,\Theta\vert\Theta_2\vert\not{\mathrm{B}}\mathrm{a}$

727. **Bromlite**	$(\frac{1}{2}\dot{B}a+\frac{1}{2}\dot{C}a)\ddot{C}$	$\text{Ꞓ}\,\Theta\|\Theta_2\|(\frac{1}{2}Ba+\frac{1}{2}\text{Ꞓ}a)$
728. **Strontianite**	$\dot{S}r\,\ddot{C}$	$\text{Ꞓ}\,\Theta\|\Theta_2\|Sr$
729. **Cerussite**	$\dot{P}b\,\ddot{C}$	$\text{Ꞓ}\,\Theta\|\Theta_2\|Pb$

III. BARYTOCALCITE GROUP. Monoclinic. $I \wedge I$=106°—107°.

730. **Barytocalcite**	$(\frac{1}{2}\dot{B}a+\frac{1}{2}\dot{C}a)\ddot{C}$	$\text{Ꞓ}\,\Theta\|\Theta_2\|(\frac{1}{2}Ba+\frac{1}{2}\text{Ꞓ}a)$

IV. PARISITE GROUP. Carbonate containing fluorine.

731. **Parisite**	$(\dot{C}e, \dot{L}a, \dot{D}i)\ddot{C}+\frac{1}{2}(Ca, Ce)F$
732. **Kischtimite**	$6\,\dot{L}a\ddot{C}+Ce^2O^3+Ce^2F^3+2\,\dot{H}$

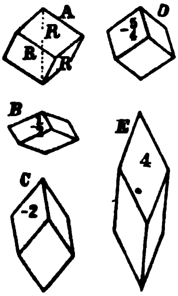
V. PHOSGENITE GROUP. Carbonate containing chlorine.

733. **Phosgenite**	$\dot{P}b\,\ddot{C}+Pb\,Cl$

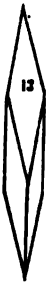
715. CALCITE. Marmor (Marble) pt. *Plin.* Lapis calcarius. Saxum calcis (*Calx* in Latin meaning burnt lime), Kalchstein *Agric.*, De Nat. Foss., 320, Interpr., 468, 1546. Kalksten *Wall.*, Min., 1747. Spatig Kalksten, Kalkspat, *Cronst.*, Min., 13, 1758. Kalk, Kalkspath, Kalkstein, *Germ.* Calx aerata *Bergm.*, 1774, and Opusc., i. 24 1780. Calcareous Spar; Limestone; Carbonate of Lime. Chaux carbonatée *Fr.* Calcit *Haid.*, Handb., 498, 1845.

Rhombohedral. $R \wedge R$ (f. 550A, over a terminal edge)=105° 5′, $O \wedge R$ =135° 23′; a=0·8543. Cleavage: R highly perfect.

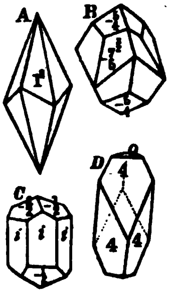
550



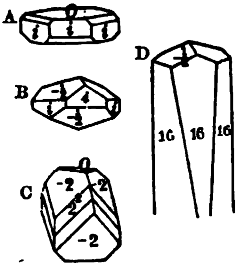
551



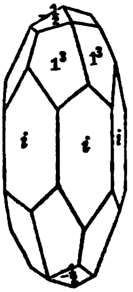
552



553

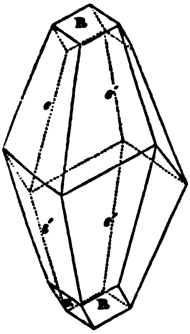


554

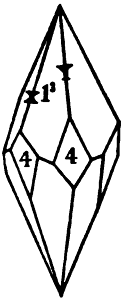


Observed forms: 1. *Rhombohedrons;* forms whose planes are in the same vertical zone with R (one of which, 4, is shown in f. 559, 550E, and three of the *minus* series, in −2, $-\frac{5}{4}$, $-\frac{1}{2}$, in f. 564, 550C, D, B); the *plus* rhombohedrons ranging from $\frac{1}{4}R$ (the vertical axis of which is $\frac{1}{4}$th that of R relatively to the lateral axes) to $28R$, the planes of the former nearly coincident with the basal plane o, and of the latter as nearly with those of the vertical prism; the *minus* rhombohedrons ranging from $-\frac{1}{10}$ to −14; the fundamental rhombohedron R (f. 550A) uncommon, except in combination with other planes, or as a cleavage form; $-\frac{1}{2}R$ (f. 550B, often called *nail-head* spar) corresponding to a truncation of the terminal edge of R, very common, and especially in combination (f. 552C, 553A, B, 564, 565); $-2R$ (f. 550c), called the *inverse* by Haüy, because the angle over the lateral edges is near that over the terminal of R, common; $-\frac{1}{4}R$ (f. 550D).

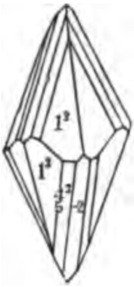
555



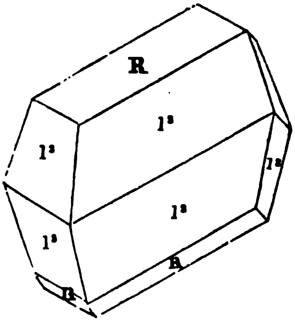
557



558

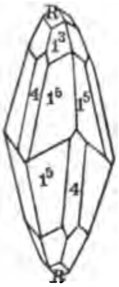


556

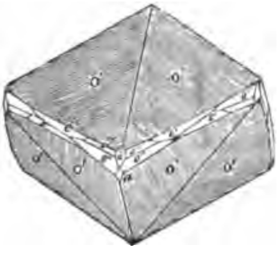


Rossie.

559

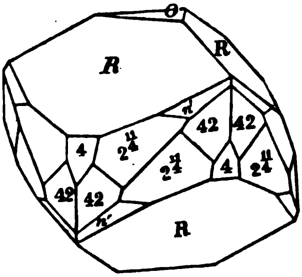


560



Rossie.

561

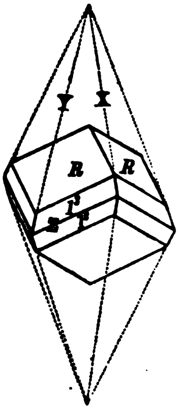


Rossie.

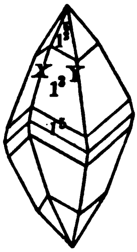
or the cuboid of Haüy, its angles being rather near those of a cube, and the acute form $4R$ (f. 550E), also common; $13R$ (f. 551) of not unfrequent occurrence; $16R$ (f. 553D).

2. Scalenohedrons. (*a*) Planes bevelling the lateral edges of R, f. 562, which, when more extended, take the form in the dotted lines of the same figure, or the complete scalenohedron; the series having the general symbol 1^n, and including all the forms in the table beyond from $1^{\frac{19}{18}}$ to 1^{18} (the 1 signifying that they are thus related to the rhombohedron $1R$, and the annexed number indicating the length of the vertical axis as compared with that of $1R$; also a *minus* series, -1^n, having the same relation to $-1R$; three of the *minus* series are combined in the illustrative figure, f. 563, and two of the *plus* in

562

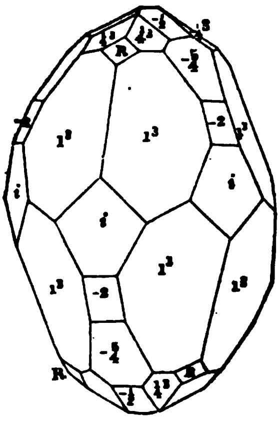


563



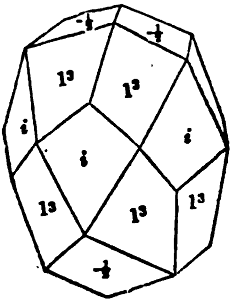
f. 559); scalenohedron 1^3 (f. 552A, *dog-tooth spar*) very common, both simple and in combination (the latter in f. 555 to 559, 564, 565; f. 556 a distorted form of f. 555). (*b*) Planes bevelling the lateral edges of $-2R$ (f. 553c), and having the general symbol -2^n. (*c*) Planes having the same relation to other rhombohedrons, but if referred to the fundamental rhombohedron, *R*, replacing its lateral or terminal angles, or terminal edges (f. 561, 564). (*d*) The last mentioned bevelling the terminal edges of *R* (as $\frac{1}{4}^3$ in f. 564), having the general symbol m^n, with $\frac{3}{2}mn-\frac{1}{2}m=1$ when the scalenohedron is *plus* like the *R*, but $\frac{3}{2}mn+\frac{1}{2}m=1$ when *minus*. (*e*) Bevelments of terminal edges of other rhombohedrons, $m'R$, having the same general symbol m^n, but with $\frac{3}{2}mn-\frac{1}{2}m=m'$, when of like signs with $m'R$, and $\frac{3}{2}mn+\frac{1}{2}m=m'$, when of unlike signs.

564

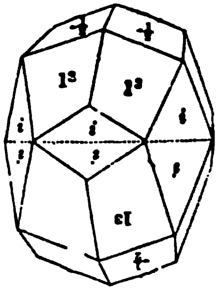


Derbyshire.

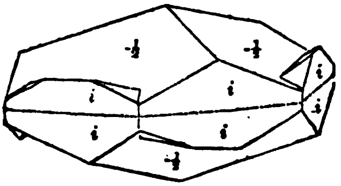
565



566

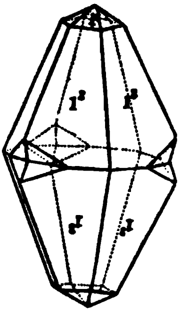


567

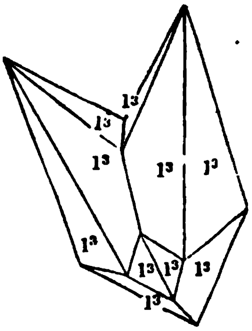


Alston-Moor.

568



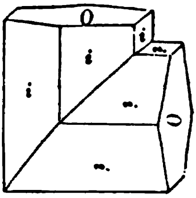
569



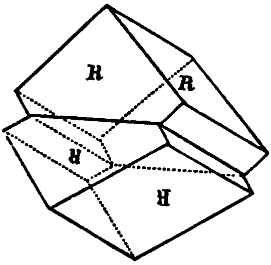
3. *Regular six-sided pyramids;* general symbol m-2, as 4-2, f. 561.

4. *Prisms.* (*a*) The regular six-sided prism *i*, very common, either short or long (f. 552c, 553A, B, 554, 570). (*b*) Prism *i*-2, only in combination and not common. (*c*) Twelve-sided prisms i-$\frac{3}{2}$, i-$\frac{5}{4}$.

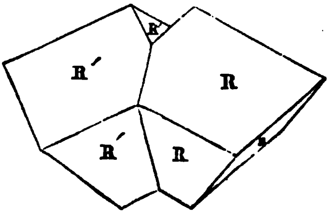
570



571



572



5. *Basal*, plane *O*, as in 552D, 553A, C, 570, far less frequent as a termination of crystals than rhombohedral and scalenohedral planes.

ANGLES OF RHOMBOHEDRONS.

R is a face of the fundamental rhombohedron 1*R*; *R'* the particular rhombohedron below in each line; *o* the basal plane:

	Term. Edge.	$o \wedge R$	$R \wedge R'$		Term. Edge.	$o \wedge R$	$R \wedge R'$
$\frac{1}{4}$	156° 2'	166° 9'	149° 14'	-5	63° 51'	101° 28'	123° 9'
$\frac{1}{3}$	152 35	161 48	153 35	$-\frac{9}{2}$	64 42	102 42	121 55
$\frac{2}{5}$	142 55	158 28	156 55	-4	65 50	104 17	120 20
$\frac{1}{2}$	134 57	153 45	161 48	$-\frac{7}{2}$	67 26	106 9	118 28
$\frac{10}{13}$ (?)	116 52	152 48	163 35	$-\frac{11}{4}$	71 18	110 14	114 23
$\frac{4}{7}$	129 40	150 35	164 48	$-\frac{5}{2}$	73 15	112 5	112 32
1*R*	105 5	135 23	180	$-\frac{12}{5}$	74 9	112 56	111 41
$\frac{7}{4}$	82 56	120 5	164 42	$-\frac{9}{4}$	76 9	116 16	110 21
$\frac{5}{2}$	73 15	112 5	156 42	-2	78 51	116 52	107 45
3	69 24	108 40	153 7	$-\frac{13}{8}$	85 26	121 58	102 39
$\frac{13}{4}$	68 25	107 20	151 57	$-\frac{11}{7}$	86 36	122 49	101 58
4	65 50	104 17	148 50	$-\frac{3}{2}$	88 18	124 6	100 2
$\frac{17}{4}$	65 6	103 24	148 1	$-\frac{7}{5}$	90 55	125 58	98 39
$\frac{9}{2}$	64 42	102 42	147 19	$-\frac{5}{4}$	95 28	129 2	95 35
6	62 43	99 35	144 12	$-\frac{6}{5}$	97 10	130 11	94 48
7	62 1	98 14	142 51	$-\frac{8}{7}$	99 14	131 35	93 2
9	61 14	96 25	141 3	$-\frac{7}{8}$	111 18	139 12	85 25
13	60 36	94 27	139 4	$-\frac{4}{5}$	115 7	141 43	82 54
16	60 20	93 38	138 15	$-\frac{2}{3}$	123 10	146 40	77 57
18	60 19	93 13	137 50½	$-\frac{3}{5}$	127 39	149 23	75 14
28	60 8	92 4	136 41	$-\frac{1}{2}$	134 57	153 45	70 52
-14	60 31	94 8	138 45	$-\frac{1}{4}$	156 2	166 9	58 38
-11	60 50	95 19	129 18	$-\frac{1}{5}$	160 42	168 50	55 47
-8	61 33	97 13	127 25	$-\frac{1}{10}$	170 14	174 22	51 15

ANGLES OF SCALENOHEDRONS.

	Long E.	Short E.	Mid. E.		Long E.	Short E.	Mid. E.
$\frac{1}{16}^{7}$	154° 37'	145° 55'	61° 36'	$\frac{1}{4}^{3}$ (f. 577)	159° 24'	138° 5'	64° 54'
$\frac{1}{4}^{25}$	130 16	121 14	131 19	$\frac{1}{4}^{5}$	146 10	128 15	93 20

	Long E.	Short E.	Mid. E.		Long E.	Short E.	Mid. E.
$\frac{1}{2}^{\frac{7}{3}}$, S.	161° 58′	133° 53′	66° 31′	$\frac{11}{2}^{\frac{19}{7}}$?	157° 14′	83° 55′	140° 40′
$\frac{1}{2}^{20}$, S.	116 58	110 48	164 43	$10^{\frac{17}{8}}$?	134 3	66 44	125 4
$\frac{3}{8}^{2}$	164 1	130 37	67 41	$\frac{17}{2}^{\frac{19}{7}}$?	166 10	71 36	132 37
$\frac{3}{8}^{3}$	152 40	123 35	90 20	$-8^{\frac{5}{4}}$	169 39	71 18	129 3
$\frac{1}{2}^{\frac{6}{5}}$	166 57	125 53	69 16	$-5^{\frac{7}{6}}$	164 59	76 54	132 1
$\frac{4}{7}^{\frac{3}{2}}$	169 5	122 37	69 45	$-4^{\frac{6}{5}}$, Rh.	158 30	83 34	137 34
$\frac{4}{7}^{5}$, Hg	136 48½	112 59	133 53	$-\frac{7}{2}^{\frac{4}{3}}$	159 4	87 37	130 45
$\frac{4}{9}^{\frac{7}{5}}$	170 29	120 14	71 5	$-2^{\frac{3}{2}}$	163 11	86 6	122 32
$\frac{3}{5}^{\frac{4}{3}}$, S.	174 26	118 23	71 36	$-2^{\frac{4}{3}}$	159 20	88 18	127 29
$\frac{7}{10}^{\frac{9}{7}}$	172 30	116 59	72 1	-2^{2}	153 16	92 9	135 19
$\frac{33}{38}^{\frac{11}{4}}$, Hg.	147 4	105 13½	125 53½	$-2^{\frac{6}{5}}$?	146 53	96 22	143 34
$1^{\frac{10}{9}}$	171 48	102 55	88 16	-2^{3}	142 30	99 58	149 21
$1^{\frac{7}{5}}$	168 1	102 21	94 1	-2^{4}	139 36	106 25	163 24
$1^{\frac{3}{2}}$	165 33	102 6	97 57	$-\frac{7}{4}^{\frac{34}{27}}$?	172 40	84 45	112 20
$1^{\frac{4}{3}}$, Hg.	169 56	102 36	91 18	$-\frac{5}{3}^{\frac{17}{8}}$? Da.$a$	174 44	85 32	102 31
$1^{\frac{6}{5}}$	161 58	101 55	108 52	$-\frac{3}{2}^{\frac{4}{3}}$?	147 31	98 32	137 33
$1^{\frac{7}{4}}$	160 13	101 56	106 34	$-\frac{8}{5}^{\frac{9}{4}}$?	150 15	96 22	135 6
$1^{\frac{9}{5}}$	159 17	101 57	108 7	$-\frac{7}{5}^{\frac{3}{2}}$, Da.$b$	164 8	92 46	111 46
1^{2}	155 50	102 11	113 45	$-\frac{7}{5}^{\frac{11}{7}}$, S.	161 32	83 15	114 25
$1^{\frac{7}{3}}$	151 7	102 52	121 34	$-\frac{4}{3}^{\frac{8}{5}}$?	151 6	99 6	127 40
1^{3}	144 24	104 38	132 58	$-\frac{4}{3}^{\frac{7}{5}}$	167 6	95 15	103 40
$1^{\frac{13}{3}}$	136 47	107 48	146 28	$-\frac{4}{3}^{\frac{8}{5}}$	158 8	96 51	117 8
1^{5}	134 28	109 1	150 44	$-\frac{9}{7}^{\frac{3}{2}}$, Wr.	167 23	98 2	103 48
$1^{\frac{16}{3}}$, Hg.	133 53	109 34	152 30	$-\frac{9}{7}^{2}$	155 7	99 26	119 6
$1^{\frac{17}{3}}$	132 41	110 3	154 5	$-1^{\frac{4}{3}}$?	169 56	102 36	91 13
$1^{\frac{19}{3}}$, Rh.	131 31	110 36	156 42	$-1^{\frac{6}{5}}$	161 53	101 55	103 52
1^{7}	130 10	111 39	158 53	$-1^{\frac{7}{3}}$, 1^{3}, $1^{\frac{13}{3}}$, 1^{5}, same as $+1^{\frac{7}{4}}$, 1^{2}, $1^{\frac{13}{3}}$, 1^{5}			
1^{9}	127 50	113 21	163 30	$-\frac{4}{5}^{3}$	145 15	107 38	124 39
1^{11}	126 26	114 24	166 28	$-\frac{2}{3}^{\frac{7}{5}}$	164 7	111 54	103 4
1^{12}	125 47	114 50	167 35	$-\frac{1}{2}^{\frac{7}{3}}$	157 5	120 26	88 9
1^{13}	125 30	115 12	168 32	$-\frac{1}{2}^{3}$	149 43	117 23	102 25
$\frac{4}{5}^{\frac{13}{9}}$	165 59	95 27	105 24	$-\frac{1}{2}^{4}$	142 32	115 17	117 50
$\frac{7}{5}^{\frac{9}{7}}$	170 0	91 34	103 21	$-\frac{1}{2}^{\frac{13}{3}}$?	140 44	114 57	121 39
$\frac{8}{5}^{3}$	142 53	100 55	145 28	$-\frac{1}{2}^{5}$	138 23	114 34	128 30
$2^{\frac{11}{4}}$, Hg.	144 30	98 25½	146 42	$-\frac{1}{2}^{9}$	129 10	115 5	150 0
2^{3}	142 30	99 58	149 21	$-\frac{1}{2}^{10}$, Hg	128 7	115 21	152 53
$\frac{16}{7}^{3}$	153 2	91 12	137 48	$-\frac{1}{2}^{13}$	126 1	116 4	158 59
$\frac{5}{2}^{3}$	152 54	90 46	139 12	$-\frac{1}{3}^{\frac{6}{5}}$	170 16	140 18	50 12
$3^{\frac{25}{9}}$	148 50	97 28	151 51	$-\frac{2}{7}^{5}$	144 6	124 56	100 47
$4^{\frac{3}{2}}$	162 23	80 10	133 19	$-\frac{1}{5}^{3}$	162 35	144 45	54 6
4^{3}	152 29	88 57	144 29	$-\frac{1}{5}^{7}$	141 41	128 7	99 58
4^{5}	141 51	98 40	155 39	$-\frac{1}{8}^{5}$	158 19	147 13	56 6

The *long* E., above, is edge Y (f. 562); *short* E., edge X; *mid.* E., edge Z.

ANGLES OF PYRAMIDS.

	Pyram.	Basal.		Pyram.	Basal.
$\frac{2}{3}$-2	151° 21′	59° 20′	2-2	128° 52′	119° 20′
$\frac{10}{9}$-2	139 44	87 1	$\frac{8}{3}$-2	125 30½	132 36
$\frac{4}{3}$-2	135 51½	97 26½	4-2	122 39	147 28

	Pyram.	Basal.		Pyram.	Basal.
$\frac{14}{3}$-2	121° 59′	151° 50′	6·2	121° 13′	157° 54′
$\frac{16}{3}$-2	121 30½	149 22	8-2	120 42	163 0

Twins: (1) Composition-face basal (or parallel to *o*), as f. 566 in the form f. 565, f. 567 in that of f. 553B, f. 568 in one similar to f. 552A. (2) C.-face *R*, f. 570, the vertical axes of the two forms nearly at right angles (90° 46′), since $o \wedge R = 135° \ 23'$; producing complex forms when highly modified. (3) C.-face $-2R$, as f. 569, in the scalenohedron 1^3, f. 552A. (4) C.-face $-\frac{1}{2}R$ (f. 571), the vertical axes of the two forms inclined to one another 127° 34′; composition often repeated, producing an alternation of thin lamellæ; and often occurring as lamellæ intersecting different forms, or cleavage rhombohedrons; common in the grains of granular limestone (Oschotz, ZS. G., vii. 5). (5) C.-face prismatic plane *i*-2. (6) C.-face plane *i* (f. 572).

Also fibrous, both coarse and fine; sometimes lamellar; often granular; from coarse to impalpable, and compact to earthy. Also stalactitic, tuberose, nodular, and other imitative forms.

H.=2·5–3·5; some earthy kinds (chalk, etc.) 1. G.=2·508–2·778; pure crystals, 2·7213–2·7234, Beud.; fibrous, lamellar, and stalactitic, 2·70–2·72, but when pulverized, 2·729–2·7233. Lustre vitreous—subvitreous—earthy. Color white or colorless; also various pale shades of gray, red, green, blue, violet, yellow; also brown and black when impure. Streak white or grayish. Transparent—opaque. Fracture usually conchoidal, but obtained with difficulty when the specimen is crystallized. Double refraction strong.

573

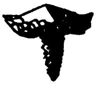
Phenixville.

The following are some of the irregular forms or conditions in the crystallization of calcite: (1) With *curved* surfaces. The rhombohedron $\frac{1}{2}R$, top part of f. 574, and the hexagonal prism f. 574A, and prism of f. 576. (2) *Spirally group*, f. 573, in which the spires consist of small crystals of the form in f. 552C. (3) *Grouped in curving columns:* one case is mentioned by Kenngott in which the column was a pile of rhombohedrons (form in f. 553B) in a single series, the breadth $\frac{1}{16}$ in. (4) *Made up of a succession of unlike forms:* in f. 576 a prism is surmounted by the form in f. 553B, the crystal, after forming as a hexagonal prism with a rounded summit through indistinct scalenohedral planes, having been completed by a form wholly different; in f. 575 a prism with a rhombohedral termination contains inside a scalenohedron (1^3), showing that it reached nearly its actual height as a scalenohedron, and, moreover, before the new form commenced, the scalenohedron was tipped by a cube of fluorite: f. 579, in which the sunken plane *o* has arisen from additions to the other faces, in the process of completion of the crystal, with none to *o*, the conditions producing that modification having ceased (5) *Irregular changes in the development of the same form:* in f. 574, the form called *nail-head spar* has the unusual accompaniment of the shank of the nail, made up of very small but similar rhombohedrons; *lateral* development having been prevented for a while (perhaps by an accompanying deposition of sediment) and the form consequently elongating upward by successive additions of small crystals, but finally, when the obstruction is no longer acting, a single crystal taking a broad expansion and topping the column (6) *Symmetrical arrangement of impurities:* in f. 577, 578, showing the tops of a prism, like f. 552C, the impurities being crystals of pyrite.

The planes in the tables above, with the calculated angles, when not otherwise accredited, are from Zippe, Kryst. rhomb. Kalkhaloides, Denkschr. Ak. Wien, iii. 1854. For the others, Hg. stands for Hessenberg, Min. Not., iii., iv., v., vii.; Wr., Wimmer, Jahresb. 1854, 865; Rh., v

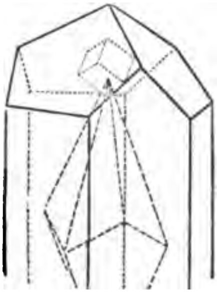
Rath, Pogg., cxxxii. 387; S., Quintino Sella, Studii Min. Sarda, and Quadro crist. Argento Rosso del Quarzo, e del Calcare; Da., Dana, *a*, from a Rossie crystal (f. 560, *o*), *b*, from a Bergen Hill crystal, f. 552B. Sella also enumerates in his table (but not from his own special observations) the forms

574



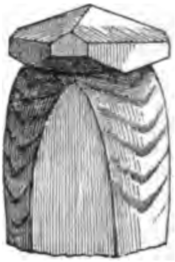
Przibram.

575



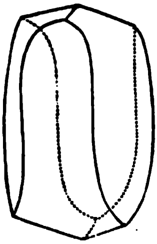
Phenixville.

576

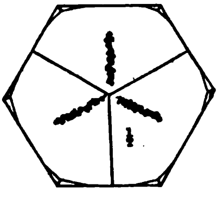


Bristol, Ct.

574A

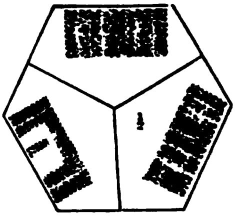


577



Phenixville.

578



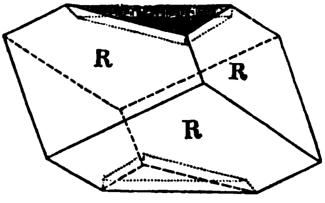
Phenixville.

$$1^{\frac{11}{3}},\ 1^{4},\ 161^{\frac{35}{33}},\ -\tfrac{154}{3}^{\frac{35}{33}},\ -\tfrac{8}{3}^{\frac{7}{3}},\ -\tfrac{7}{5}^{\frac{9}{7}},\ -\tfrac{5}{4}^{\frac{13}{9}},\ -\tfrac{8}{7}^{\frac{9}{4}},\ -\tfrac{4}{5}^{\frac{5}{2}},\ -\tfrac{1}{4}^{\frac{11}{3}},\ -\tfrac{1}{5}^{13}.$$

See also on the crystallography of calcite, F. Hochstetter, Denkschr. Ak. Wien, vi. 89, 1854. Figures 573, 575, 577, 578 are from a paper by J. L. Smith, in Am. J. Sci., xx. 251, the figures drawn by the author; and f. 574 is from Przibram crystals in the cabinet of Prof. Brush. Fig. 561 is from Hessenberg. To the enumerated scalenohedrons add (fr. v. Rath, l. c.) $\frac{1}{5}^{\frac{11}{3}}$, having Y=157° 23′, X=140° 40′, Z=124° 45′.

Comp., Var.—Calcite is carbonate of lime, $\dot{C}a\,\ddot{C}$=Carbonic acid 44, lime 56=100. Magnesia, protoxyd of iron, or protoxyd of manganese frequently, and strontia, barytes, oxyd of zinc, or oxyd of lead occasionally, replace part of the lime.

579



Rossie.

The varieties are very numerous, and diverse in appearance. They depend mainly on the following points: (1) differences in crystallization; (2) in structural condition, the extremes being perfect crystals and earthy massive forms; (3) in color, diaphaneity, odor on friction, due to impurities; (4) in modes of origin.

The following are the most common impurities and their effects:

Red oxyd of iron ($\ddot{\overline{F}}e$) produces different shades of red, from flesh-red or paler to opaque blood-red and brownish-red, according to the proportions present; the latter Hausmann names *Hæmatoconite* (from ἁιμα, *blood*, and κονις, *powder*, Handb., 1304, 1847), as in the marble *Rosso antico* of Italy. The hydrated oxyd ($\ddot{\overline{F}}e^{2}\dot{H}^{3}$) causes yellowish to opaque ochre-yellow and yellowish-brown; the deeper, *Sideroconite* of Hausmann (ib., 1306). Protoxyd of iron, oxyd of chrome, silicate of iron, cause shades of green.

Carbonaceous matters, or carbon, give a clear yellowish tint to some crystallized calcite, and various dull colors, from pale drab and buff through gray and bluish-gray to deep black, to compact calcite or limestone; the carbonaceous matters having been derived from the animals of the shells, corals, etc., out of which the limestones were originally made, or from the plants of the same seas, just as soils and mud are now colored from the same cause; and when these carbonaceous matters are allied to petroleum or bitumen, the rock has a fetid or bituminous odor when struck with a hammer. The fact that the dark colors mentioned are due to carbonaceous substances and not to metallic oxyds is proved by the rocks affording, when burnt, *white* quicklime. The black marbles thus colored are named *Anthraconite* (from ἄνθραξ, *coal*) by v. Moll (Ephemer., ii. 305, 1806), *Lucullan* by John (Ch. Unters., 219), and *Lucullite* by Jameson (Min., ii. 180, 1816); they include the *Marmor Luculleum* Plin. (xxxvi. 6). The *Nero Antico* of the Italians belongs here. The bituminous or *fetid* limestones are also called anthraconite when black; and also, from the odor, *Swinestone* (syn. *Stinkstone; Stinkstein, Saustein, Stinkkalk*, Germ.), some being light gray in color.

Dolomite, or carbonate of lime and magnesia, often constitutes the veins and shells of a compact limestone, as shown by Hunt; and the magnesia found by analysts in such rocks may be generally present as a mixture of dolomite with calcite, rather than as a chemical substitution of magnesia for lime. (See under DOLOMITE.)

Sand, chlorite, and other minerals are sometimes taken up mechanically by crystallizing calcite.

Mica, talc, chlorite, serpentine are often disseminated in crystalline limestones, having been formed in them at the time of their crystallization, and are among the materials which produce the cloudings or variegated colors of such limestones.

The varieties that have been named are as follows:

A. *Well crystallized.*

1. *Ordinary.* Crystals and crystallized masses afford easily cleavage rhombohedrons; and when transparent they are what is called *Iceland Spar*, and also *Doubly-refracting Spar* (Doppel-spath *Germ.*).

The crystals vary in proportions from broad tabular to moderately slender acicular, and take a great diversity of forms. But the extreme kinds so pass into one another through those that are intermediate that no satisfactory classification is possible. Many are stout or short in shape because normally so. But other forms that are long tapering in their full development occur short and stout because abbreviated by an abrupt termination in a broad *o*, or an obtuse rhombohedron (as $-\frac{1}{2}$ or R), or a low scalenohedron (as $\frac{1}{4}^3$), or a combination of these forms; and thus the crystals having essentially the same combinations of planes vary greatly in shape. The following groups may answer some purpose in the arrangement of the crystals in a cabinet. They are here characterized by stating the form or forms that are dominant, or most largely developed; and the term *abbreviated* is used as above explained. Intermediate forms may be assigned to the group with which they have the most in common. (*b*) *o* group, or flat tabular (f. 553A); the edges of the tables may be made of prismatic planes, or of rhombohedral, etc. (*c*) Low rhombohedral or nail-head, $-\frac{1}{2}R$, $-\frac{1}{4}R$, etc. (*d*) R group, the fundamental rhombohedron dominant (f. 550). (*e*) $\frac{4}{3}R$, or cuboid group. (*f*) $2R$ group. (*g*) $2R$ abbreviated. (*h*) $4R$ group. (*i*) $4R$ abbreviated. (*j*) Long rhombohedron group, including the longer rhombohedrons, of which 11, 13, −14, are rather common (f. 551). (*k*) Long rhombohedron abbreviated, producing sometimes forms that look much like 3- or 6-sided prisms (f. 553D). (*l*) Low scalenohedron group, as $\frac{1}{4}^3$, $\frac{2}{3}^2$, etc. (*m*) Ordinary scalenohedron or dog-tooth group, that of 1^3, one of the most common of forms (f. 552A, 555–559). (*n*) Same abbreviated (f. 564, 565). (*o*) Long scalenohedron group, or that of 1^7, 1^9, etc. (*p*) Same abbreviated. (*q*) Prism-scalenohedron group, the scalenohedral planes being combined with an oblong prism *i* (f. 554). (*r*) Prismatic group, the prism *i* being elongated and dominant; and variously terminated.

Preunnerite Esmark, from amygdaloid in Faröe, is calcite in cuboid crystals and massive, smalt-blue to violet in color, brownish-yellow by transmitted light, subtransparent to translucent, and chalcedonic in aspect.

2. *Twin-crystals.* Groups *a–f* corresponding to the different kinds described on p. 675.

3. *Crystals with internal impurities, etc.* (*a*) Having interior planes or other evidence of changes in the progress of their formation (f. 575, 576, 579). (*b*) Containing impurities symmetrically arranged.

4. *Spiral or curved aggregations of crystals.* (*a*) Spirally arranged crystals. (*b*) Bent or curved crystallizations.

5. *Pseudomorphous calcite.* *Natrocalcite* includes pseudomorphs of calcite after *celestite* from Sangerhausen, named under the mistaken idea that the material contained soda.

6. *Reichite* (Breith., B. H. Ztg., xxiv. 311) is a pure calcite from Alston-Moor in Cumberland, white in color, *with an angle of* 105° 20′, according to Breithaupt's measurements, and G.=2·666–2·677.

B. *Varieties, crystallized as well as uncrystallized, based on the presence of other carbonates, and of different impurities.*

7. *Dolomitic calcite.* Containing carbonate of magnesia and lime, or dolomite—a fact ascertainable only by chemical methods, unless the amount of magnesia be considerable, when it is apparent in crystals in the angle $R \wedge R$.

8. *Ferrocalcite.* Containing carbonate of iron, and turning brown on exposure.

9. *Manganocalcite.* Containing carbonate of manganese, and becoming brownish-black on exposure.

10. *Plumbocalcite* Johnston (Ed. Phil. J., vi. 79, 1829), white to yellowish and reddish-brown, and having $R \wedge R = 105° 5\frac{3}{4}'$, Breith.; 105° 5′, Dufr.; 105°, Kenng. G.=2·772, v. Hauer; 2·746–2·748, Descl. Contains some carbonate of lead.

11. *Neotype* Breith. (Handb., 313, 1841). Grayish-white, and occurring in rhombohedrons $2R$; $R \wedge R = 105° 8'$, Breith. G.=2·819–2·840. Contains some carbonate of barytes. From Cumberland, England.

12. *Spartaite* Breith. (B. H. Ztg., xvii. 53, 1858). White, grayish-white, becoming brownish-black on exposure; $R \wedge R = 104° 57\frac{1}{2}'$, Breith.; G.=2·808–2·818. Occurs with franklinite and zincite at Sparta, Sterling Hill, Hamburg, N. J., and contains some carbonate of manganese. Shepard proposed the name *calcimangite* for the mineral from Sterling (anal. 6).

13. *Strontianocalcite* Genth (Proc. Ac. Sci. Philad., vi. 114, 1852); in opaque white crystals, occurring in globules which have a surface consisting of the terminations of acute rhombohedrons, and H.=3·5. Contains some strontia, and hence gives a decided red flame before the blowpipe.

14. *Fontainebleau limestone* (Lassonne, Mem. Ac. Paris, 1775, Chaux carbonatée quartzifère *H.*, 1801); crystals of the form in fig. 550c, from Fontainebleau and Nemours, France, which contain a large amount of sand, some 50 to 63 p. c. according to Delesse, with G.=2·53–2·84, the latter from one containing 57 p. c. of sand.

15. *Hislopite* Haughton (Phil. Mag., IV. xvii. 16, 1859) is a grass-green cleavable calcite from Central India, containing about 14 p. c. of a siliceous material like glauconite (q. v.), to which the color is owing.

C. *Varieties based on fibrous or lamellar structure.*

16. *Satin Spar;* fine fibrous, with a silky lustre. Resembles fibrous gypsum, which is also called satin spar, but is much harder and effervesces with acids.

17. *Argentine* Kirwan (Min., i. 104, 1794; *Schieferspath* Hofmann, Bergm. J., 188, 1789; Slate Spar). A pearly lamellar calcite, the lamellæ more or less undulating; color white, grayish, yellowish, or reddish.

18. *Aphrite*, in its harder and more sparry variety (*Schaumspath* Freiesleben), is a foliated white pearly calcite, near argentine; in its softer kinds (*Schaumerde* W., *Silvery Chalk* Kirwan, *Ecume de Terre* H.) it approaches chalk, though lighter, pearly in lustre, silvery-white or yellowish in color, soft and greasy to the touch, and more or less scaly in structure.

D. *Granular massive to cryptocrystalline; Limestone, Marble, Chalk.*

19. *Granular limestone* (*Saccharoidal limestone*, so named because like loaf sugar in fracture). The texture varies from quite coarse to very fine granular, and the latter passes by imperceptible shades into *compact* limestone. The colors are various, as white, yellow, reddish, green, and usually they are clouded and give a handsome effect when the material is polished. When such limestones are fit for polishing, or for architectural or ornamental use, they are called *marbles*. (*a*) *Statuary marble* is pure white, fine grained, and firm in texture. The *Parian* marble from the island of Paros (the *Lychnites* of the ancients), *Pentelican* from the quarries near Athens, *Luni* marbles of the coast of Tuscany, and the *Carrara*, of Modena, Italy, are among the best of statuary marbles. *Architectural* marble includes both white and colored. (*b*) The *Cipolin* of Italy is white, with pale greenish shadings from green talc; it does not stand the weather well. (*c*) *Giallo antico* of Italy is ochre-yellow to cream-yellow, with some whitish spots. (*d*) The *Sienna*, or *Brocatello de Sienna*, is yellow, veined or clouded with bluish-red, having sometimes a tinge of purple. (*e*) The *Mandelato* is a light red with yellowish-white spots. A red kind from Tiree in Scotland has different shades of red, as rose-red, flesh-red, reddish-white; one from Tennessee is clouded with brownish- and purplish-red. (*f*) The *Bardiglio* is gray with crowded dark well-defined cloudings, consisting partly of serpentine, from Corsica. (*g*) *Turquois-blue* marble, from the quarries of Seravezza near Carrara, has a fine grayish-blue color, veined with white. (*h*) *Verd-Antique* is clouded green, the color, owing to the presence of serpentine (see p. 465), yellowish-green to bluish-green.

20. *Hard compact limestone.* Varies from nearly pure white, through grayish, drab, buff, yellowish, and reddish shades, to bluish-gray, dark browish-gray, and black, and sometimes

variously veined. The colors dull, excepting ochre-yellow and ochre-red varieties. Many kinds make beautiful marble when polished.

(*a*) *Black*, (*b*) *yellow*, (*c*) *red*, and (*d*) *fetid* kinds have been mentioned (pp. 676, 677).

The *Portor* (*d*), called sometimes Egyptian marble, is of black color, handsomely veined with yellow dolomite, and comes from Porto-Venere, near Spezia; the rock is of the lower Lias. (*e*) *Panno-di-Morte* (Death's Robe) of Italy is black, with some white fossil shells. (*f*) *Marble of Languedoc* is fine deep red or brownish-red, with some white and gray due to fossils, and is from St. Beaume in France. (*g*) *Griotte*, from the Dept. of Herault, France, has a reddish-brown base, with somewhat regularly arranged spots of clear red, and some whitish round spots due to goniatites. (*h*) *Sarencolin* marble, from the Pyrenees, is deep red mixed with gray and yellow. (*i*) Bird's-eye marble is gray, with whitish crystalline points, and is from central New York.

(*k*) *Shell-marble* includes kinds consisting largely of fossil shells; (*l*) *Madreporic* marble, those containing corals; (*m*) *Encrinal*, those containing encrinal (crinoidal) remains. (*n*) *Lumachelle* is a dark brown shell-marble, with brilliant fire-like or chatoyant internal reflections proceeding from the shells, and from Bleiberg in Carinthia; and another kind, with the shells yellow, comes from Astrachan.

(*o*) *Ruin-marble* is a kind of compact calcareous marl, showing, when polished, pictures of fortifications, temples, etc., in ruins, due to infiltration of oxyd of iron; from Florence, Italy.

(*p*) *Lithographic stone* is a very even-grained compact limestone, usually of buff or drab color; as that of Solenhofen.

(*q*) *Breccia marble* is made of fragments of limestone cemented together, and is often very beautiful when the fragments are of different colors, or are imbedded in a base that contrasts well. The colors are very various.

(*r*) *Pudding-stone* marble consists of pebbles or rounded stones cemented. It is often called improperly breccia marble.

(*s*) *Hydraulic limestone* is an impure limestone. The French varieties contain 2 or 3 p. c. of magnesia, and 10 to 20 of silica and alumina (or clay). The varieties in the United States contain 20 to 40 p. c. of magnesia, and 12 to 30 p. c. of silica and alumina. A variety worked extensively at Rondout, N. Y., afforded Professor Beck (Min. N. Y., 78) Carbonic acid 34·20, lime 25·50, magnesia 12·35, silica 15·37, alumina 9·13, sesquioxyd of iron 2·25. Oxyd of iron is rather prejudicial to it than otherwise. Vicat observes that in the best French there are 20 to 30 p. c. of clay, and in that only moderately good 10 to 12 p. c. An impure limestone of France, which needs no sand for making the cement, it containing calcite 54 p. c., clay 31, oxyd of iron 15=100, is called *plaster-cement* (Dufr. Min., ii.).

21. *soft compact limestone*. (*a*) *Chalk* is white, grayish-white, or yellowish, and soft enough to leave a trace on a board. The consolidation into a rock of such softness may be owing to the fact that the material is largely the hollow shells of rhizopods.

The *creta* of the Romans (usually translated *chalk*) was mostly a white clay, true chalk being little known to the ancients. The kind described by Pliny as the most inferior kind of cretaceous earth, and as used for marking the feet of slaves, was probably true chalk.

(*b*) *Calcareous marl* (Mergelkalk *Germ.*) is a soft earthy deposit, often hardly at all consolidated, with or without distinct fragments of shells; it generally contains much clay, and graduates into a calcareous clay.

22. *Concretionary massive*. (*a*) *Oolite* (Rogenstein *Germ.*) is a granular limestone, but its grains are minute rounded concretions, looking somewhat like the roe of fish, the name coming from ὠόν, *egg*. It occurs among all the geological formations, from the Lower Silurian to the most recent, and it is now forming about the coral reefs of Florida. (*b*) *Pisolite* (Erbsenstein *W.*) consists of concretions as large often as a small pea, or even larger, the concretions having usually a distinct concentric structure. It is formed in large masses in the vicinity of the Hot Springs at Carlsbad in Bohemia.

23. *Deposited from calcareous springs, streams, or in caverns, etc.*

(*a*) *Stalactites* are the calcareous cylinders or cones that hang from the roofs of limestone caverns, and which are formed from the waters that drip through the roof; these waters hold some bicarbonate of lime in solution, and leave carbonate of lime to form the stalactite when evaporation takes place. Stalactites vary from transparent to nearly opaque; from a granular crystalline structure to a radiating fibrous; from a white color and colorless to yellowish-gray and brown.

(*b*) *Stalagmite* is the same material covering the floors of caverns, it being made from the waters that drop from the roofs, or from sources over the bottom or sides; cones of it sometimes rise from the floor to meet the stalactites above. It consists of layers; but these are very irregularly curved, or bent, owing to the knobs and conelets that are made over the floor; and polished specimens generally owe much of their beauty to the agate-like or onyx-like bandings.

Stalagmite is the *Alabastrites* (alabaster-stone) in part (if not wholly) of Theophrastus, Pliny, and other ancient writers; that is, the stone of which ointment vases, of a certain form called *alabasters*, were made. (See GYPSUM, p. 640.) A locality near Thebes, now well known, was largely explored by the ancients, and the material has often been hence called Egyptian alabaster It was also formerly called *onyx* and *onychites;* Horace, in the 3d book of his Odes, speaks of an ointment vase of onyx. Pliny mentions columns of "onyx," or "alabastrites," that were 32 ft in height, and mentions Damascus as affording a kind whiter than that of Thebes. In the arts it is often now called *Oriental Alabaster;* and sometimes also *Gibraltar-stone*, from the occurrence of the material in a cavern at Gibraltar.

(*c*) *Calc-sinter*, *Travertine*, *Calc Tufa.* Travertine (*Confetto di Tivoli*) is of essentially the same origin with stalagmite, but is distinctively a deposit from springs or rivers, especially where in large deposits, as along the river Anio, at Tivoli, near Rome, where the deposit is scores of feet in thickness. It has a very cavernous and irregularly banded structure, owing to its mode of formation. It is the *Lapis Tiburtinus* of Vitruvius, ii. c. 7, and Pliny, xxxvi. 48, etc.; the word *travertine* being a corruption of *tiburtine*. It includes also, especially under the name of *calc tufa*, cellular depositions from the waters of small springs or sources, which often contain fossil leaves, twigs, moss, nuts or seed, etc. The *Osteocollus* (Beinwelle, Beinbruch) Gesner (p. 31, 1565), "qui ossa fracta intra corpus sumptus," as was thought at the time (*osteocolla* of later authors), is, as long since shown, a cellular calc tufa, consisting of incrustings of fragments of reeds or other marsh plants. It means *bone-glue*. *Inolite*, Gallitzin, is also calc-sinter.

(*d*) *Agaric mineral;* Rock-milk (*Bergmilch*, *Montmilch*, Germ.) is a very soft, white material, breaking easily in the fingers, deposited sometimes in caverns, or about sources holding lime in solution.

(*e*) *Rock-meal* (*Berg-mehl* Germ., *Farina fossilis* Bruckm., etc.) is white and light, like cotton, becoming a powder on the slightest pressure. It is an efflorescence, and is common near Paris, especially at the quarries of Nunterre.

Analyses: 1, 2, Stromeyer (Gilb. Ann., xlv. 225, Unters., 52); 3, Schnabel (Ramm. 3d Suppl., 62); 4, Ahrend (Hausm. Min., 1324); 5, Stromeyer (l. c.); 6, Jenzsch (Pogg., xcvi. 147); 7, Richter (Ramm. Min. Ch., 209); 8, Tyler (Am. J. Sci., II. xxxix. 174); 9, Gibbs (Ramm. 3d Suppl., 62); 10, 11, Monheim (ib.); 12, T. S. Hunt (this Min., 1854, 438); 13, Johnston (Edinb. N. J. Sci., vi. 79); 14, Delesse (Rev. Sci. et Ind., xii. 118); 15, v. Hauer (Ber. Ak. Wien, xii. 701); 16, Kæppel (J. pr. Ch., lvii. 324):

	$\ddot{C}$	$\dot{F}e$	$\dot{M}n$	$\dot{Z}n$	$\dot{M}g$	$\dot{C}a$
1. Iceland, *trp.*	43·70	0·15		—	—	56·15=100 Strom.
2. Andreasberg	43·56	0·36		—	—	55·98, $\dot{H}$ 0·10=100 Strom.
3. Brilon, Westphalia	43·52	—	—	—	0·13	55·30, $\dot{H}$ 1·07=100·02 S.
4. Höllengrunde, *gnh.*	43·92	2·19	0·50	—	0·18	53·79=100·58 Ahrend.
5. Schwarzenberg, *Schieffersp.*	41·66	—	2·70	—	—	55·00=99·36 Strom.
6. Sparta, *Spartaite*	40·77	0·38	6·83	0·38	0·92	48·75, $\dot{H}$ 0·32=98·35 J.
7. " "	44·04	7·13		—	1·21	47·92=100·30 Richter.
8. Stirling, N. J., " G.=2·815	42·01	—	13·79	—	—	43·65=99·45 Tyler.
9. Zinc m. of Olkuck	43·81	0·51	—	4·07	0·85	50·76=100 Gibbs.
10. " Altenberg	43·28	5·78	—	1·06	—	50·10=100·22 Monheim.
11. " "	43·05	5·11	0·42	0·65	—	50·26, $\ddot{Si}$ 0·18=99·67 M.

	$\dot{C}a\ddot{C}$	$\dot{F}e\ddot{C}$	$\dot{M}g\ddot{C}$	$\dot{P}b\ddot{C}$
12. Loc. ?, *Ferrocalcite*	93·90	4·64	1·59	—=100·13 Hunt. G.=2·715.
13. Wanlockhead, *Plumbocalc.*	[92·2]	—	—	7·8=100 Johnston.
14. Leadhills, "	97·61	—	—	2·34=99·95 Delesse.
15. " "	92·43	—	—	7·74=100·17 Haner. G.=2·772.
16. *Carrara Marble*	98·765	—	0·900	—, $\ddot{Si}$ 0·006, $\ddot{\bar{F}}e$, $\ddot{\bar{M}}n$, $\ddot{\bar{A}}l$ 0·083, sand 0·156, $\ddot{\bar{P}}$ and loss 0·090=100 Kæppel.

Natrocalcite afforded Marchand (J. pr. Ch., xlvi. 95) $\dot{C}a\ \ddot{C}$ 94·37, $\ddot{\bar{A}}l$, $\ddot{\bar{F}}e$ 1·15, $\dot{C}a\ \dddot{S}$ 2·02, $\dot{H}$ 1·34, gangue 1·10=99·98. Iodine has been found in certain fossiliferous limestones, as at Gouzon, by Lembert (J. d. Pharm., III. xix. 240).

Pyr., etc.—In the closed tube sometimes decrepitates, and, if containing metallic oxyds, may change its color. B.B. infusible, but becomes caustic, glows, and colors the flame red; after ignition the assay reacts alkaline; moistened with muriatic acid imparts the characteristic lime color to the flame. In borax dissolves with effervescence, and if saturated yields on cooling an opaque, milk-white, crystalline bead. Varieties containing metallic oxyds color the borax and salt of phosphorus beads accordingly. With soda on platinum foil fuses to a clear mass; on charcoal it at first fuses, but later the soda is absorbed by the coal, leaving an infusible and strongly luminous residue of lime. In the solid mass effervesces when moistened with muriatic acid, and fragments dissolve with brisk effervescence even in cold acid.

Obs.—Andreasberg in the Harz is one of the best European localities of crystallized calcite;

there are other localities in the Tyrol, Styria, Carinthia, Hungary, Saxony, Hesse Darmstadt (at Auerbach), Hesse Cassel, Norway, France, and in England in Derbyshire, Cumberland, Cornwall, Scotland; in Iceland. In Iceland a single rhombohedron (*R*) over 6 yds. long and 3 high has been observed.

In the U. States, in *N. York*, in St. Lawrence and Jefferson Cos.. especially at the Rossie lead mine; crystals highly modified (f. 560, 561), and often transparent even when large; one nearly transparent, in the cabinet of Yale College, weighing 165 pounds; often covered in part by crystals of galenite; at the Natural Dam, 2 m. from Gouverneur, in the same vicinity, good crystals; also at the Wilson vein in Gouverneur, and the Jepson vein in Rossie; at the Parish ore bed in Gouverneur, fine geodes, in specular iron; in Jefferson Co.. near Oxbow, on the land of Mr. Benton, from a decomposing limestone, large crystals sometimes as clear as Iceland spar; rose and purple varieties very beautiful; some large crystals of a hundred lbs. and upward; 4. m. S. of Oxbow, in Antwerp, a vein of calcite and lead, which affords beautiful cleavage masses of white, purple, and brownish shades; also interesting crystals; in Essex Co., town of Moriah, on Mill Brook, near Port Henry, crystals of calcite in white limestone; dog-tooth spar (f. 552A, 1^3 and also 1^3, -2), in Niagara Co., near Lockport, with pearl spar, celestite, selenite, and anhydrite; in Onondaga Co., near Camillus, along the railroad; good crystals in Herkimer Co., 1 m. S. of Little Falls, in the bed of a small stream; in Lewis Co., at Leydon and Lowville, and at the Martinsburg lead mine; on the western bank of Dry Sugar River, near Boonville, Oneida Co. (f. 552C); at Anthony's Nose on the Hudson, formerly groups of large tabular crystals (f. 553A); at Watertown, *Agaric mineral*, covering the sides of a cave; at Schoharie, fine *stalactites* in many caverns, of which Ball's cave is the most famous; at Camillus and Schoharie (near the barite locality), *fibrous*, in considerable abundance, and at De Long's Mill, St. Lawrence Co., of a fine satin lustre. In *Maine*, at Thomaston, lenticular and prismatic crystals, common. In *N. Hamp.*, at the iron mines, Franconia, *argentine*. In *Mass.*, at Williamsburg and Southampton, *argentine*. In *Conn.*, at the lead mine, Middletown, in crystals (i-2, $-\frac{1}{2}$, *I*, short or long, and 1^3, *R*). In *N. Jersey*, at Bergen, fine crystallizations of yellow calcite, with datolite, etc., in trap (f 552B); at Franklin, a pink variety, and good cleavage specimens. In *Penn.*, in York Co., Iceland spar. In *Virginia*, at the celebrated Wier's cave, *stalactites* of great beauty; also in the large caves of *Kentucky*. At the Lake Superior copper mines, splendid crystals often containing scales of native copper.

At Warsaw, Illinois, in great variety of form, lining geodes and implanted on quartz crystals; at Quincy, Ill.

In Nova Scotia, at Partridge I., a wine-colored calcite, and other interesting varieties.

Corals, of which large reefs are formed in tropical regions, consist mainly of carbonate of lime. B. Silliman, Jr., obtained for a recent species of Madrepora (Dana's Report on Zoophytes, and also Am. J. Sci., II. i. 189) Carbonate of lime 94·807, phosphates, fluorids, etc., 0·745, organic matter 4·448. And the deposit of phosphates and fluorids afforded the percentage—$\ddot{\mathrm{S}}\mathrm{i}$ 12·5, $\dot{\mathrm{C}}\mathrm{a}$ 7·5, $\dot{\mathrm{M}}\mathrm{g}$ 4·2, Mg F 26·62, Ca F 26·34, $\dot{\mathrm{M}}\mathrm{g}\,\ddot{\bar{\mathrm{P}}}$ 8·00, $\ddot{\mathrm{A}}\mathrm{l}$ and $\ddot{\bar{\mathrm{F}}}\mathrm{e}$ 14·84. Other analyses gave similar results.

The material of the common marbles is either granular or compact limestone. These rocks when burnt form quicklime.*

Alt.—Calcite occurs under the forms of dolomite, calamine, spathic iron, malachite, azurite, gypsum, smithsonite, barite, fluorite, limonite, göthite, red iron ore, minium, meerschaum, chlorite, quartz, chalcedony, garnet, feldspar, mica, pyrolusite, hausmannite, manganite, marcasite, galenite, blende, native copper. The change to *dolomite*, as Bischof explains, may take place through bicarbonate of magnesia in solution; to *spathic iron* ($\dot{\mathrm{F}}\mathrm{e}\,\ddot{\mathrm{C}}$) through sulphate of iron in solution, forming sulphate of lime and carbonate of iron; or by carbonated waters containing bicarbonate of iron, which slowly dissolve calcite, while the carbonate of iron takes its place, forming a pseudomorph by substitution; to *smithsonite* ($\dot{\mathrm{Z}}\mathrm{n}\ddot{\mathrm{C}}$) through sulphate of zinc in solution; to *calamine* ($\dot{\mathrm{Z}}\mathrm{n}^2\,\ddot{\mathrm{S}}\mathrm{i}+1\frac{1}{2}\,\dot{\mathrm{H}}$) probably by a change first to $\dot{\mathrm{Z}}\mathrm{n}\,\ddot{\mathrm{C}}$ and then to the silicate, through alkaline silicates in solution; to *malachite* through a solution of sulphate of copper, which forms carbonate of copper and sulphate of lime; to *gypsum* or *anhydrite* through the action of sulphuric acid, which acid is produced by the oxydation of sulphuretted hydrogen or otherwise, thus forming sulphate of lime; to *quartz* by waters containing alkaline silicates, which afford free silica; to *fluorite*, *limonite*, and other species, by the removal of the $\dot{\mathrm{C}}\mathrm{a}\,\ddot{\mathrm{C}}$ by waters which hold carbonic acid or alkaline silicates, and at the same time contain the ingredients forming the replacing mineral. *Limonite* or *red iron ore* might result from the decomposition of pyrite in the vicinity.

Hollow scalenohedrons from the province of Arnsberg were found by Nöggerath (Verh. nat. Ver. Bonn, 1863, 137) to consist of an exterior coating of azurite, and an interior layer of malachite.

16. DOLOMITE. Pierres calcaires très-peu effervescentes avec les acides *D. Dolomieu*, J. de Phys., xxxix. 1, 1791. Dolomie *Saussure*, Voy. Alpes, § 1929, 1796. Dolomite *Kirwan*, Min.,

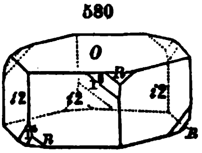
---

* For various analyses of limestones, see Rammelsberg's Handw. der Min., and Supplements, Kenngott's Uebers. for 1844–1862; the Jahresbericht of Berzelius, and its continuation.

i. 111, 1794. Bitterspath, Rhomboidalspath, Kohlensauerter Kalkerde, Bittersalzerde (with anal.), *Klapr.* Schrift. Nat. Fr. Berl., v. 51, 1784, Beitr., i. 300, 1795; also Beitr., iii. 297, iv 204, 236, v. 103, vi. 323. Spath magnésien *Delameth.*, Sciagr., i. 207, 1792. Miemit *Klapr.*, Beitr., iii. 292, 1802 (discov. at Miemo by D. Thomson in 1791, and sent by him to Kl. labelled Magnesian spar). Rautenspath pt. *Wern.*, 1800. Ludwig's Werner, i. 51, 154, 1803. Chaux carbonaté magnesifère pt., C. c. aluminifère (fr. Saussure's anal.), *H.*, Tr., 1801. Bitterkalk pt. *Hausm.*, Handb., 960, 1813; Perlspath pt., Rauhkalk, Kalktalkspath. *Germ.* Pearl Spar pt., Brown Spar pt., Rhomb Spar pt., Magnesian Limestone. Spath perlé *Fr.*

Conites, Flintkalk, *Retzius*, Min., 1795. Conite *Schumacher*, Verzeichniss, etc., 20, 1801. Konit *Germ.* Gurhofian *Karst.*, Mag. Nat. Fr. Berl., i. 4, 257, 1807, and Tabell., 50, 1808. Tharandit *Freiesleben*, Geogn. Arbeit., v. 212, 1820. Brossit *Hirzel*, ZS. f. Pharm., 24, 1850.

580



Rhombohedral. $R \wedge R = 106° \ 15'$, $O \wedge R = 136° \ 8\frac{1}{2}'$, $a = 0{\cdot}8322$. Observed planes: O, i-2, R, 4, −2, $-\frac{1}{2}$, 1^3, 1^5 (hemihedral). $O \wedge i\text{-}2 = 90°$, $O \wedge 4 = 104° \ 35'$, $O \wedge 2 = 117° \ 29'$, $O \wedge \frac{1}{2} = 154° \ 20'$, $\frac{1}{2} \wedge \frac{1}{2} = 135° \ 57'$, $2 \wedge 2 = 79° \ 36'$. $R \wedge R$ varies between 106° 10′ and 106° 20′. An increase of 100° C. diminishes the angle 4′. Cleavage: R perfect. Faces R often curved, and secondary planes usually with horizontal striæ. Twins: similar to f. 572, page 673. Also in imitative shapes; also amorphous, granular, coarse or fine, and grains often slightly coherent.

H.=3·5–4. G.=2·8–2·9, true dolomite. Lustre vitreous, inclining to pearly in some varieties. Color white, reddish, or greenish-white; also rose-red, green, brown, gray, and black. Subtransparent to translucent. Brittle.

Comp., Var.—Normal or true dolomite has the formula $\dot{Ca}\,\ddot{C} + \dot{Mg}\,\ddot{C}$ = Carbonate of lime 54·35, carbonate of magnesia 45·65. Some kinds included under the name have the two carbonates in other proportions; but this may arise from their being mixtures of dolomite with calcite or magnesite. Protoxyd of iron replaces part of the magnesia in some dolomite; so also protoxyd of manganese; and more rarely oxyd of cobalt or zinc.

The varieties are the following:

(1) *Crystallized Pearl spar* includes rhombohedral crystallizations with curved faces.

(2) *Columnar* or fibrous.

Miemite, from Miemo, Tuscany, is either in crystals, columnar, or granular, and pale asparagus-green in color.

(3) *Granular*, or *saccharoid*, constitutes many of the kinds of white statuary marble, and white and colored architectural marbles, names of some of which have been mentioned under calcite.

(4) *Compact massive*, like ordinary limestone. Many of the limestone strata of the globe are here included, and much *hydraulic limestone*, noticed under calcite.

(5) *Compact porcellanous, Gurhofian;* snow-white and subtranslucent, with a conchoidal fracture, sometimes a little opal-like; from Gurhof, in lower Austria.

(6) *Ferriferous; Brown spar*, in part. Contains carbonate of iron, and as the proportion increases it graduates into ankerite (q. v.). The color is white to brown, and becomes brownish on exposure through the oxydation of the iron. A columnar kind, containing 10 p. c. of carbonate of iron, has been called *Brossite* (anal. 19); G.=2·915. *Tharandite*, from Tharand, near Dresden, is crystallized, and contains 4 p. c. of $\dot{Fe}$.

(7) *Manganiferous.* Colorless to flesh-red. $R \wedge R = 106° \ 23'$ (anal. 20, by Ettling); 106° 16′ (anal. 21, by Ott).

(8) *Cobaltiferous.* Colored reddish (anal. 23); G.=2·921, Gibbs.

(9) The varieties based on variations in the proportions of the carbonates are the following: (*a*) *Normal dolomite*, ratio of $\dot{Ca}\,\ddot{C}$ to $\dot{Mg}\,\ddot{C}$ = 1 : 1 (anal. 1–24); (*b*) ratio $1\frac{1}{2}$: 1 = 3 : 2 (anal. 25–30); (*c*) ratio = 2 : 1 (anal. 31–33), includes *gurhofian* or *gurhofite*; (*d*) ratio 3 : 1 (anal. 34); (*e*) ratio = 5 : 1 (anal. 35); (*f*) ratio 1 : 3 (anal. 36, 37), or *conite*. The last (*f*) may be dolomitic magnesite; and the others, from *b* to *e*, dolomitic calcite, or calcite + dolomite. The manner in which dolomite is often mixed with calcite, forming its veins and its fossil shells (see below), shows that this is not improbable.

Analyses: Ratio 1 : 1. 1, Suckow (J. pr. Ch., viii. 408); 2, Lavizzari (Jahrb. Min. 1845, 302, 1846, 580); 3, Abich (G. Beob., p. iv.); 4, J. Roth (J. pr. Ch., lviii. 82); 5, Waltershausen (Pogg., xciv. 115); 6, Hirzel (ZS. Pharm., 1850, 24); 7, Rammelsberg (2d Suppl., 25); 8, Göbel (Pogg., xx. 536); 9, Scheerer (Pogg., lxv. 283); 10, Laugier (Mem. Mus. d'Hist. Nat., xix. 142); 11, Rammelsberg (Min. Ch., 213); 12, Alsop (Ann. Lyc. N. Y., viii. 104). *Containing over 3 p. c. of carbonate of iron.* 13, Meitzendorff (ib., 213); 14, Kühn (Ann. Ch. Pharm., lix. 363); 15, Pelletier (Ann. Ch. Phys., xiv. 192); 16, T. S. Hunt (this Min., 1854, 442); 17, Grimm (Jahrb. G. Reichs., vi. 98); 18, Fiedler (ib.); 19, Roth (J. pr. Ch., lviii. 82); 20, Hirzel (l. c.). *Containing manganese, zinc, or cobalt.* 21, Ettling (Ann. Ch. Pharm., xcix. 204); 22, Ott (Haid. Ber., ii. 493); 23, Monheim (Verh. nat. Ver. Bonn, v. 41); 24, W. Gibbs (Pogg., lxxi. 564).

Ratio 3 : 2, 2 : 1, 3 : 1, 5 : 1, 1 : 3. 25, Beck (Min. N. Y., 254); 26, Rammelsberg (Handw., i. 95); 27, Klaproth (Beitr., i. 300, and iii. 297); 28, Wackenroder (Schw. J., lxv. 41); 29, Abich (l. c.); 30, Kühn (l. c.); 31–33, Klaproth (Beitr., iv., v., vi.); 34, 35, Kühn (l. c.); 36, John (Schw. J., v. (vi.?) 13); 37, Hirzel (l. c.):

Ratio 1 : 1.

		Ċa C̈	Ṁg C̈	Ḟe C̈	Ṁn C̈
1.	Jena, *cryst.*, *uncol.*	55·2	44·7	——	——=99·9 Suckow.
2.	St. Gothard, *cryst.*, *gyh.-w.*	55·77	43·59	——	——=99·36 Lavizzari.
3.	V. di Sambuco, *gran.*	56·57	43·43	——	——=100 Abich.
4.	Monte Somma	57·25	42·75	——	——=100 Roth. G.=2·72.
5.	Binnen, *gran.*	55·06	44·55	——	——=99·61 Altersh. G.=2·845.
6.	Tinz, near Gera	54·02	45·28	0·79	——=100·09 Hirzel.
7.	Ilfeld, *Rauhkalk*	55·62	42·40	0·56	——=98·58 Rammelsberg.
8.	Scheidama, *gran.*	55·01	42·67	1·54	——=99·22 Göbel.
9.	Gulbrandsdal, "	55·88	40·47	2·81	——=99·16 Scheerer.
10.	Spezzia, "	55·36	41·30	2·00	——=98·66 Laugier.
11.	Miemo, *Miemite*	57·91	38·97	1·74	0·57=99·19 Rammelsberg.
12.	Westchester Co., N. Y.	54·91	43·63	1·23	——, insol. 1·30=100·07 Alsop.
13.	Zillerthal, *cryst.*	56·66	38·60	3·30	1·70=100·26 Moitzendorff.
14.	Tharand, *Tharandite*	54·76	42·10	4·19	——=101·05 Kühn.
15.	Traversella	51·00	44·32	4·68	——=100 Pelletier. G.=2·629.
16.	Roxbury, Vt., *massive*	53·90	44·04	3·05	——=100·99 Hunt. G.=2·856.
17.	Wermsdorf	53·25	38·84	5·33	——, Ḣ 1·01=98·43 Grimm.
18.	Lettonitz	54·21	39·55	6·13	——=99·89 Fiedler.
19.	La Valenciana, Mex.	53·18	34·35	10·46	Ḣ 1·22, Ḟe 0·22=99·43 Roth.
20.	Traversella, *Brosite*	52·71	33·46	11·13	2·84=100·14 Hirzel.

Ratio 1 : 1, *containing manganese, zinc, or cobalt.*

21.	Freiberg, *flesh-red*	53·20	40·15	2·14	5·23=100·71 Ettling. G.=2·830.
22.	Kapnik, *uncol.*	52·46	41·16	1·09	5·41=100·12 Ott. G.=2·89.
23.	Altenberg, *zincif.*	54·31	43·26	0·99	0·56, Żn C̈ 1·38=100·50 Monheim.
24.	Przibram, *cobaltif.*	56·77	35·70	2·03	——, Ċo C̈ 7·42=2·03 Gibbs.

Ratio 3 : 2=Ċa C̈ 64·1, Ṁg C̈ 35·9.

25.	Lockport, *Pearl spar*	59·00	39·50	1·50	——=100 Beck.
26.	Kolosoruk, *cryst.*	61·00	36·53	2·73	——=100·26 Rammelsberg.
27.	Glucksbrunn, *fib.*	60·00	36·50	4·00	——=100·50 Klaproth.
28.	Liebenstein	63·88	33·24	0·91	0·07=98·10 Wackenroder.
29.	Sorrento, Italy	65·21	34·79	——	——=100 Abich.
30.	Bohemia	61·30	32·20	6·27	——=99·77 Kühn.

Ratio 2 : 1=Ċa C̈ 70·4, Ṁg C̈ 29·6.

31.	Gurhof, *Gurhofian*	70·50	29·50	——	——=100 Klaproth.
32.	Hall, *cryst.*	68·0	25·5	1·0	——, Ḣ 2·0, clay 2·0=98·50 Klaproth
33.	Taberg, "	73·0	25·0	——	——, F̈e 2·25=100·25 Klaproth.

Ratio 3 : 1 to 5 : 1.

34.	Bohemia	77·63	18·77	3·67	——=100·07 Kühn.
35.	Kolosoruk, *cryst.*	85·84	10·39	5·53	——=101·76 Kühn.

Ratio 1 : 3.

	$\dot{Ca}\ddot{C}$	$\dot{Mg}\ddot{C}$	$\dot{Fe}\ddot{C}$
36. Meissner, *Conite*	28·0	67·4	3·5=98·9 John.
37. " "	27·53	67·97	5·05=100·55 Hirzel.

The following are analyses of some uncrystalline stratified limestones. 1, Litton, of Lower Magnesian limestone, Calciferous age (Swallow's G. Rep. Missouri, 1855); 2–5, J. D. Whitney of Trenton, Galena, and Niagara limestones (Rep. G. Iowa, 1858):

	$\dot{Ca}\ddot{C}$	$\dot{Mg}\ddot{C}$	$\dot{Fe}\ddot{C}$
1. Warsaw, Mo., *L. Magn.*	47·01	38·86	—, $\ddot{\bar{Al}}$, $\ddot{\bar{Fe}}$ 0·52, $\ddot{Si}$ 13·27=99·66 Litton.
2. New Galena, "	52·47	42·13	1·78, insol. 2·75, $\dot{Na}$, $\dot{K}$, etc. 0·87=100 Whitney.
3. Clayton Co., Iowa, *Trent. L.*	44·90	34·23	1·69, insol. 18·36=99·18 Whitney.
4. " " *Gal. L.*	52·01	42·25	0·93, insol. 4·43, $\dot{Na}$, $\dot{K}\ddot{C}$ 0·38=100 Whitney.
5. Jackson Co., Iowa, *Niag. L.*	52·18	42·64	*tr.*, insol. 3·88, $\ddot{\bar{Al}}$, $\ddot{\bar{Fe}}$ 0·63, $\dot{Na}$, $\dot{K}$, $\ddot{C}$ 0·35=99·68 W.

Very many of the limestone strata of the globe are thus partly or wholly dolomitic, though usually not as pure as in the above analyses. T. S. Hunt says that dolomites make up the chief part of the Calciferous, Clinton, Trenton, Guelph, Niagara, and Onondaga limestones of Canada (Logan's Rep., 1863, 456). In 1857 (Logan's Rep., 1857, 200) he announced that the veins and shells of some ordinary limestones were magnesian. In the Portor marble (p. 679) the body of the rock contains only 1·0 p. c. of carbonate of magnesia, and the veins 35·5 p. c. A limestone from Dudswell, Canada, contains $\dot{Ca}\ddot{C}$ 92·5, $\dot{Mg}\ddot{C}$ 1·8, sand 6·2; and the fossils are of similar composition; but a yellowish material enveloping the fossils and filling veins consists of $\dot{Ca}\ddot{C}$ 56·60, $\dot{Mg}\ddot{C}$ 11·76, $\dot{Fe}\ddot{C}$ 3·23, with 26·72 insoluble=98·31. This being a mixture of dolomite and calcite, the latter was removed by acetic acid, and the residue, 52 p. c., then afforded $\dot{Ca}\ddot{C}$ 51·75, $\dot{Mg}\ddot{C}$ 35·73, $\dot{Fe}\ddot{C}$ 12·52=100. In the Trenton limestone of Ottawa, the fossil corals, shells, and crustaceans are changed to whitish dolomite; and a fragment of an Orthoceras gave $\dot{Ca}\ddot{C}$ 56·00, $\dot{Mg}\ddot{C}$ 37·80, $\dot{Fe}\ddot{C}$ 5·95=99·75.

Pyr., etc.—B.B. acts like calcite, but does not give a clear mass when fused with soda on platinum foil. Fragments thrown into cold acid are very slowly acted upon, while in powder in warm acid the mineral is readily dissolved with effervescence. The ferriferous dolomites become brown on exposure.

Obs.—Massive dolomite constitutes extensive strata, called limestone strata, in various regions. Crystalline and compact varieties are often associated with serpentine and other magnesian rocks, and with ordinary limestones. Some of the prominent localities are at Salzburg, the Tyrol, Schemnitz in Hungary, Kapnik in Transylvania, Freiberg in Saxony, the lead mines at Alston in Derbyshire, etc.

In the U. States, in *Vermont*, at Roxbury, large, yellow, transparent crystals of the rhomb-spar variety, in talc. In *Rhode Island*, at Smithfield, a coarse cleavable variety, occasionally presenting perfect crystals, with white talc in calcite. In *N. Jersey*, at Hoboken, white hexagonal crystals (f. 580), and in rhombohedrons. In *N. York*, at Lockport, Niagara Falls, and Rochester, with calcite, celestite, and gypsum; also at Glenn's Falls; in Richmond Co., at the quarantine, crystallized dolomite, in rhombohedrons, and at the Parish ore bed, St. Lawrence Co.; on Hustis's farm in Phillipstown, a variety resembling *Gurhofite*, with a semi-opaline appearance and a fracture nearly like porcelain.

Dolomite is generally supposed to be injurious as a manure for soils, on account of its magnesia; but this is not so, unless used after calcination, before it is fully air-slaked. The lime it affords when burnt makes a more durable cement than common limestone.

Named after Dolomieu, who announced some of the marked characteristics of the rock in 1791—its not effervescing with acids, while burning like limestone, and soluble after heating in acids. He observes in his paper that, as early as 1786, he had found the white marble of many of the ancient statues and monuments of Italy to consist of this peculiar rock; and eighteen months before the date of his paper he discovered "immense quantities of similar limestones" in the Tyrol.

Woulfe, in the Phil. Trans. for 1779 (at p. 29), describes a ferriferous dolomite or ankerite, with some analytical determinations, which was in pearly rhombohedrons, resembling somewhat those of spathic iron, and came from Joachimsthal. "In its natural state" it effervesced strongly with "rectified" muriatic acid, which would indicate the presence of more iron than he obtained (5 or 6 p. c. of FeO, CO_2). It may have been ankerite.

Alt.—Dolomite occurs altered to spathic iron, calamine, steatite, limonite, red iron ore, göthite pyrolusite, and quartz, and by processes similar to those explained under calcite.

717. ANKERITE. Dolomite pt. Brown Spar and Pearl Spar pt. Paratomes Kalk-Haloid *Mohs*, Grundr., i. 536, 1822, ii. 116, 1824. Rohwand, Wandstein, *Styrian Miners.* Ankerit *Haid.*, Mohs's Min., i. 100, 1825. Tautoklin *Breith.*, Char., 70, 1832, Uib., 20, 1830.

Rhombohedral. $R \wedge R = 106° 12'$, Styria, Mohs; 106° 6′, Belnhausen (anal. 6), Ettling. Also crystalline massive, coarse or fine granular, and compact.

H.=3·5–4. G.=2·95–3·1. Lustre vitreous to pearly. Color white, gray, reddish. Translucent to subtranslucent.

Comp.—$\dot{\mathrm{Ca}}\ddot{\mathrm{C}} + (\dot{\mathrm{M}}\mathrm{g}, \dot{\mathrm{F}}\mathrm{e}, \dot{\mathrm{M}}\mathrm{n})\ddot{\mathrm{C}}$, or a dolomite in which the magnesia is more or less completely replaced by protoxyd of iron, or of iron and manganese. By the increase in the proportion of the magnesian carbonate to the iron and manganesian, the mineral graduates into true dolomite. The kinds with 10 p. c. or less of carbonate of iron are placed under dolomite, and those with more, having G. above 2·95, under ankerite.

The ratios of $\dot{\mathrm{M}}\mathrm{g}\ddot{\mathrm{C}}$ to $(\dot{\mathrm{F}}\mathrm{e}, \dot{\mathrm{M}}\mathrm{n})\ddot{\mathrm{C}}$ in the analyses below are as follows:

1.	1 : 2	6.	1·7 : 1	11.	2·7 : 1
2.	1 : 2½	7.	1·5 : 1	12.	3 : 1
3.	1 : 1·1	8.	2 : 1	13.	2·8 : 1
4.	1·3 : 1	9.	2 : 1	14.	3·1 : 1
5.	1 : 1	10.	2·1 : 1	15.	4 : 1

Tautoclin Breith., is a grayish-white variety, containing about 15 p. c. of carbonate of iron, and having G.=2 961, Ettling; from Beschertglück, near Freiberg in Saxony (anal. 11).

Analyses: 1, Fridau (Haid. Ber, v. 1); 2, Schrotter (Baumg. ZS., viii. 1); 3, Luboldt (Pogg., ii. 455); 4, v. Hauer (Jahrb. G. Reichs., iv. 827); 5, Schmidt (Ramm. Min. Ch., 217); 6, Ettling Ann. Ch. Pharm., xcix. 204); 7. Berthier (Ann. d. M., vii. 316, II. iii.); 8, v. Hauer (l. c); 9, T. Jackson (Proc. Soc. N. H., Bost., v. 246); 10, Berthier (l. c.); 11, Schmidt (Ramm. Min. Ch., 217); 12, Schnabel (ib.); 13, 14, Berthier (l. c.); 15, Kühn (Ann. Ch. Pharm., lix. 363); 16, Schweizer (J. pr. Ch., xxiii. 281):

	$\dot{\mathrm{Ca}}\ddot{\mathrm{C}}$	$\dot{\mathrm{M}}\mathrm{g}\ddot{\mathrm{C}}$	$\dot{\mathrm{F}}\mathrm{e}\ddot{\mathrm{C}}$	$\dot{\mathrm{M}}\mathrm{n}\ddot{\mathrm{C}}$
1. Admont, Styria	47·59	13·73	34·74	2·13, insol. 0·15=98·34 Fridau.
2. Styria	50·11	11·85	35·31	3·08=100·85 Schrötter.
3. Lobenstein	51·61	18·94	27·11	2·24=99·90 Luboldt. G.=3·01.
4. Pinzgau	49·40	24·31	26·29	——=100 Hauer.
5. Freiberg	56·45	18·89	15·94	10·09=101·37 Schmidt.
6. Belnhausen	51·24	27·32	21·75	——=100·31 Ettling. G.=3·008.
7. Golrath, Styria	51·1	25·7	20·0	3·0=99·8 Berthier.
8. " "	49·2	30·0	20·8	——=100 Hauer.
9. Nova Scotia	49 2	30·2	20·3	=99·70 Jackson.
10. Corniglion	50·9	29·0	18·7	0·5=99·1 Berthier.
11. *Tautoclin*	49·07	33·28	14·89	2·09=99·33 Ettling.
12. Siegen	50·00	84·08	13·26	2·57, $\dot{\mathrm{H}}$ 0·15=100·01 Schnabel.
13. Schams, Grisons	51·6	31 2	14·8	0·4=98·0 Berthier.
14. Mühlen, "	52·8	32·2	14·0	0·4=99·4 Berthier.
15. Schneeberg	52·64	86·35	12·40	0·34=101·73 Kühn.
16. Tinzen, Grisons	46 40	26·95	25·40	——, insol. 0·75=99·50 Schweizer.

In the last analysis the ratio of $(\dot{\mathrm{F}}\mathrm{e}, \dot{\mathrm{M}}\mathrm{n}, \dot{\mathrm{M}}\mathrm{g})\ddot{\mathrm{C}}$ to $\dot{\mathrm{Ca}}\ddot{\mathrm{C}}$ is 1 to less than 1; but the specimen ay have been a mixture.

Pyr., etc.—B.B. like dolomite, but darkens in color, and on charcoal becomes black and mag- tic; with the fluxes reacts for iron and manganese. Soluble with effervescence in the acids.

Obs.—Occurs with spathic iron at the Styrian mines, and at the localities above mentioned.

Named after Prof. Anker of Styria.

18. MAGNESITE. Kohlensaurer Talkerde *Mitchell & Lampadius* (first anal.) Samml. pr. Ch. Abh., iii. 241. Reine Talkerde, Talcum carbonatum, *Wern.*, Ludwig, ii. 134, 1803. Magnesite pt. *Brongn.*, Min., i. 489, 1807. Magnesit *Karst.*, Tabell., 48, 92, 1808. Carbonate of Magnesia

Magnésie carbonatée *Fr.* **Kohlensaurer Talk, Talkspath,** *Germ.* **Baudisserite** ***Delameth.*** **Min., ii. 1812. Giobertite** ***Beud.*****, Tr., 410, 1824. Breunnerite** ***Haid.*****, Mohs's Min. trl., i. 411, 1825. Walmstedtite** ***Leonh.*****, Handb., 297, 1826. Brown Spar pt.**

Rhombohedral. $R \wedge R = 107° \ 29'$, $O \wedge R = 136° \ 56'$; $a = 0{\cdot}8095$ Cleavage: rhombohedral, perfect. Also massive; granular to very compact.

H.=3·5—4·5. G.=3—3·08, cryst.; 2·8, earthy; 3—3·2, when ferriferous. Lustre vitreous; fibrous varieties sometimes silky. Color white, yellowish or grayish-white, brown. Transparent—opaque. Fracture flat conchoidal.

Var.—1. *Ordinary.* (*a*) Crystallized. In distinct rhombohedral crystals; $R \wedge R = 107° \ 28'$, fr. Snarum, Breith.; 107° 16′, fr. Tragössthal (anal. 4), Fœtterle. (*b*) *Lamellar;* cleavable. (*c*) *Compact*, fine, granular; (*d*) Compact, and like unglazed porcelain in fracture. (*e*) *Earthy;* being mixed with hydrated silicate of magnesia or sepiolite (meerschaum); including the *Baudisserite*, from Baudissero, near Turin, which has some resemblance to chalk, and adheres to the tongue. Even the purer varieties of compact magnesite usually contain more or less of the silicate.

2. *Ferriferous, Breunerite;* containing several p. c. of protoxyd of iron; G.=3—3·2; white, yellowish, brownish, rarely black and bituminous; often becoming brown on exposure, and hence called *Brown Spar.* $R \wedge R$ in mineral fr. Salzburg (anal. 16) 107° 32′, Dufr.; fr. Pfitsch (anal. 21) 107° 22½′, Mitscherlich; fr. Tyrol (anal. 19) 107° 25′, Brooke, 107° 25½′ Breith. The name *Breunerite* was originally given by Haidinger (after M. Breuner) to the variety analyzed by Stromeyer containing 5 to 10 p. c. of protoxyd of iron (or 8 to 17 p. c. of carbonate); and *Walmstedtite* to an included kind from the Harz, analyzed by Walmstedt (anal. 18), differing only in containing a little more protoxyd of manganese than usual (2 p. c.).

Comp.—Carbonate of magnesia, $\dot{\mathrm{M}}\mathrm{g}\,\ddot{\mathrm{C}}$ = Carbonic acid 52·4; magnesia 47·6=100; but protoxyd of iron often replacing some magnesia. The ferriferous part may be present as *mesitine* mixed with true magnesite.

Analyses: 1, 2, Marchand & Scheerer (J. pr. Ch., l. 395); 3, Münster (Pogg., lxv. 292); 4, v. Hauer (Jahrb. G. Reichs., 1855, 68); 5, Sommer (Jahrb. Min. 1866, 456); 6, Lampadius (l. c.); 7, 8, Stromeyer (Kastn. Arch., iv. 432, Unt.); 9, Rammelsberg (Handw., 397); 10, Marchand & Scheerer (l. c.); 11, Cornwall (Ann. Lyc. N. Y., viii. 123); 12, 13, W. Beck (Verh. Min. St. Pet., 1862, 89):

A. *Crystallized.*

		$\ddot{\mathrm{C}}$	$\dot{\mathrm{F}}\mathrm{e}$	$\dot{\mathrm{M}}\mathrm{n}$	$\dot{\mathrm{M}}\mathrm{g}$	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\mathrm{H}}$
1.	Snarum, *yw.*	51·45	0·79	——	47·29	——	0·47=100 Scheerer; G.=3·017
2.	" *w.*	51·57	1·41	——	47·02	——	——=100 Scheerer.
3.	" "	50 79	2·26	——	45·36	——	0·26, $\dddot{\mathrm{A}}\mathrm{l}$ 1·12=99·79 Münster; G.=3·065
4	Tragössthal, *w.*	52·24	0·43	——	47·25	——	——=99·92 Hauer; G.=3·033
5.	Salzburg	49·67	$\overline{\mathrm{F}}\mathrm{e}$ 3·62	0·28	44·53	0·65	——, *insol.* 0·58=99·33 Sommer

B. *Compact.*

6.	Hrubschütz	51·0	——	——	47·0	——	1·6=99·6 Lampadius.
7.	Salem, India	51·83	——	——	47·89	0·28	——=100 Strom.
8.	Frankenstein	50·22	——	0·21	48·36	——	1·39=100·18 Strom.
9.	"	52·10	——	——	47·90	——	——=100 Ramm.
10.	"	52·34	——	——	47·66	——	——=100 Scheerer.
11.	Hoboken, N. J., *white*	50·00	0·56	——	46·71	*tr.*	0·30, $\ddot{\mathrm{S}}\mathrm{i}$ 0·23=97·80 Cornwall.
12.	Orenberg, " ($\frac{3}{2}$)	51·80	0·41	——	46·13	1·20	0·68, $\ddot{\mathrm{S}}\mathrm{i}$ 0·12=100·29 Beck.
13.	L. Urgun, Russia, " ($\frac{1}{2}$)	52·90	0·04	——	45·25	1·15	0·50, $\ddot{\mathrm{S}}\mathrm{i}$ 0·20=100·04 Beck.

C. *Ferriferous Magnesite; Breunerite, Walmstedtite.*

14, v. Hauer (Jahrb. G. Reichs., iii. 154, 1852); 15, Stromeyer (Schw. J., li.); 16, Dufrénoy (Min. ii.); 17, Stromeyer (l. c.); 18, Walmstedt (Schw. J., xxxv. 398, 1822); 19, Brooke (Ann. Phil., II v. 382); 20, Stromeyer (l. c.); 21, Magnus (Pogg., x. 145); 22, Stromeyer (l. c); 23, Joy (Ramm 5th Suppl., 161):

	$\ddot{C}$	$\dot{F}e$	$\dot{M}n$	$\dot{M}g$	$\dot{C}a$	$\dot{H}$
14. Semmering, *white*	50·45	3·19	——	42·49	2·18	——, C 1·29=99·60 Hauer.
15. Hall, *black*	50·92	5·00	1·51	42·71	——	——, C 0·11=100·25 Strom.
16. Salzburg, "	50·60	5·20	——	43·10	——	——, C *undet.*=98·90 Duf.
17. St. Gothard, *yellow*	50·32	6·54	0·56	41·80	——	——=99·22 Strom.
18. Harz	49·22	6·22	1·98	40·15	——	0·51, C 1·62, $\ddot{S}i$ 0·30=100 Walm.
19. Tyrol, *yw. cryst.*	50·07	8·16	——	40·98	——	——=99·21 Brooke.
20. Zillerthal, *yw.*	49·92	8·58	0·42	40·38	——	——=99·30 Strom.
21. Potschthal, *rbdn.*	50·07	9·63	0·73	39·48	——	——=99·96 Magnus.
22. Fassa, *yw.-bn.*	50·16	10·53	0·48	34·47	——	——=100·64 Strom.
23. Zillerth., *cryst.*	49·17	16·09	——	31·60	1·97	1·17=100 Joy.

Ratio of $\dot{M}g\ddot{C}$ to $\dot{F}e\ddot{C}$ in the preceding analyses:

14.	25 : 1	18.	9 : 1	21.	7 : 1
15.	12 : 1	19.	9 : 1	22.	6 : 1
16.	12 : 1	20.	8 : 1	23.	4 : 1
17.	11 : 1				

T. S. Hunt (Logan's Rep., 1863, 457, 611) found the magnesite rock of Canada to contain 8 to 10½ p. c. of carbonate of iron, with 8 to 40 p. c. of insoluble matters, mostly mixed quartz. That of Sutton afforded $\dot{M}g\ddot{C}$ 83·35, $\dot{F}e\ddot{C}$ 9·02, mixed silica 8·03=100·40.

The white portions of the verd-antique of Roxbury, Mass., are magnesite with about 4 p. c. of carbonate of iron, as shown by Jackson, Hayes, and Hunt.

In the baudisserite, Berthier found $\ddot{C}$ 41·80, $\dot{M}g$ 39·00, meerschaum 19·20=100 (Ann. d. M., 1822, 316). A variety of the same was early analyzed by Giobert (J. d. M., xx. 291, 401, 1803), and another, from Castellamonte, by Guyton (Ann. d. Ch., xlvii. 85, 1803).

A magnesite from Sasbach. Kaiserstuhl, contains hydromagnesite. P. Meyer found (Ann. Ch. Pharm., cxv. 129), after separating the impurities, $\ddot{C}$ 45·27, $\dot{M}g$ 47·69, $\dot{C}a$ 2·47, $\dot{H}$ 4·57, equivalent to $\dot{M}g\ddot{C}$ 82·88, $\dot{C}a\ddot{C}$ 4·41, $\dot{M}g$ 8·14, $\dot{H}$ 4·57.

Pyr., etc.—B.B. resembles calcite and dolomite, and like the latter is but slightly acted upon by cold acids; in powder is readily dissolved with effervescence in warm muriatic acid.

Obs.—Found in talcose schist, serpentine, and other magnesian rocks; as veins in serpentine, or mixed with it so as to form a variety of verd-antique marble (*magnesitic ophiolite* of Hunt); also, in Canada, as a rock, more or less pure, associated with steatite, serpentine, and dolomite. The breunerite variety has been found in a meteorite from Orgueil (Descl.).

Occurs at Hrubschütz in Moravia, where it was first discovered by Mitchell; at Kraubat and Tragössthal, Styria; at Frankenstein in Silesia; Snarum, Norway; Baudissero and Castellamonte in Piedmont; at other localities above mentioned. In America, at Bolton, Mass., in indistinctly fibrous masses, traversing white limestone; at Lynnfield, Cavendish, and Roxbury, Mass., mixed with or veining serpentine; at Barehills, near Baltimore, Md.; in Penn., in crystals at West Goshen, Chester Co.; near Texas, Lancaster Co.; as a rock, in Sutton and Bolton, Canada East; in Canton Upata, Venezuela, near Mission Pastora, looking like porcelain in the fracture, as observed by N. S. Manross: in Tulare, Alameda, Mariposa, and Tuolumne Cos., California.

Delamethérie, in his Théorie de la Terre, ii. 93, 1795, uses the name magnesite for the carbonate of magnesia, sulphate, nitrate, and muriate, and the carbonate is placed first in the series. Brongniart, in his Mineralogy, ii. 489, 1807, applies the name to a group, including (1) the carbonate called *Mitchell's magnesite*, (2) meerschaum, (3) the Piedmont magnesite, and (4) other siliceous varieties. As both Brongniart and Delamethérie gave the *first* place to the carbonate, the name magnesite would rightly fall to it in case of the division of the group. Karsten, in his Tabellen, 1808, recognized this division of the species, and formally gave to the carbonate the name *magnesite*. The German mineralogists have followed Karsten, as should have been done by all. But in France, Beudant, in 1824, gave the name *giobertite* to the *carbonate*, leaving *magnesite* for the silicate, and most of the French mineralogists have followed Beudant. Giobert analyzed only the siliceous variety from Baudissero, the true composition of the mineral having been ascertained by Lampadius, somewhat earlier, from specimens brought by Mitchell from Moravia.

719. MESITITE. Mesitinspath pt. *Breith.*, Pogg., xi. 170, 1827. Mesitin *Breith.*, Pogg., lxx. 148, 1847.

Rhombohedral. $R \wedge R$=107° 14′. Cleavage rhombohedral, perfect. H.=4–4·5. G.=3·33–3·36. Lustre vitreous, or a little pearly. Color yellowish-white, yellowish-gray, yellowish-brown. Streak nearly white, or colorless. Transparent to subtranslucent.

Comp.—$2\dot{M}g\dot{C}+\dot{F}e\dot{C}$=Carbonate of magnesia 59·2. carbonate of iron 48·0=100. Analyses 1, Gibbs (Pogg., lxxi. 566); 2, Fritzsche (Pogg., lxx. 146); 3, Patera (Haid. Ber., ii. 296):

	$\dot{C}$	$\dot{F}e$	$\dot{M}g$	$\dot{C}a$	
1. Traversella	45·76	24·18	28·12	1·30=99·36 Fritzsche.	G.=3·35.
2. "	46·05	26·61	27·12	0·22=100 Gibbs	
3. Werfen, *ywh.-bn.*	45·84	27·37	26·76	——=97·97 Patera.	G.=3·33.

Pyr., etc.—B.B. blackens and becomes magnetic. But slightly acted upon in mass by cold acids; readily dissolved with effervescence when in powder by hot muriatic acid.

Obs.—From Traversella, Piedmont; Werfen, with lazulite.

Named from μεσίτης, *a go-between*, it being intermediate between magnesite and siderite. The species as first described included pistomesite.

720. PISTOMESITE. Mesitin pt. *Breith.*, Pogg., xi. 170, 1827. Pistomesit *Breith.*, Pogg. lxx. 146, 1847.

Rhombohedral. $R \wedge R=107° 18'$. Cleavage rhombohedral. Coarse granular.

H.=3·5–4. G.=3·412–3·417, Thurnberg, Breith.; 3·427, Ettling. Lustre vitreous, or somewhat pearly. Color yellowish-white to yellowish-gray. Streak uncolored.

Comp.—$\dot{M}g\dot{C}+\dot{F}e\dot{C}$=Carbonate of magnesia 42, carbonate of iron 58=100. Analyses: 1, Stromeyer (Breith., Pogg., xi. 170); 2, Fritzsche (Pogg., lxx. 146); 3, Ettling (Ann. Ch. Pharm., xcix. 204):

	$\dot{C}$	$\dot{F}e$	$\dot{M}g$	$\dot{C}a$	
1. Traversella	44·09	35·53	20·34	——=99·96 Stromeyer.	
2. Thurnberg, *Pistom.*	43·62	33·92	21·72	——=99·26 Fritzsche.	G.=3·41.
3. " "	44·57	33·15	22·29	——=100·01 Ettling.	G.=3·427.

Pyr., etc.—Closely resembling mesitite.

Obs.—Occurs at Thurnberg, near Flachau in Salzburg; also at Traversella in Piedmont.

Named by Breithaupt from πιστός and μεσίτης, after he had already used *Mesitine* (q. v.), and because pistomesite is nearer the middle between chalybite and magnesite than mesitine.

721. SIDERITE. ? Vena ferri jecoris colore optima, *Germ.* Stahelreich Eisen, *Gesner*, Foss., 90, 1565. Spatformig Jernmalm, Minera ferri alba spathiformis, *Wall.*, 256, 1747. Järn med Kalkjord förenadt, *Germ.* Stahlstein, *Cronst.*, 29, 1758. Ferrum cum magnesio et terra calcarea acido aereo mineralisatum *Bergm.*, Opusc., ii. 184, 1780. Spathiger Eisen, Spatheisenstein, *Germ.* Fer spathique *de Lisle*, iii. 281, 1783. Calcareous or Sparry Iron Ore *Kirwan.* Spathic Iron, Spathose Iron. Brown Spar pt. Steel Ore. Carbonate of Iron. Fer carbonaté, Mine d'acier, *Fr.* Kohlensaures Eisen, Eisenkalk, *Germ.* Eisenspath *Hausm.*, Handb., 951, 952, 1813. Spherosiderit *Hausm.*, ib., 1070, 1818, 1847, 1853. Siderose *Beud.*, ii. 346, 1832. Junckérite *Dufr.*, Ann. Ch. Phys., lvi. 198, 1834. Siderit *Haid*, Handb., 499, 1845. Chalybit *Glock.*, Syn, 241, 1847.

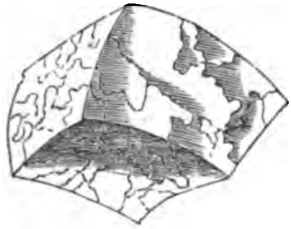
Oligonspath *Breith.*, Handb., ii. 235, 1841=Oligonit *Hausm.*, Handb., 1362, 1847. Thomait *Meyer*, Jahrb. Min. 1845, 200. Siderodot *Breith.*, Haid. Ber., i. 6, 1847. Sideroplesit *Breith.*, B. H. Ztg., xvii. 54, 1858. Thoneisenstein=Clay Iron Ore pt.

Rhombohedral. $R \wedge R=107°$, $O \wedge R=136° 37'$; $a=0·81715$. Observed planes: rhombohedral, 1, 4, −5, −2, $-\frac{1}{2}$; scalenohedral, 1^3; pyramidal, $\frac{4}{3}$-2; prismatic, I, i-2; and basal, O. The faces often curved, as below.

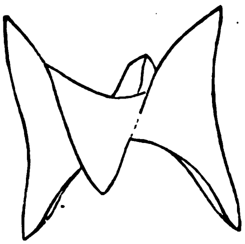
$O \wedge 2 = 117° \ 53'$ $\quad \tfrac{1}{2} \wedge \tfrac{1}{2} = 136° \ 34'$ $\quad 4 \wedge 4 = 66° \ 18'$

$O \wedge \tfrac{4}{3}\text{-}2 = 132 \ \ 30$ $\quad i \wedge R = 133 \ \ 23$ $\quad i\text{-}2 \wedge 1^{s} = 155 \ \ 45$

Cleavage: rhombohedral, perfect. Twins: plane of composition $-\tfrac{1}{2}$. Also in botryoidal and globular forms, subfibrous within, occasionally silky fibrous. Often cleavable massive, with cleavage planes undulating. Coarse or fine granular.



581



582

H.=3·5—4·5. G.=3·7—3·9. Lustre vitreous, more or less pearly. Streak white. Color ash-gray, yellowish-gray, greenish-gray, also brown and brownish-red, rarely green; and sometimes white. Translucent—subtranslucent. Fracture uneven. Brittle.

Comp., Var.—Carbonate of iron, $\dot{\mathrm{Fe}}\,\ddot{\mathrm{C}}$=Carbonic acid 37·9, protoxyd of iron 62·1. But part of the protoxyd of iron ($\dot{\mathrm{Fe}}$) usually replaced by manganese, and often by magnesia or lime.

The principal varieties are the following:

(1) *Ordinary.* (*a*) *Crystallized.* (*b*) *Concretionary=Spherosiderite;* in globular concretions, either solid or concentric scaly, with usually a fibrous structure. (*c*) *Granular* to *compact massive.* (*d*) *Oolitic*, like oolitic limestone in structure. (*e*) *Earthy*, or stony, impure from mixture with clay or sand, constituting a large part of the clay iron-stone of the Coal formation and other tratified deposits; H.=3 to 7, the last from the silica present; G.=3·0—3·8, or mostly 3·15—3·65.

(2) Through differences in the bases replacing part of the iron, there are the following kinds:

A. Containing little or no manganese ($\dot{\mathrm{Mn}}$), magnesia ($\dot{\mathrm{Mg}}$), or lime ($\dot{\mathrm{Ca}}$). G.=

B. Containing 5 to 12 p. c. of $\dot{\mathrm{Mn}}$, with little $\dot{\mathrm{Mg}}$ or $\dot{\mathrm{Ca}}$=7 $\dot{\mathrm{Fe}}\,\ddot{\mathrm{C}}+\dot{\mathrm{Mn}}\,\ddot{\mathrm{C}}$ to 4 $\dot{\mathrm{Fe}}\,\ddot{\mathrm{C}}+\dot{\mathrm{Mn}}\,\ddot{\mathrm{C}}$.

C. Containing 17 to 18 p. c. of $\dot{\mathrm{Mn}}$=2½ $\dot{\mathrm{Fe}}\,\ddot{\mathrm{C}}+\dot{\mathrm{Mn}}\,\ddot{\mathrm{C}}$.

D. Containing 25 p. c. of $\dot{\mathrm{Mn}}$=1½ $\dot{\mathrm{Fe}}\,\ddot{\mathrm{C}}+\dot{\mathrm{Mn}}\,\ddot{\mathrm{C}}$; the *oligonspar* of Breithaupt, or *oligonite*, having $R \wedge R$=107° 4′; G.=3·714—3·745; color yellowish to between flesh- and iron-red; streak yellowish-white; remarkably phosphorescent when heated.

E. Containing little manganese and much magnesia, 4 $\dot{\mathrm{Fe}}\,\ddot{\mathrm{C}}+\dot{\mathrm{Mg}}\,\ddot{\mathrm{C}}$.

F. Ditto, 2 $\dot{\mathrm{Fe}}\,\ddot{\mathrm{C}}+\dot{\mathrm{Mg}}\,\ddot{\mathrm{C}}$, the *sideroplesite*, Breith., from Pöhl, having $R \wedge R$=107° 6′, Breith.; .=3·616—3·660. Also from other localities. Von Zepharovich obtained from a cleavage hombohedron from Salzburg (anal. 21) $R \wedge R$=107° 5′ 16″, and G.=3·699.

G. Containing 20 p. c. of carbonate of lime, and looking like some calamine, the color green; om Altenberg; formula 8 $\dot{\mathrm{Fe}}\,\ddot{\mathrm{C}}+2\,\dot{\mathrm{Mn}}\,\ddot{\mathrm{C}}+3\,\dot{\mathrm{Ca}}\,\ddot{\mathrm{C}}$.

H, I. Other miscellaneous kinds.

The *siderodot* of Breithaupt is a calciferous spathic iron from Radstadt in Salzburg, having G. =3·41.

Analyses: *Division* A. 1, 2, Karsten (Karst. Archiv., ix. 220); 3, Thomson (Min., i. 445); 4, tromeyer (Unters.); 5, Bischof (Rammelsb. Min. Chemie, 222); 6, Berthier (Ann. d. M., viii. 887); Glasson (Ann. Ch. Pharm., lxii. 89). B. 8–11, Karsten (l. c.); 12, Stromeyer (l. c.); 13, Schnabel (Ramm. Min. Ch., 223). C. 14, Schnabel (Ramm. 3d Suppl., 112). D. 15, Magnus (Pogg., x. 45). E. 16, Khuen (Ramm. Min. Ch., 224). F. 17, Fritzsche (B. H. Ztg., xvii. 54); 18–20, erthier (Ann. d. M., viii. 887); 21, Sommer (Jahrb. Min. 1866, 455). G. 22, Monheim (J. pr. ., xlix. 318). H. 23, Peischel (Ramm. 1st Suppl., 139); 24, Sander (Ramm. Min. Ch., 217). I. T. G. Clemson (Am. J. Sci., xxiv. 170):

	$\dot{C}$	$\dot{Fe}$	$\dot{Mn}$	$\dot{Mg}$	$\dot{Ca}$
A.—1. Babkovsky, *black*	36·61	57·91	1·51	*tr.*	0·59, gangue 0·60=97·22 Karsten.
2. Erzberg, Styria	38·35	55·64	2·80	1·77	0·92=99·48[a] Karsten.
3. Durham, Engl.	35·90	54·57	1·15	—	3·18, Ḣ 2·63=97·43 Thomson.
4. Hanau, *Spherosid.*	38·04	59·63	1·89	—	0·20=99·91 Stromeyer.
5. L. Laach, "	38·16	60·00	—	—	1·84=100 Bischof.
6. Pierre Rousse, Isère	88·0	53·8	1·7	3·7	1·0=98·2 Berthier.
7. Bieber, *white*	38·41	53·06	4·20	2·26	1·12, gangue 0·48=100·01 Glasson
B.—8. Hackenburg, *white*	38·64	50·41	7·51	2·35	—, gangue 0·32=99·23 Karsten.
9. Siegen, *ywh.*	38·90	50·72	7·64	1·48	0·40, " 0·48=99·62 Karsten.
10. " "	38·85	47·20	8·34	3·78	0·63, " 0·95=99·72 Karsten.
11. Müsen, *white*	89·19	47·96	9·50	3·12	—=99·77 Karsten.
12. Stolberg	38·22	48·20	7·07	1·84	0·67, Ḣ 0·25=96·24 Stromeyer.
13. Stahlberg	88·50	47·16	10·61	8·23	0·50=100 Schnabel.
C.—14. Siegen, *Spherosid.*	38·22	43·59	17·87	0·24	0·08=100 Schnabel.
D.—15. Ehrenfriedersdorf, *Olig.*	38·35	36·81	25·31	—	—=100·47 Magnus.
E.—16. Mitterberg, Tyrol	39·51	51·15	1·62	7·72	—=100 Khuen. G.=3·735.
F.—17. Pöhl, Voigtland	(½) 41·93	45·06	—	12·76	—=99·15 Fritzsche. G.=3·616
18. Allevard, Isère	41·8	42·8	—	15·4	—=100 Berthier.
19. Autun	40·4	45·2	0·6	12·2	—=98·4 Berthier.
20. Vizelle, Isère	42·6	43·6	1·0	12·8	—=100 Berthier.
21. Salzburg	40·31	43·86	2·57	10·46	0·40, F̶e 4·07=101·76 Sommer.
	$\dot{Fe}\dot{C}$	$\dot{Mn}\dot{C}$		$\dot{Mg}\dot{C}$	$\dot{Ca}\dot{C}$
G.—22. Altenberg	64·04	16·56		—	20·12, S̈i 1·10 Monheim.
H.—23. Neudorf	79·34	9·69		7·60	5·43=101·06 Peischel.
24. Erzberg, Styria	79·87	0·16		10·88	11·91=100·82 Sander.
I.—25. Plymouth, Vt.	74·28	6·56		16·40	—, F̶e 0·30, insol. 1·40=98·94 C.

[a] 9·78 gangue removed.

Schnabel has analyzed many ores from different mines in Siegen, referable to division B (see l. c.).

Pyr., etc.—In the closed tube decrepitates, evolves carbonic oxyd and carbonic acid, blackens and becomes magnetic. B.B. blackens and fuses at 4·5. With the fluxes reacts for iron, and with soda and nitre on platinum foil generally gives a manganese reaction. Only slowly acted upon by cold acid, but dissolves with brisk effervescence in hot muriatic acid. Exposure to the atmosphere darkens its color, rendering it often of a blackish-brown or brownish-red color.

Obs.—Siderite occurs in many of the rock strata, in gneiss, mica slate, clay slate, and as clay ironstone in connection with the Coal formation and many other stratified deposits. It is often associated with metallic ores. At Freiberg it occurs in silver mines. In Cornwall it accompanies tin. It is also found accompanying copper and iron pyrites, galenite, vitreous copper, etc. In New York, according to Beck, it is almost always associated with specular iron. Occasionally it is to be met with in trap rocks as *spherosiderite*.

In the region in and about Styria and Carinthia this ore forms extensive tracts in gneiss, which extend along the chain of the Alps, on one side into Austria, and on the other into Salzburg. At Harzgerode in the Harz, it occurs in fine crystals in gray-wacke; also in Cornwall, Alston-Moor, and Devonshire.

The *Spherosiderite* occurs in greenstone at Hanau, Steinheim, and Dransberg, and many other places. Clay iron-stone, which is a siliceous or argillaceous carbonate of iron, occurs in coal beds near Glasgow; also at Mouillar, Magescote, etc., in France, etc.

In the United States, in *Vermont*, at Plymouth. In *Mass.*, at Sterling. In *Conn.*, at Roxbury, an extensive vein in quartz, traversing gneiss; at Monroe, Lane's mine, in small quantities. In *N. York*, at the Sterling ore bed in Antwerp, Jefferson Co., in rhombohedral crystals; at the Rossie iron mines, St. Lawrence Co. In *N. Carolina*, at Fentress and Harlem mines. The argillaceous carbonate, in nodules and beds (clay iron-stone), is abundant in the coal regions of Penn., Ohio, and many parts of the country. In a clay-bed under the Tertiary along the west side of Chesapeake Bay for 50 m.

Named *Spherosiderite* by Hausmann in 1813, from the concretionary variety, and retained by him for the whole. Haidinger reduced the name to *Siderite*, the prefix *sphero* being applicable only to an unimportant variety. Beudant's name *Siderose* has an unallowable termination. *Chalybite*, Glöcker, should yield to Haidinger's earlier name siderite, as recognized by v. Kobell and Kenngott.

Alt.—Spathic iron becomes brown or brownish-black on exposure, owing to a peroxydation of the iron and its passing to *limonite* ($\dddot{\bar{\mathrm{F}}}\mathrm{e}^2\dot{\bar{\mathrm{H}}}^3$); and by a subsequent loss of water, it may pass to *red iron ore* or *specular iron* ($\dddot{\bar{\mathrm{F}}}\mathrm{e}$), or to *magnetite* ($\dot{\mathrm{F}}\mathrm{e}\ \dddot{\bar{\mathrm{F}}}\mathrm{e}$), the last at times a result of deoxydation of $\dddot{\bar{\mathrm{F}}}\mathrm{e}$ by organic substances. It also changes by substitution, or through the action of alkaline silicates, to *quartz*.

722. **RHODOCHROSITE.** Magnesium acido aëreo mineralisatum *Bergm.*, Sciagr., 1782 (without descr. or loc.). Rother Braunsteinerz [=Red Manganese Ore], Rothspath, Magnesium ochraceum rubrum, Oxide de manganèse couleur de rose, pt., *of later part of 18th cent.* (it being confounded with the silicate analyzed by Ruprecht in 1782, and Bergmann's announcement being doubted). Luftsaures Braunsteinerz (or Carbonate, after Bergm.) pt. *Lenz*, Min., ii. 1794 (with mention of druses of small crystals in "Rhomben," others in "Pyramiden," but with cit. of Ruprecht's anal.). Manganèse oxydé carbonaté (after Bergm.) *H.*, Tabl. comp., 111, 1809. Dichter Rothstein pt. *Hausm.*, Handb., 302, 1813. Rhodochrosit, ? Kohlensaures Magnesium oxydul (fr. Lampadius's anal. of a Kapnik sp'n, in his Pr. Ch. Abh., iii. 239, 1800), *Hausm.*, ib., 1081, 1813. Carbonate of Manganese. Manganspath *Wern.* Dialogite *Jasche*, Germar, Schw. J., xxvi. 119=Blättrige Rothmanganerz *Jasche*, Kl. Min. Schrift., 4, 1817. Diallogite (wrong Orthogr.). Rosenspath, Himbeerspath, *Breith.*, Handb., 228, 229, 1841 (Char., 67, 68, 1832).

Rhombohedral. $R \wedge R = 106°\ 51'$, $O \wedge R = 136°\ 31\frac{1}{2}'$; $a = 0{\cdot}8211$. Observed planes: O; rhombohedrons, R, $-\frac{1}{2}$, -2; scalenohedrons, 1^3, $\frac{1}{4}^3$; prism, i-2. Cleavage: R, perfect. Also globular and botryoidal, having a columnar structure, sometimes indistinct. Also granular massive; occasionally impalpable; incrusting.

H.=3·5—4·5. G.=3·4—3·7; 3·592, Kapnik. Lustre vitreous inclining to pearly. Color shades of rose-red; yellowish-gray, fawn-colored, dark red, brown. Streak white. Translucent—subtranslucent. Fracture uneven. Brittle.

Comp.—$\dot{\mathrm{M}}\mathrm{n}\,\ddot{\mathrm{C}}$=Carbonic acid 38·6, protoxyd of manganese 61·4; but part of the $\dot{\mathrm{M}}\mathrm{n}$ usually replaced by lime ($\dot{\mathrm{C}}\mathrm{a}$), and often, also, by magnesia ($\dot{\mathrm{M}}\mathrm{g}$), or iron ($\dot{\mathrm{F}}\mathrm{e}$); and sometimes by cobalt ($\dot{\mathrm{C}}\mathrm{o}$), when the color is of a deeper red, and G.=3·6608, Bergemann (anal. 11). Analyses: 1, Grüner (Ann. d. M., III. xviii. 61); 2, Berthier (Ann. d. M., vi. 595); 3–5, Stromeyer (G. Anz. Gött., 1081, 1843); 6, Kersten (J. pr. Ch., xxxvii. 163); 7, 8, R. Kane (Phil. Mag., Jan., 1848); 9, Hildebrand (Verh. nat. Nassau, xiv. 434); 10, Birnbacher (Ann. Ch. Pharm., xcviii. 144); 11, Bergemann (Verh. nat. Ver. Bonn, 111, 1857):

	$\dot{\mathrm{M}}\mathrm{n}\,\ddot{\mathrm{C}}$	$\dot{\mathrm{F}}\mathrm{e}\,\ddot{\mathrm{C}}$	$\dot{\mathrm{C}}\mathrm{a}\,\ddot{\mathrm{C}}$	$\dot{\mathrm{M}}\mathrm{g}\,\ddot{\mathrm{C}}$
1.	97·1	0·7	1·0	0·8, $\dddot{\bar{\mathrm{M}}}\mathrm{n}$ 0·1=99·7 Grüner.
2. Freiberg	89·2	7·3	8·9	1·6=100 Berthier.
3. "	73·70	5·75	13·08	7·26, $\dot{\bar{\mathrm{H}}}$ 0·05=99·84 Stromeyer.
4. Kapnik	89·91	——	6·05	3·30, $\dot{\bar{\mathrm{H}}}$ 0·44=99·70 Stromeyer.
5. Nagyag	86·64	——	10·58	2·43, $\dot{\bar{\mathrm{H}}}$ 0·31=99·96 Stromeyer.
6. Voigtsberg	81·42	8·10	10·31	4·28, $\dot{\bar{\mathrm{H}}}$ 0·83=99·44 Kersten. G.=3·553.
7. Ireland	74·55	15·01	*tr.*	——, clay 0·33, org. matters & loss 10·11 Kane.
8. "	79·94	11·04	2·43	——, clay 0·37, org. matters & loss 6·22 Kane.
9. Oberneisen, *cryst.*	89·55	0·99	5·18	4·28=100 Hildebrand.
10. "	91·31	3·06	5·71	——=99·79 Birnbacher.
11. Rheinbreitbach	90·88	——	2·07	1·09, $\dot{\mathrm{C}}\mathrm{o}$ 3·71, $\dddot{\mathrm{S}}\mathrm{i}$ 1·36=99·11 Bergemann.

Pyr., etc.—B.B. changes to gray, brown, and black, and decrepitates strongly, but is infusible. With salt of phosphorus and borax in O.F. gives an amethystine-colored bead, in R.F. becomes colorless. With soda on platinum foil a bluish-green manganate. Dissolves with effervescence in warm muriatic acid. On exposure to the air changes to brown, and some bright rose-red varieties become paler.

Obs.—Occurs commonly in veins along with ores of silver, lead, and copper, and with other ores of manganese.

Found at Schemnitz and Kapnik in Hungary; Nagyag in Transylvania; near Elbingerode in the Harz; at Freiberg in Saxony; at Glendree in the County of Clare, Ireland, where it forms a layer 2 in. thick below a bog, and has a yellowish-gray color (anal. 7, 8); botryoidal at Hartshill in Warwickshire.

It has been observed in a pulverulent form, coating triplite, at Washington, Conn., on the land of Joel Camp; in New Jersey, with franklinite at Mine Hill, Franklin Furnace. Abundant at the silver mines of Austin, Nevada; at Placentia Bay, Newfoundland, in slates, fawn-colored and brown, containing 84·6 $\dot{\mathrm{M}}\mathrm{n}\,\ddot{\mathrm{C}}$, with 14·4 silica.

Named *rhodochrosite* from ῥόδον, *a rose*, and χρῶσις, *color;* and *dialogite*, from διαλογή, *doubt*. The latter name is attributed to Jasche by Germar (l. c.).

Alt.—Quartz pseudomorphs occur near Klein-Voigtsberg.

723. SMITHSONITE. Calamine pt. Galmei pt. Zincum acido aëro mineralisatum *Bergm.*, Sciagr., 144, 1782, Opusc., ii. 209, 1780 (from his own anal.). Zinkspath, Kohlengalmei, *Germ.* Carbonate of Zinc. Smithsonite *Beud.*, Tr., ii. 354, 1832. Zinkspath, Kapnit (or Capnit), *Breith.*, Handb., 241, 236, 1841. Herrerite *Del Rio* is Smithsonite *F. A. Genth*, Proc. Ac. Sci. Philad., vii. 232. Dry-bone *Miners.*

Rhombohedral. $R \wedge R = 107°\ 40'$, $O \wedge R = 137°\ 3'$; $a = 0·8062$. Observed planes: O; rhombohedrons, R, 4, $-\frac{1}{2}$, -2, $-\frac{7}{2}$, -5; scalenohedron 1^3; prism i-2. $\frac{1}{2} \wedge \frac{1}{2} = 137°\ 7'$, $2 \wedge 2 = 80°\ 33'$, $\frac{7}{2} \wedge \frac{7}{2} = 68°\ 14'$, $5 \wedge 5 = 64°\ 17'$, $O \wedge \frac{1}{2} = 155°\ 2'$. R generally curved and rough. Cleavage: R perfect. Also reniform, botryoidal, or stalactitic, and in crystalline incrustations; also granular, and sometimes impalpable, occasionally earthy and friable.

H.=5. G.=4—4·45; 4·45, Levy; 4·42, Haidinger. Lustre vitreous, inclining to pearly. Streak white. Color white, often grayish, greenish, brownish-white, sometimes green and brown. Subtransparent—translucent. Fracture uneven—imperfectly conchoidal. Brittle.

Comp., Var.—$\dot{\mathrm{Z}}\mathrm{n}\,\ddot{\mathrm{C}}$=Carbonic acid 35·2, oxyd of zinc 64·8=100; but part of the protoxyd of zinc often replaced by that of iron or manganese, and by traces of lime, magnesia; sometimes by oxyd of cadmium (anal. 9).

Varieties.—(1) *Ordinary.* (*a*) *Crystallized;* (*b*) *botryoidal* and *stalactitic*, common; (*c*) *granular* to *compact massive;* (*d*) *earthy*, impure, in nodular and cavernous masses, varying from grayish-white to dark gray, brown, brownish-red, brownish-black, and often with drusy surfaces in the cavities; "dry-bone" of American miners.

VAR. *depending on Composition.* (1) Containing less than 5 p. c. of any other carbonate, and without copper; anal. 1–10.

(2) *Ferriferous* (Zinkeisenspath), containing over 20 p. c. of carbonate of iron; *capnite* Breith., having $R \wedge R = 107°\ 7'$, Breith.; anal. 11–20.

(3) *Manganiferous*, containing over 5 p. c. of carbonate of manganese; G.=3·95—4·2; anal. 21–24.

(4) *Cupriferous*, *Herrerite* of Del Rio, apple-green, with rhombohedral cleavage; anal. 25. There are no lines of strong demarcation between these varieties based on composition.

Analyses: 1, 2, Smithson (Nicholson's J., vi. 76); 3, Heidingsfeld (Ramm. 5th Suppl.); 4, Schmidt (J. pr. Ch., li. 257); 5, Elderhorst (G. Rep. Arkansas, 153, 1858); 6, 7, H. Risse (Verh. nat. Ver. Bonn, 86, 1865); 8, v. Kobell (J. pr. Ch., xxviii. 480); 9, Long (Jahrb. Min. 1858, 289); 10, Marigny (Ann. d. M., V. xi. 672); 11–15, Monheim (Ramm. 3d Suppl., 131, J. pr. Ch., xlix 382); 16–20, H. Risse (l. c.); 21, Karsten (Syst. d. Metall., iv. 425); 22–24, Monheim (l. c.); 25 Genth (Am. J. Sci., II. xx. 119):

	$\ddot{\mathrm{C}}$	$\dot{\mathrm{Z}}\mathrm{n}$	$\dot{\mathrm{F}}\mathrm{e}$	$\dot{\mathrm{P}}\mathrm{b}$		
A.—1. Somersetshire	35·2	64 8	—	—	=100 Smithson.	G.=4·339.
2. Derbyshire	34·8	65·2	—	—	=100 Smithson.	

		C̈	Żn	Ḟe	Ṗb	
3.	Altenberg	35·13	64·56	—	0·16,	S̈i 0·15=100 Heidingsfeld.
4.	Moresnet, Belgium	33·78	63·06	0·34	—,	S̈i 1·58, Ḣ 1·28=100·04 Schmidt.
5.	Marion Co., Ark.	[31·45]	65·97	*tr.*	—,	Ċa 1·07, quartz 1·51=100 Elderhorst.

		Żn C̈	Ḟe C̈	Ṁn C̈	Ṁg C̈	Ċa C̈	
6.	Altenberg, *w. cryst.*	98·24	0·52	0·15	0·23	0·20,	insol. 0·07=99·41 Risse.
7.	" *bnh.* "	97·92	2·26	0·10	—	*tr.*	=100·28 Risse.
8.	Nertschinsk	96·00	2·03	—	—	—,	Ṗb C̈ 1·12=99·15 Kobell.
9.	Wiesloch, *ywh.*	89·97	0·57	—	0·32	2·43,	Ċa C̈ 3·36, Żn Ḣ 1·94, Zn S 0·47, sand 0·45 Long.
10.	Algiers	90·10	—	—	1·74	2·30,	Ṗb C̈ 0·44, Äs 3·30, F̈e 1·50, sand 0·30=99·68 Marigny
B.—11.	Altenberg, *gn.*	60·35	32·21	4·02	0·14	1·90,	calamine 2·49=101·11 M. G.=4·15
12.	"	55·89	36·46	3·47	—	2·27,	calamine 0·41=98 50 M. G.=4·04
13.	"	58·52	35·41	3·24	—	3·67,	calamine 0·48=101·82 Monheim.
14.	"	71·08	23·98	2·58	—	2·54	=100·18 Monheim.
15.	"	40·43	53·24	2·18	—	5·09	=100·94 Monheim.
16.	" *w. cryst.*	88·72	10·30	*tr.*	0·10	1·02,	insol. 0 18=100·32 Risse.
17.	" *leek-gn.*	84·92	13·46	0·43	0·37	1·03.	insol. *tr.*=100·21 Risse.
18.	" *ywh.-gn.*	78·32	15·66	5·23	*tr.*	1·20,	insol. *tr.*=100·41 Risse.
19.	" *ywh.*	77·31	15·43	1·16	4·04	1·66,	insol. 1·07=100·67 Risse.
20.	"	67·89	29·83	1·30	*tr.*	1·17,	insol. *tr.*=100·24 Risse.
C.—21.	Nertschinsk	89·14	—	10·71	—	—	=99·85 Karsten.
22.	Herrenberg, *gn.*	85·78	2·24	7·62	4·44	0·98,	S̈i 0·09, Ḣ *tr.*=101·15 M. G.=4·08
23.	" *pale gn.*	74·42	3·20	14·98	3·88	1·68,	S̈i 0·20, Ḣ 0·56=98·92 M. G.=3·98
24.	Altenberg, *ywh.-w.*	84·92	1·58	6·80	2·84	1·58,	calamine 1·85=99·57 M. G.=4·20
D.—25.	Albarradon, Mex.	93·74	—	1·50	0·29	1·48,	Ċu C̈ 3·42=100·43 Genth

But a part of the 24 analyses of Altenberg smithsonite by H. Risse are given above. He writes the formula nŻn C̈+m(Ḟe, Ṁn, Ṁg, Ċa) C̈. The ratio of the 1st to the 2d member in anal. 16 (above) is 7 : 1; in 17, 5 : 1; in 19, 3 : 1; in 20, 2 : 1.

Pyr., etc.—In the closed tube loses carbonic acid, and, if pure, is yellow while hot and colorless on cooling. B.B infusible; moistened with cobalt solution and heated in O.F. gives a green color on cooling. With soda on charcoal gives zinc vapors, and coats the coal yellow while hot, becoming white on cooling; this coating. moistened with cobalt solution, gives a green color after heating in O.F. Cadmiferous varieties, when treated with soda, give at first a deep yellow or brown coating before the zinc coating appears. With the fluxes some varieties react for iron, copper, and manganese. Soluble in muriatic acid with effervescence.

Obs.—Smithsonite is found both in veins and beds, especially in company with galenite and blende; also with copper and iron ores. It usually occurs in calcareous rocks, and is generally associated with calamine, and sometimes with limonite. It is often produced by the action of sulphate of zinc upon carbonate of lime or magnesia.

Found at Nertschinsk in Siberia, one variety of a dark brown color, containing cadmium, another of a beautiful bright green; at Dognatzka in Hungary; Bleiberg and Raibel in Carinthia; Wiesloch in Baden, in Triassic limestone; Moresnet in Belgium; Altenberg, near Aix la Chapelle (Aachen), in concentric botryoidal groups. In the province of Santander, Spain, between the Bay of Biscay and the continuation of the Pyrenees range, at Puente Viesgo, the mountains being only four leagues from the coast; the smithsonite here occurs in mountain limestone; in other places it is found in dolomite, probably muschelkalk; it is in vertical lodes, found frequently in scalenohedrons as a pseudomorph after calcite. At Ciguenza, 5 miles E. of Santander, the lode varies in width from 1 to 2 meters to 1 inch; the mineral is drusy, cavernous; blende is abundant, and changes into pure white smithsonite; the latter also occurs like chalcedony, in reniform and botryoidal masses; it sometimes contains galena and cerussite. In England, at Roughten Gill, Alston Moor, near Matlock, in the Mendip Hills, and elsewhere; in Scotland, at Leadhills; in Ireland, at Donegal.

In the U. States, in *Conn.*, at Brookfield in very small quantities. In *N. Jersey*, at Mine Hill, near the Franklin furnace, only pulverulent from decomposition of zincite. In *Penn.*, at Lancaster abundant, and often in fine druses of crystals, also sometimes pseudomorphous after dolomite; at the Perkiomen lead mine; at the Ueberroth mine, near Bethlehem, in scalenohedrons, also an earthy variety abundant as an ore. In *Wisconsin*, at Mineral Point, Shullsburg, etc., constituting pseudomorphs after blende and calcite. In *Minnesota*, at Ewing's diggings, N.W. of

Dubuque, etc. In *Missouri* and *Arkansas*, along with the lead ores in Lower Silurian limestone.

Alt.—Smithsonite changes through the action of alkaline silicates to calamine ($\dot{Z}n^3 \ddot{S}i + \frac{1}{2}\dot{H}$) or becomes incrusted with silica and forms quartz pseudomorphs. It is also sometimes replaced by limonite or göthite. The concretionary variety from Spain has a nucleus of calamine.

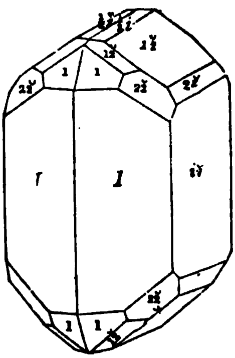
724. ARAGONITE. Spath calcaire crist. en prismes hexagones dont les deux bouts sont stries du centre à la circonference, id. dont les deux bouts sont lisses (fr. Spain), *Davila*, Cat. Cab., ii. 50. 52, 1767. Arragonischer Apatit *Wern.*, Bergm. J., i. 95, 1788; *Klapr.*, ib., i. 299, Crell's Ann., i. 387, 1788 (making it carbonate of lime). Arragonischer Kalkspath *Wern.*, Bergm. J., ii. 74. 1790 (after Klapr. anal.). Arragon Spar (var. of Calc Spar) *Kirwan*, Min., i. 87, 1794. Arragonit *Wern.*, Estner's Min., ii. 1039, 1796. Excentrischer Kalkstein *Karsten*, Tabell., 34, 74, 1800. Arragonite (first made distinct from Calc Spar through cryst.) *Haüy*, Tr., ii. 1801, and Broch. Min., i. 576, 1800. Iglit (fr. Iglo, Transylvania) *Esmark*, Bergm. J., iii. 99, 1798; Igloit. Nadelstein *Lenz.* Erbsenstein pt., Faserkalk pt., Schallenkalk pt., Sprudelstein, *Germ.* Chimborazite *E. D. Clarke*, Ann. Phil., II. ii. 57, 147, 1821. Tarnovizit *Breith.*, Handb., 252, 1841; Tarnovicit *Haid.*, Handb., 1845. Mossottite *Luca*, Cimento, vii. 453, 1858. Oserskit *Breith.*, B. H. Ztg., xvii. 54, 1858.

Stalactites Flos Ferri, Marmoreus ramulosus, *Linn.*, Syst., 183, 1768. Stalagmites coralloides *Wall.*, ii. 388, 1778. Coralloidal Aragonite. Chaux carbonaté coralloides *H.*, Tr., ii. 1801. Eisenblüthe pt. *Wern.*

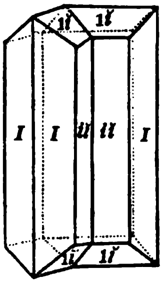
Orthorhombic. *I* ∧ *I*=116° 10′, *O* ∧ 1-ī=130° 50′; *a* : *b* : *c*=1·1571 : 1 : 1·6055. Observed planes: *O*; vertical, *I*, *i*-ĭ, *i*-ī; domes, ½-ĭ, 1-ĭ, 3/2-ĭ, 2-ĭ, 3-ĭ, 5-ĭ, 6-ĭ, 9-ĭ; 1-ī; octahedral, 1, 6, 9, 1-2̆, 2-2̆, 6-3/2̆.

O ∧ 1-ī=130° 50′
O ∧ 1=126 15
O ∧ 1-2̆=137 15
O ∧ 2-2̆=118° 25′
O ∧ ½-ĭ=160 11
O ∧ 1-ĭ=144 13
2-ĭ ∧ 2-ĭ, top,=69° 30′
1-ĭ ∧ 1-ĭ, top,=108 26
I ∧ *i*-ĭ=121 55

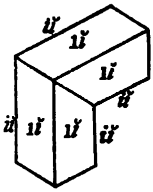
583



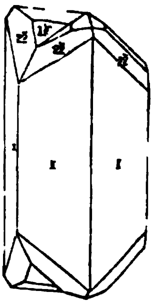
584



584A

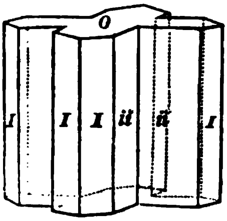


585

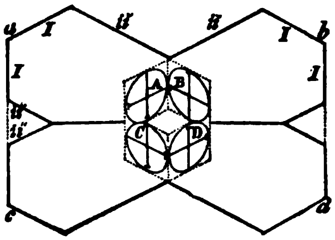


Crystals usually having *O* striated parallel to the shorter diagonal. Cleavage: *I* imperfect; *i*-ĭ distinct; 1-ĭ imperfect. Twins: composition-face *I*. (1) *Consisting of two individuals*; (*a*) the two parts with the planes *i*-ĭ largely and normally developed, f. 584 and 584A, the latter a section; prismatic angles 116° 10′ (=*I* ∧ *I*) and 121° 55′ (=*I* ∧ *i*-ĭ) with the reëntering angle, and also the opposite salient, 116° 10′; (*b*) *i*-ĭ undeveloped on one side, and the form consequently a six-sided prism, f. 585, and a section in f. 588A, and having three angles of 116° 10′ (namely, *I* ∧ *I*, *I*′ ∧ *I*′, and *i-ĭ* ∧ *i-ĭ′*), two of 121° 55′ (*I* ∧ *i-ĭ*), and one of 127° 40′ (*I* ∧ *I′*); the simple form of f. 585 is shown in f. 583; (*c*) similar to f. 584, but penetration twins, the two parts penetrating and crossing one another at middle, as in f. 586, a transverse section of which is shown in f. 587 (it may also be regarded as consisting of 4 individuals, arranged as represented by the 4 nucleal rhombs at the centre of f. 587, but two by intersection may produce the same result). (2) *Consisting of more than two individuals;* (*a*) combined about the acute angle, as the form consisting of *three* individuals, in f. 588B, a view of base, or section, the dotted lines showing the relations of the constituent parts; by extension of the combined crystals the form may be a hexagonal prism, either of simple juxtaposition or of penetration; also consisting of more than three individuals, 588C; (*b*) combined about the obtuse angle, as in f. 588D, which, by the extension of the parts, may become a hexagonal prism with or without reëntering angles; also in f. 588E, in which the three individuals extend across the middle, making a penetration twin, as illustrated by the numbering of the parts. The penetration or crossing twins often have the different parts very unequally developed (one or two of the three individuals extending across and not the other) and also of very unequal dimensions. Figures 588B to E are views of base of prism, showing the usual striæ parallel to the shorter diagonal; angle $m=r=116^\circ\ 10'$, $n=127^\circ\ 40'$, $s=168^\circ\ 30'$. (3) Twinning often many times repeated in the same crystal, producing successive reversed layers, the alternate of which may be exceedingly thin, a structure illustrated in f. 588F; often so delicate as to produce by the succession a fine striation of the faces of a prism or of a cleavage plane.

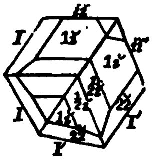
586



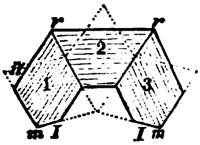
587



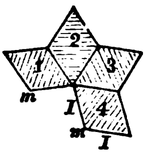
588A



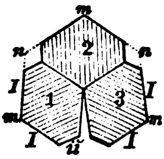
588B



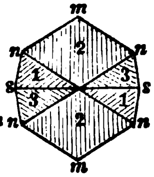
588C



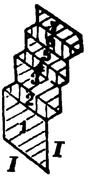
588D



588E



588F



Also globular, reniform, and coralloidal shapes; sometimes columnar, composed of straight or divergent fibres; also stalactitic; incrusting.

H.=3·5—4. G.=2·931, Haidinger; 2·927, Biot; 2·945—2·947, small crystals, and others when pulverized, Beudant; 2·932, fr. Kammsdorf, Schmid. Lustre vitreous, sometimes inclining to resinous on surfaces of fracture. Color white; also gray, yellow, green, and violet; streak uncolored. Transparent—translucent. Fracture subconchoidal. Brittle.

Var.—1. *Ordinary.* (*a*) Crystallized in simple or compound crystals, the latter much the most common; often in radiating groups of acicular crystals. (*b*) Columnar; a fine fibrous variety with silky lustre is called *Satin spar.* (*c*) Massive.

2. *Scaly massive;* snow-white (*Schaumkalk*); G.=2·984; from Wiederstadt, a pseudomorph after gypsum.

3. *Stalactitic* or *stalagmitic* (either compact or fibrous in structure); as with calcite; *Sprudelstein* is stalactitic from Carlsbad.

4. *Coralloidal;* in groupings of delicate interlacing and coalescing stems, of a snow-white color, and looking a little like coral.

5. *Tarnovicite;* a kind containing carbonate of lead, from Tarnowitz in Silesia; it has $I \wedge I$= 116° 13′, and $O \wedge$ 1-ĭ=144° 15′, Websky.

Mossottite is a light green, columnar, radiated variety, from the Lias of Gerfalco, in Tuscany, containing nearly 7 p. c. of carbonate of strontian and a trace of copper; G.=2·884. *Oserskite* is only columnar aragonite from Nertschinsk, Silesia; G.=2·854—2·855.

Slender crystals from Gross-Kammsdorf, near Saalfeld, owe their tapering form to the planes 9-ĭ, 6, and 9 (Schmid, Pogg., cxxvi. 147). Figs. 583, 585, 588 are from Naumann.

Comp.—$\dot{C}a\ddot{C}$, like calcite,=Carbonic acid 44, lime 56=100. Analyses: 1–4, Stromeyer (De Arag.; also Schw. J., xiii. 862, 490, Gilb. Ann., xliii. xlv. xlvii. xlix. li. liv. lxiii.); 5, 6, Nendtwich (Versamml. ung. Naturf. Neusohl, 1846); 7, Böttger (Pogg., xlvii. 497); 8, Stieren (Arch. Pharm., II. lxii. 81); 9, Winkler (B. H. Ztg., xxiv. 819):

	$\dot{C}a\ddot{C}$	$\dot{S}r\ddot{C}$	$\dot{P}b\ddot{C}$	$\dot{H}$	$\overline{F}e^2\dot{H}^3$
1. Brisgau	97·0963	2·4609	——	0·4102	——=99·9674 Stromeyer.
2. Nertschinsk	97·9834	1·0933	——	0·2578	——=99·3345 Stromeyer.
3. Eschwege	96·1841	2·2390	——	0·3077	0·2207=98·9515 Stromeyer.
4. Aussig	98·00	1·0145	——	0·2139	0·1449=99·3733 Stromeyer.
5. Herrengrund	98·62	0·99	——	0·17	$\overline{F}e$ 0·11=99·89 Nendtwich.
6. Retzbanya	99·81	0·06	——	0·33	$\dot{C}u\ddot{C}$ 0·19=99·89 Nendtwich.
7. *Tarnowitzite*	95·940	——	3·859	0·157	——=99·956 Böttger.
8. Papenberg	97·39	2·22	——	——	——=$\dot{H}$ 0·39=100 Stieren.
9. Alston-Moor	97·35	——	——	——	——, $\dot{M}g\ddot{C}$ 2·49, Ca F *tr.*=99·84 W.

Delesse finds in the aragonite of Herrengrund, near Neusohl, Hungary, no strontia, and 0·13 p. c. of water. A Thurnberg variety afforded E. Riegel (Jahrb. pr. Pharm., xxiii. 348), 2·2 p. c. of carbonate of strontian. A fibrous variety from Dufton in Cumberland afforded 4·25 p. c. of $\dot{M}n\ddot{C}$.

Kersten detected 2·19 p. c. of carbonate of lead in one specimen. The *Sprudelstein* of Carlsbad contains 0·69 p. c. of fluorid of calcium and 0·27 of arsenic. Jenzsch reports most aragonites as containing fluorine, and finds in one of unknown locality Ca F 3·27, $\dot{C}a^3\dddot{\dot{P}}$ 1·24 p. c.; G.=2·830.

Luca gives for the *Mossottite* (l. c.) $\ddot{C}$ 41·43, $\dot{C}a$ 50·08, $\dot{S}r$ 4 69, $\dot{C}u$ 0·95, $\overline{F}e$ 0·82, F *tr.*, $\dot{H}$ 1·36= 99·83. Plattner found only carbonate of lime in the oserskite.

Aragonite and calcite were the first case of dimorphism observed. Kirwan suggested in 1794 that the prismatic form was due to the presence of strontia, which Stromeyer disproved in 1813.

Pyr., etc.—B.B. whitens and falls to pieces, and sometimes, when containing strontia, imparts a more intensely red color to the flame than lime; otherwise reacts like calcite.

Obs.—The most common repositories of aragonite are beds of gypsum, beds of iron ore (where it occurs in coralloidal forms, and is denominated *flos-ferri*, "*flower of iron*"), basalt, and trap rock; occasionally it occurs in lavas. It is often associated with copper and iron pyrites, galenite, and malachite. It is forming at an old mine in Monte Vasa, Italy, at a temperature below the boiling point of water. It constitutes the pearly layer of shells. Minute pointed crystals occur in drusy cavities in the sinter of the thermal springs of Baden.

First discovered in Aragon, Spain (whence its name, the word in Spain having but one *r*), at Molina and Valencia, near Migranilla, in six-sided prisms, with gypsum, imbedded in a ferruginous clay. Since found at Bilin in Bohemia, in a vein traversing basalt in fine prisms; at Breisgau in Baden; at Baumgarten and Tarnowitz in Silesia; at Leogang in Salzburg, Austria; in Waltsch, Bohemia, and many other places. The *flos-ferri* variety is found in great perfection in the Styrian mines, coating cavities and even caves of considerable extent, and associated with spathic iron. At Dufton, a silky, fibrous variety, called *satin spar*, occurs traversing shale in thin veins, generally associated with pyrite. In Buckinghamshire, Devonshire, etc., it occurs in stalactitic forms in caverns, and of snowy whiteness at Leadhills in Lanarkshire.

Aragonite in fibrous crusts and other forms occurs in serpentine at Hoboken, N. J. (it has been called magnesite). Coralloidal aragonite occurs sparingly at Lockport, N. Y., coating gypsum in geodes; at Edenville, N. Y., lining cavities of arsenopyrite and cube ore; at the Parish ore bed, Rossie, N. Y.; at Haddam, Conn., in thin seams between layers of gneiss; at New Garden, in Chester Co., Penn.; at Wood's Mine, Lancaster Co., Penn.; at Warsaw, Ill., lining geodes; on the north boundary of the Creek nation, 16 m. from the crossing of the Arkansas, in hexagonal crystals nearly ½ in. through.

Alt.—Aragonite may undergo similar changes with calcite. It also passes to calcite, through paramorphism. Pseudomorphs of copper after aragonite are reported from Bolivia, and also from Corocoro, Peru.

725. MANGANOCALCITE. Manganocalcit *Breith.*, Pogg., lxix. 429, 1846. Fasriger Braunspath *Wern.*

In rhombic prisms like aragonite, and closely related to that species. Cleavage lateral, also brachydiagonal. Radiated fibrous or columnar.

H.=4–5. G.=3·037. Lustre vitreous. Flesh-red to dull reddish-white. Streak colorless. Translucent.

Comp.—2 $\dot{\mathrm{M}}\mathrm{n}\,\ddot{\mathrm{C}}+(\dot{\mathrm{C}}\mathrm{a},\ \dot{\mathrm{M}}\mathrm{g})\,\ddot{\mathrm{C}}$, with a little of the manganese replaced by iron; or of the general formula $\dot{\mathrm{R}}\,\ddot{\mathrm{C}}$. Analyses: 1, Rammelsberg (Pogg., lxviii. 511); 2, Missoudakis (Jahrb. Min. 1846, 614):

	$\dot{\mathrm{M}}\mathrm{n}\,\ddot{\mathrm{C}}$	$\dot{\mathrm{F}}\mathrm{e}\,\ddot{\mathrm{C}}$	$\dot{\mathrm{M}}\mathrm{g}\,\ddot{\mathrm{C}}$	$\dot{\mathrm{C}}\mathrm{a}\,\ddot{\mathrm{C}}$	
1.	67·48	3·22	9·97	18·81	=99·48 Ramm.
2.	77·98	3·31	——	18·71	=100 Missoudakis.

Pyr., etc.—Same as for rhodochrosite.

Obs.—From Schemnitz in Hungary, with quartz, blende, galenite, etc.

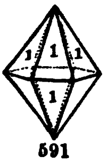
THOMAITE Mayer (Jahrb. Min. 1845, 200). A carbonate of iron, occurring in pyramidal crystallizations which are said to be orthorhombic; also massive. G.=3·10. Lustre pearly. An analysis by Meyer afforded $\ddot{\mathrm{C}}$ 33·89, $\dot{\mathrm{F}}\mathrm{e}$ 53·72, $\dot{\mathrm{M}}\mathrm{n}$ 0·65, $\dot{\mathrm{M}}\mathrm{g}$ 0·43, $\dot{\mathrm{C}}\mathrm{a}$ 1·52, $\ddot{\bar{\mathrm{A}}}\mathrm{l}$ 4·25, $\ddot{\mathrm{S}}\mathrm{i}$ 6·04=100. From Bleis-Bach, in Siebengebirge. Named after Prof. Thomä of Wiesbaden.

Junckerite of Dufrénoy was described as having the same characters, but proved to be only common spathic iron; and the same fate may befall thomaite.

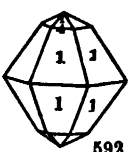
726. WITHERITE. Terra ponderosa aerata *Withering*, Trl. Bergm. Sciagr., 29, 1783, Phil. Trans., 293, 1784. Witherit *Wern.*, Bergm. J., 1790, ii. 225. Aerated Barytes *Watt*, Mem. Manchester Soc., iii. 599, 1790. Barolite *Kirwan*, Min., i. 134, 1794. Kohlensaurer Baryt *Germ.* Baryte carbonatée *Fr.*

Orthorhombic. $I \wedge I$=118° 30′, $O \wedge 1\text{-}\bar{\imath}$=128° 45′; $a : b : c$=1·246 : 1·6808. Observed planes, I, $\frac{1}{4}$, $\frac{1}{2}$, 1, $\frac{3}{2}$, 2. $O \wedge 1$=124° 35½′, $I \wedge 1$=45° 24½′, $I \wedge 2$=160° 58½′, $I \wedge \frac{3}{2}$=155° 18½′, $I \wedge \frac{1}{2}$=125° 57½′, $I \wedge \frac{1}{4}$=

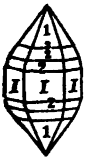
589



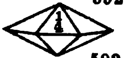
590



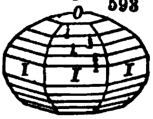
591



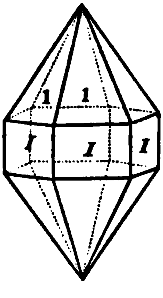
592



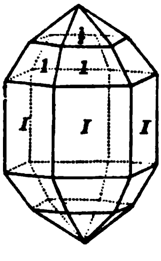
593



594



595



109° 55½′, 1 ∧ 1, mac.,=130° 13′, brach., 89° 57′, bas., 110° 49′. Twins: all the annexed figures, composition parallel to *I*; reëntering angles sometimes observed. Cleavage: *I* distinct; also in globular, tuberose, and botryoidal forms; structure either columnar or granular; also amorphous.

H.=3—3·75. G.=4·29—4·35. Lustre vitreous, inclining to resinous, on surfaces of fracture. Color white, often yellowish, or grayish. Streak white. Subtransparent—translucent. Fracture uneven. Brittle.

Comp.—$\dot{B}a\,\ddot{C}$=Carbonic acid 22·3, baryta 77·7=100. Analyses of the Anglezarke mineral: Klaproth (Beitr., i. 260, ii. 84) obtained $\ddot{C}$ 22, $\dot{B}a$ 78; Withering (l. c.), $\ddot{C}$ 21·4, $\dot{B}a$ 78·6.

Thomson's *Sulphato-carbonate of Baryta* (Rec. Gen. Sci., i. 375, 1835, and Min., i. 106) is witherite incrusted by barite, as shown by Heddle (Phil. Mag., IV. xiii. 537), who analyzed specimens from Hexham in Northumberland, and Dufton Fells in Westmoreland.

Pyr., etc.—B.B. fuses at 2 to a bead, coloring the flame yellowish green; after fusion reacts alkaline. B.B. on charcoal with soda fuses easily, and is absorbed by the coal. Soluble in dilute muriatic acid; this solution, even when very much diluted, gives with sulphuric acid a white precipitate which is insoluble in acids.

Obs.—Occurs at Alston-Moor in Cumberland, associated with galenite, in veins traversing the coal formation; at Fallowfield near Hexham in Northumberland, in splendid crystals, sometimes transparent, and occasionally 6 in. long; at Anglezarke in Lancashire, a fibrous variety; at Arkendale in Yorkshire; near St. Asaph in Flintshire; Tarnowitz in Silesia; Szlana, Hungary; Leogang in Salzburg; Peggau in Styria; Zméoff in the Altai; some places in Sicily: the mine of Arqueros, near Coquimbo, Chili; L. Etang Island; near Lexington, Ky., with barite.

Witherite is extensively mined at Fallowfield, and is used in chemical works in the manufacture of plate-glass, and in France in making beet-sugar.

Alt.—Witherite is altered to barite ($\dot{B}a\,\dddot{S}$) through the action of sulphate of lime in solution at the ordinary temperature, or by the action of other sulphates in solution, or of water containing sulphuric acid.

727. BROMLITE. Barytocalcite *J. F. W. Johnston*, Phil. Mag., III. vi. 1, 1835, x. 373, 1837. Bicalcareo-carbonate of Barytes (from a wrong anal.) *Thomson*, Rec. Gen. Sci., i. 373, 1835. Bromlite *Thoms.*, Phil. Mag., xi. 45, 48, 1837. Alstonite *Breith.*, Handb., ii. 255, 1841.

Orthorhombic. *I* ∧ *I*=118° 50′, Descl., *O* ∧ 1-ī=128° 39′; *a* : *b* : *c*=1·2504 : 1 : 1·6920. Observed planes: *O*; prism, *I*; octahedrons, 1, 2; domes, 1-ĭ, 2-ĭ. *O* ∧ 1-ĭ=143° 32½′, 1-ĭ ∧ 1-ĭ, bas.,=72° 55′, 2-ĭ ∧ 2-ĭ, bas.,=111° 50′, 1 ∧ 1, mac.,=130° 27′, 1 ∧ 1, brach.,=89° 40′. Twins: double six-sided pyramids, with angles 122° 30′, and 142°; reëntering angle 178° 51′. Cleavage: *I* and *O* rather indistinct.

H.=4—4·5. G.=3·718, Thomson; 3·706, Johnston. Lustre vitreous. Colorless, snow-white, grayish, pale cream-color, pink. Translucent. Fracture granular and uneven.

Comp.—$\dot{B}a\,\ddot{C}+\dot{C}a\,\ddot{C}$, like barytocalcite=Carb. baryta 66·3, carb. lime 33·7=100.

Analyses: 1, Johnston (l. c.); 2, Thomson (Phil. Mag., xi. 45); 3, Delesse (Ann. Ch. Phys., III. xiii. 425); 4, v. Hauer (Ber. Ak. Wien, iv. 832, 1853):

	$\dot{B}a\,\ddot{C}$	$\dot{C}a\,\ddot{C}$	$\dot{S}r\,\ddot{C}$	$\dot{M}n\,\ddot{C}$
1. Bromley	62·16	30·29	6·64	——=99·9 Johnston.
2. Fallowfield	60·63	30·19	——	9·18=100 Thomson.
3. "	65·31	32·90	1·10	——, $\dddot{S}i$ 0·20, $\dot{M}n$ 0·16=99·67 Delesse.
4. "	65·71	34·29	——	——, $\dddot{S}i$ *tr.*=100 Hauer.

Pyr., etc.—Same as in barytocalcite.

Obs.—Found at the lead mine of Fallowfield, near Hexham in Northumberland, with witherite, and at Bromley Hill near Alston in Cumberland, in veins with galenite, whence the name *Bromlite*, given by Thomson. Most English mineralogical authors have set aside Thomson's name although the earliest and of British origin, for Breithaupt's. There appears to be no sufficient reason for this.

723. **STRONTIANITE.** Strontianit *Sulzer*, Lichtenberg's Mag., vii. 3, 68, Bergm. J., 1791, i. 5. 433. Strontian *Wern.* Strontianit, Kohlensaure Strontianerde, *Klapr.*, Crell's Ann., 1793, ii. 189; 1794, i. 99; Beitr., i. 268. Mineral from Strontian, Strontian Spar (*not* Strontites=Strontia), *Hope*, Edinb. Trans., iv. 8, 1798 (Art. read Nov., 1793). Carbonate of Strontian. Strontiane carbonateé *Fr.*

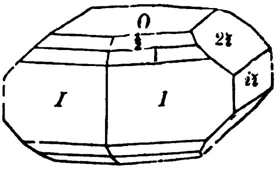
Emmonite, Calcareo-carbonate of Strontian, *Thomson*, Rec. Gen. Sci., iii. 415, 1836. Barystrontianite, Stromnite, *S. Traill*, Ed. Phil. J., i. 380, 1819.

Orthorhombic. $I \wedge I = 117° 19'$, $O \wedge 1\text{-}\bar{i} = 130° 5'$; $a : b : c = 1{\cdot}1883 : 1 : 1{\cdot}6421$. Observed planes: octahedrons, $\frac{1}{2}$, $\frac{4}{5}$, 1, $\frac{3}{2}$, 2, 3, 4, 8; domes, $\frac{1}{2}\text{-}\bar{i}$, $1\text{-}\bar{i}$, $\frac{3}{2}\text{-}\breve{i}$, $2\text{-}\breve{i}$, $4\text{-}\breve{i}$, $6\text{-}\breve{i}$, $8\text{-}\breve{i}$, $12\text{-}\bar{i}$.

$O \wedge \frac{1}{2}\text{-}\bar{i} = 149° 17'$	$O \wedge 1\text{-}\breve{i} = 144° 6'$	$1 \wedge 1$, mac., $= 130° 1'$
$O \wedge \frac{1}{2} = 145\ 11$	$1\text{-}\breve{i} \wedge 1\text{-}\breve{i}$, bas., $= 71\ 48$	$1 \wedge 1$, brach., $= 92\ 11$
$O \wedge 1 = 125\ 43$	$2\text{-}\breve{i} \wedge 2\text{-}\breve{i}$, bas., $= 110\ 44$	$1 \wedge 1$, bas., $= 108\ 35$

Cleavage: *I* nearly perfect, $i\text{-}\breve{i}$ in traces. Crystals often acicular and in divergent groups. Twins: like those of aragonite. *O* usually striated parallel to the shorter diagonal. Also in columnar globular forms; fibrous and granular.

596



H.=3·5—4. G.=3·605—3·713. Lustre vitreous; inclining to resinous on uneven faces of fracture. Color pale asparagus-green, apple-green; also white, gray, yellow, and yellowish-brown. Streak white. Transparent—translucent. Fracture uneven. Brittle.

Comp.—Carbonate of Strontia, $\dot{\text{Sr}}\,\ddot{\text{C}}$=Carbonic acid 29·8, strontia 70·2; but a small part of the strontia often replaced by lime.

Analyses: 1, Klaproth (Beitr., i. 270, ii. 84); 2, Stromeyer (Unters., i. 193); 3, Thomson (Min., i. 108); 4, Stromeyer (l. c.); 5, Jordan (Schw. J., lvii. 344); 6, Redicker (Pogg., l. 191); 7, Schnabel (Ramm. 5th Suppl.); 8, Von der Mark (Verh. nat. Ver. Bonn, vi., Jahrg., 272):

	$\ddot{\text{C}}$	$\dot{\text{Sr}}$	$\dot{\text{Ca}}$	$\dot{\bar{\text{F}}}\text{e}$	$\dot{\bar{\text{M}}}\text{n}$	$\dot{\text{H}}$
1. **Strontian.**	30·0	69·5	——	——	——	0·5=100 Klapr.
2. "	30·31	65·60	3·47	0·07		0·07=99·52 Strom.
3. "	30·66	65·53	3·52	0·01	——	——=99·72 Thomson.
4. **Bräunsdorf, Sax.**	29·94	67·52	1·28	——	0·09	0·07=98·90 Strom.
5. **Clausthal.** *white*	30·59	65·14	3·64	——	——	0·25=99·62 Jordan.
6. **Hamm, Westph.**	30·80	65·30	3·82	——	——	0·08=100 Redicker.
7. " "	30·86	64·32	4·42	——	——	——=99·60 Schnabel.
8. " "	30·84	63·57	4·80	——	——	——=99·21 Mark.

Thomson obtained in his *emmonite* (l. c.) $\dot{\text{Sr}}\,\ddot{\text{C}}$ 82·69, $\dot{\text{Ca}}\,\ddot{\text{C}}$ 12·50, $\dot{\bar{\text{F}}}\text{e}$ 1·00, zeolite 3·79=99·98. Traill's *stromnite* afforded him $\dot{\text{Sr}}\,\ddot{\text{C}}$ 68·6, $\dot{\text{Ba}}\,\dddot{\text{S}}$ (barite) 27·5, $\dot{\text{Ca}}\,\ddot{\text{C}}$ 2·6, oxyd of iron 0·1; color grayish-white; G.=3·703. It is pronounced a mixture by Greg and Lettsom. It is from near Stromness, on Pomona, one of the Orkneys.

Pyr., etc.—B.B. swells up, throws out minute sprouts, fuses only on the thin edges, and colors the flame strontia-red; the assay reacts alkaline after ignition. Moistened with muriatic acid and treated either B.B. or in the naked lamp gives an intense red color. With soda on charcoal the pure mineral fuses to a clear glass, and is entirely absorbed by the coal; if lime or iron be present they are separated and remain on the surface of the coal. Soluble in muriatic acid; the dilute solution when treated with sulphuric acid gives a white precipitate.

Obs.—Occurs at Strontian in Argyleshire, in veins traversing gneiss, along with galenite and barite, in acicular diverging and fibrous groups, rarely in perfect crystals; in Yorkshire, England; Giant's Causeway, Ireland; Clausthal in the Harz; Bräunsdorf, Saxony; Leogang in Saltzburg

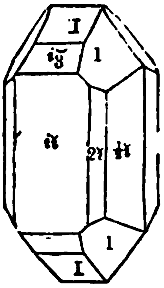
In the U. States it occurs at Schoharie, N. Y., in granular and columnar masses, and also in crystals, forming nests or geodes, often large, in the hydraulic limestone, associated with barite pyrite, and calcite. At Muscalongo Lake a massive and fibrous variety, of a white or greenish-white color, is sometimes the matrix of fluorite. Chaumont Bay and Theresa, in Jefferson Co., N. Y., are other localities.

Alt.—Strontianite is altered to celestite in the same way as witherite to barite.

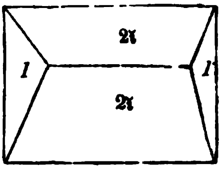
729. CERUSSITE. Ψιμύθιον *Theophr.*, etc., Cerussa *Plin.*, etc., *Agric.*, but only the artificial. Cerussa nativa ex agro Vicentino *Gesner*, Foss., 85, 1565. Blyspath (=Bleispath *Germ.*), Minera Plumbi spathacea, *Wall.*, Min., 295, 1747. Plomb spathique *Fr. Trl.* Wall. Min., i. 536, 1753. Bly-Spat, Spatum Plumbi (the hard); Bly-Ochra, Cerussa nativa (the pulverulent), *Cronst.*, Min., 1758. Plumbum acido aereo mineralisatum *Bergm.*, Opusc., ii. 426, 1780. Weissbleierz *Wern.*; Plombe blanche *Fr.*; White Lead Ore. Kohlensaures Blei *Germ.*; Carbonate of Lead; Plomb carbonaté *Fr.* Céruse *Beud.*, Tr., ii. 363, 1832. Cerussit *Haid.*, Handb., 503, 1845. Iglésiasite (Zinc-Bleispath *Kersten*) *Huot*, Min., 618, 1841.

Orthorhombic. $I \wedge I = 117° 13'$, $O \wedge 1\text{-}\bar{i} = 130° 9\frac{1}{2}'$; $a : b : c = 1{\cdot}1852 : 1 : 1{\cdot}6388$. Observed planes: O; vertical, I, $i\text{-}\breve{i}$, $i\text{-}\bar{i}$, $i\text{-}\breve{3}$, $1\text{-}\frac{5}{3}$; domes, $\frac{1}{3}\text{-}\bar{i}$, $\frac{1}{2}\text{-}\bar{i}$, $1\text{-}\bar{i}$, $2\text{-}\bar{i}$; $\frac{1}{3}\text{-}\breve{i}$, $\frac{1}{2}\text{-}\breve{i}$, $1\text{-}\breve{i}$, $2\text{-}\breve{i}$, $3\text{-}\breve{i}$, $4\text{-}\breve{i}$; octahedral, $\frac{1}{3}$, $\frac{1}{2}$, 1; $2\text{-}\breve{2}$, $2\text{-}\bar{2}$, $1\text{-}\breve{2}$, $1\text{-}\breve{3}$.

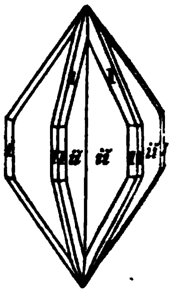
597



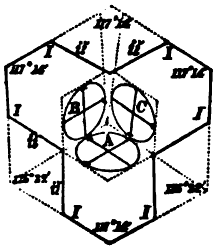
598



599



600



$O \wedge 1 = 125° 46'$
$O \wedge \frac{1}{2}\text{-}\bar{i} = 149\ 21$
$O \wedge 1\text{-}\breve{i} = 144\ 8$
$O \wedge 2\text{-}\breve{i} = 124\ 40$
$I \wedge i\text{-}\breve{i} = 121\ 24$
$i\text{-}\breve{i} \wedge 2\text{-}\breve{i} = 145\ 20$
$i\text{-}\breve{i} \wedge \frac{1}{2}\text{-}\breve{i} = 109\ 53$

$2\text{-}\breve{i} \wedge 2\text{-}\breve{i}$, bas., $= 110° 40'$
$1\text{-}\breve{i} \wedge 1\text{-}\breve{i}$, bas., $= 71\ 44$
$\frac{1}{2}\text{-}\breve{i} \wedge \frac{1}{2}\text{-}\breve{i}$, bas., $= 39\ 45$
$i\text{-}\breve{3} \wedge i\text{-}\breve{3}$, ov. $i\text{-}\breve{i}$, $= 122\ 43$
$1 \wedge 1$, mac., $= 130$
$1 \wedge 1$, brach., $= 92\ 19$
$1 \wedge 1$, bas., $= 108\ 28$

Cleavage: I often imperfect; $2\text{-}\breve{i}$ hardly less so. Crystals usually thin, broad, and brittle; sometimes stout. Twins: very common; composition face I, producing usually cruciform or stellate forms. 1. Consisting of two individuals; (*a*) similar to f. 584 under aragonite, p. 694, or to f. 600 if the left of the three rays were wanting; (*b*) cruciform, similar in mode of intersection to f. 586, 587, p. 695. 2. Consisting of more than two individuals; (*a*) three-rayed, f. 600, a view of a section, showing at centre the position of the three combined crystals; (*b*) six-rayed, f. 599, which may consist, like the last, of three combined crystals, if the crystals cross at centre so as to make a penetration-twin; the forms sometimes thin, as in f. 599, but often consisting of stout crystals similar in form to f. 597, the planes *I* in this form having the same position as *I*, *I* in f. 599.

Rarely fibrous, often granular massive and compact. Sometimes stalactitic.

H.=3—3·5. G.=6·465—6·480; some earthy varieties as low as 5·4. Lustre adamantine, inclining to vitreous or resinous; sometimes pearly; sometimes submetallic, if the colors are dark, or from a superficial change. Color white, gray, grayish-black, sometimes tinged blue or green by some of the salts of copper; streak uncolored. Transparent—subtranslucent. Fracture conchoidal. Very brittle.

Comp.—$\dot{Pb}\,\ddot{C}$=Carbonic acid 16·5, oxyd of lead 83·5=100. Analyses: 1, Westrumb (l. c); 2, Klaproth (Beitr., iii. 167); 3, J. A. Phillips (Q. J. Ch. Soc., iv. 175); 4, Bergemann (Chem. Unters. Bleib., 167, 175); 5, J. L. Smith (Am. J. Sci., II. xx. 245):

	$\ddot{C}$	$\dot{Pb}$
1. Zellerfeld	16·00	81·20, $\dot{Fe}$ 0·50, $\dot{Ca}$ 0·90=98·60 Westrumb.
2. Leadhills	16	82=98 Klaproth.
3. Durham	16·05	83·56=99·61 Phillips.
4. Eifel	16·49	83·51=100 Bergemann.
5. Phenixville, Pa.	16·38	83·76=100·14 Smith.

Stalactites from Brigham's diggings, Wis., afforded J. D. Whitney (Upp. Miss. Rep., 291, 1862) Carbonate of lead 93·84, of lime 0·18, of magnesia *tr.*, sesquioxyd of iron, etc., 1·42, clay and sand 3·43=99·27. Kersten obtained for the *iglesiasite* (Schw. J., lxv. 365) $\dot{Pb}\,\ddot{C}$ 92·10, $\dot{Zn}\,\ddot{C}$ 7·02=99·12=6 $\dot{Pb}\,\ddot{C}+\dot{Zn}\,\ddot{C}$.

Pyr., etc.—In the closed tube decrepitates, loses carbonic acid, turns first yellow, and at a higher temperature dark red, but becomes again yellow on cooling. B.B. on charcoal fuses very easily, and in R.F. yields metallic lead. Soluble in dilute nitric acid with effervescence.

Obs.—Occurs in connection with other lead minerals, and is formed from galenite (sulphid of lead), which, as it passes to a sulphate, may be changed to carbonate by means of solutions of bicarbonate of lime. It is found at Johanngeorgenstadt in beautiful crystals; at Nertschinsk and Beresof in Siberia; near Bonn on the Rhine; at Clausthal in the Harz; at Bleiberg in Carinthia; at Mies and Przibram in Bohemia; at Retzbanya, Hungary: in England, in Cornwall, in the mine of St Minvers; delicate crystals 10 in. long were formerly found near St. Austell and elsewhere; at E. Tamar mine, Devonshire; near Matlock and Wirksworth, Derbyshire; in Cardiganshire, Wales; at Leadhills and Wanlockhead. Scotland, formerly in fine crystals; in Wicklow, Ireland, magnificent, sometimes in heart-shaped macles. In pseudomorphs, imitating anglesite and leadhillite, at Leadhills.

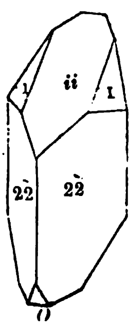
Found in *Mass.*, sparingly at the Southampton lead mine. In *Penn.*, at Phenixville, in fine crystals, often large; also good at Perkiomen. In *N. York*, at the Rossie lead mine, but rare. In *Virginia*, good crystals at Austin's mines, Wythe Co. In *N. Carolina*, at King's mine, Davidson Co., good. At Valle's diggings, Mo., but seldom crystallized; in Wisconsin and other lead mines of the northwestern States, rarely in crystals; near the Blue Mounds, Wis., at Brigham's diggings, in stalactites.

Alt.—Cerussite occurs altered to pyromorphite, or phosphate of lead; probably through the action of waters holding phosphate of lime in solution; also to galenite (Pb S) through the action of sulphuretted hydrogen, and minium by oxydation; also to breunerite, malachite, and chrysocolla.

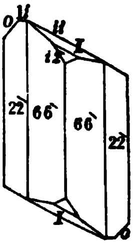
730. BARYTOCALCITE. *Brooke*, Ann. Phil., II. viii. 114, 1824.

Monoclinic. *C*=73° 52′, *I* ∧ *I*=106° 54′, *O* ∧ 1-ĭ=149°; *a* : *b* : *c*=0·81035 : 1 : 1·29583. *O* ∧ 1-*i*=147° 34′, *O* ∧ *i*-*i*=106° 8′, *i*-*i* ∧ 1-*i*=138° 34′, *i*-ĭ ∧ *i*-2̆=124°, 2-2̆ ∧ 2-2̆, over 6-6̆,=95° 8′, 6-6̆ ∧ 6-6̆, adj.,=146° 6′. Cleavage: *I*, perfect; *O*, less perfect; also massive.

603



604



H.=4. G.=3·6363–3·66. Lustre vitreous, inclining to resinous. Color white, grayish, greenish, or yellowish. Streak white. Transparent—translucent. Fracture uneven.

Comp.—$\dot{B}a\,\ddot{C}+\dot{C}a\,\ddot{C}=(\frac{1}{2}\dot{B}a+\frac{1}{2}\dot{C}a)\,\ddot{C}$=Carbonate of baryta 66·3, carbonate of lime 33·7=100. Analyses: 1, Children (Ann. Phil, viii. 116); 2, Delesse (Ann. Ch. Pharm., III. xiii. 425):

	$\dot{B}a\,\ddot{C}$	$\dot{C}a\,\ddot{C}$	$\dddot{S}i$	
1.	65·9	33·6	——	=99·5 Children.
2.	66·20	31·89	0·27	=98·36 Delesse.

Pyr., etc.—B.B. colors the flame yellowish-green, and at a high temperature fuses on the thin edges and assumes a pale green color (manganate of baryta, Plattner); the assay reacts alkaline after ignition. With the fluxes reacts for manganese. With soda on charcoal the lime is separated as an infusible mass, while the remainder is absorbed by the coal. Soluble in dilute muriatic acid.

Obs.—Occurs at Alston-Moor in Cumberland, in attached crystals and massive, in the Subcarboniferous or mountain limestone. Fig. 604 is from Brooke and Miller. Crystals 2 in. long have been obtained.

---

731. PARISITE. Musite *Medici-Spada*, 1835. Parisit *Medici-Spada*, Bunsen, Ann. Ch. Pharm., liii. 147, 1845.

Hexagonal. In elongated double six-sided pyramids, with truncated apex; basal angle 164° 58′, pyramidal 120° 34′. Cleavage: basal, very perfect.

H.=4·5. G.=4·35, Bunsen; 4·317, Dufr. Vitreous; cleavage-face pearly or resinous. Color brownish-yellow; streak yellowish-white.

Comp.—$(\dot{C}e, \dot{L}a, \dot{D}i)\,\ddot{C}+\frac{1}{2}(Ca, Ce)\,F$; whence, making $\dot{C}e:\dot{L}a:\dot{D}i=4:1:1$, as in Damour & Deville's anal., the percentage is, carbonic acid 24·5, protoxyd of cerium 40·3, protoxyd of lanthanum 10·2, protoxyd of didymium 10·4, fluorid of calcium 14·6=100. These chemists show that the water found by Bunsen is accidental. Analyses: 1, 2, Bunsen (l. c.); 3, Damour & Deville (C. R., lix. 271):

	$\ddot{C}$	$\dot{C}e$	$\dot{L}a$	$\dot{D}i$	$\dot{C}a$	$\dot{H}$	Ca F
1.	23·51		59·44		8·17	2·38	11·51
2.	23·64		60·26		3·15	2·42	10·53
3.	23·48	42·52	8·26	9·58	2·85	——	10·10, Ce F 2·16, $\dot{M}n$ *tr.*=98·95 D. & D.

Pyr., etc.—In the closed tube yields no water, but gives off carbonic acid and becomes lighter in color. B.B. glows and is infusible. With fused salt of phosphorus in the open tube gives B.B. the reaction for fluorine. With borax and salt of phosphorus in the platinum loop gives a glass, yellow while hot and colorless on cooling. Dissolves slowly in muriatic acid with effervescence.

Obs.—From the emerald mines of the Muso valley, New Granada, where it was discovered by J. J. Paris, the proprietor of the mine, and from which place it was sent in 1835 to Medici-Spada, of Rome, by Col. Acosta.

Named after J. J. Paris. The earlier name *Musite* (sometimes written *Mussite*, the name of the valley being written both Muso and Musso, as well as Muzo) is objectionable, because of the use of the name *Mussite* for a variety of amphibole.

732. **KISCHTIMITE.** Kischtim-Parisit *T. Korovaeff*, Bull. Ac. St. Pet., iv. 401, 1861, J. pr. Ch., lxxxv. 442, 1862. Kischtimite *G. J. Brush*, Am. J. Sci., II. xxxv. 427, 1863.

Amorphous.

G.=4·784. Lustre between greasy and vitreous. Color dark brownish yellow. Streak much lighter than color. In small pieces translucent. Friable.

Comp.—$6\,\dot{L}a\ddot{C}+Ce^2O^3+Ce^2F^3+2\dot{H}$, or $3\,\dot{L}a\ddot{C}+Ce^2(F,O)^3+\dot{H}$, Korovaeff,=Carbonic acid 17·6, lanthana 37·7, cerium 25·2, fluorine 7·5, oxygen 9·6, water 2·4=100. The water is probably unessential, as in parisite. Analysis: Korovaeff (l. c.):

	$\ddot{C}$	La	Ce	F	O	$\dot{H}$
(⅓)	17·19	36·56	27·81	6·35	[9·89]	2·20

Pyr., etc.—B.B. at a moderate temperature becomes dull, opaque, and opaline yellow; at a high heat glows, and on cooling has a high lustre and is brick-red. With borax in the outer flame a yellow glass, in the inner faint yellow, which becomes colorless on cooling. The powder moistened with sulphuric acid gives off fluohydric acid. Dissolves in muriatic acid, evolving carbonic acid and chlorine.

Obs.—From the gold washings of the Borsovka river, in the district of Kischtim, Urals.

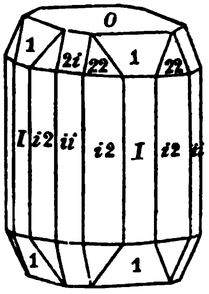
733. **PHOSGENITE.** Hornblei *Karst.*, Tab., 78, 1800. Salzsaures Bleierze *Klapr.*, Beitr., iii. 141, 1802. Corneous Lead. Bleihornerz, Chlorbleispath, *Germ.* Plomb carbonatée muriatifère, Plomb chloro-carbonaté, Plomb corné, *Fr.* Phosgen-spath *Breith.*, Char., 61, 1832. Kerasine *Beud.*, Tr., ii. 502, 1832. Phosgenit *Breith.*, Handb., ii. 183, 1841. Galenoceratite, Bleikerat, *Glocker*, Syn., 248, 1847. Cromfordite *Greg & Lettsom*, Min., 421, 1858.

Tetragonal. $O \wedge 1\text{-}i=132°\ 37'$; $a=1·0871$. Observed planes, as in the annexed figure.

$O \wedge 1=123°\ 2'$
$O \wedge 2\text{-}2=112\ 21$
$O \wedge I=90$
$O \wedge 2\text{-}i=114\ 42$

$I \wedge 1=146°\ 58'$
$1 \wedge 1$, pyr.,$=107\ 17$
$I \wedge i\text{-}i=135$

605



Sardinia.

Cleavage: I and $i\text{-}i$ bright; also basal. H.=2·75—3. G.=6—6·31. Lustre adamantine. Color white, gray, and yellow. Streak white. Transparent—translucent. Rather sectile.

Comp.—$\dot{P}b\ddot{C}+PbCl$=Carbonate of lead 49, chlorid of lead 51=100, or oxyd of lead 81·9, carbonic acid 8·1, chlorine 13·0=102·9.

Analyses: 1, Klaproth (Beitr., iii. 141, modernized); 2, Rammelsberg (Pogg., lxxxv. 141); 3, R. A. Smith (Phil. Mag., IV. ii. 121); 4, Krug v. Nidda (ZS. G., ii. 126):

	$\dot{P}b\ddot{C}$	PbCl
1. Cromford	48·4	53·5=101·9 Klaproth.
2. "	48·45	50·93=99·38 Ramm. G.=6·305.
3. "	48·22	51·78=100 Smith.
4. Tarnowitz	49·44	50·45=99·89 K. v. Nidda.

Pyr., etc.—B.B. melts readily to a yellow globule, which on cooling becomes white and crystalline. On charcoal in R.F. gives metallic lead, with a white coating of chlorid of lead. With a salt of phosphorus bead previously saturated with oxyd of copper gives the chlorine reaction. Dissolves with effervescence in nitric acid.

Obs.—At Crawford near Matlock in Derbyshire, where some of the crystals were 2 or 3 in long; very rare in Cornwall; in minute crystals at a lead mine near Elgin in Scotland, some crystals recently obtained at Crawford sold for 15 to 20 pounds sterling each; in large crystals at Gibbas (f. 605) and Monteponi in Sardinia; near Bobrek in Upper Silesia.

Recent paper on cryst., Kokscharof, Bull. Ac. St. Pet., ix. 231, 1865, from which the above figure and angles are taken.

II. HYDROUS CARBONATES.

ARRANGEMENT OF THE SPECIES.

I. Containing ammonia or soda.

735. TESCHEMACHERITE	$(\frac{1}{2}\mathrm{NH^4O}+\frac{1}{2}\mathrm{HO})\ddot{\mathrm{C}}$	$\Theta\,\Theta\mid\Theta_2\mid(\frac{1}{2}\mathrm{Am_2}+\frac{1}{2}\mathrm{H_2})$
736. NATRON	$\dot{\mathrm{Na}}\,\ddot{\mathrm{C}}+10\,\dot{\mathrm{H}}$	$\Theta\,\Theta\mid\Theta_2\mid\mathrm{Na_2}+10\,\mathrm{aq}$
737. THERMONATRITE	$\dot{\mathrm{Na}}\,\ddot{\mathrm{C}}+\dot{\mathrm{H}}$	$\Theta\,\Theta\mid\Theta_2\mid\mathrm{Na_2}+\mathrm{aq}$
738. TRONA	$(\frac{2}{3}\dot{\mathrm{Na}}+\frac{1}{3}\dot{\mathrm{H}})+\dot{\mathrm{H}}$	$\Theta\,\Theta\mid\Theta_2\mid(\frac{2}{3}\mathrm{Na_2}+\frac{1}{3}\mathrm{H_2})+\mathrm{aq}$
739. GAYLUSSITE	$(\frac{1}{2}\dot{\mathrm{Na}}+\frac{1}{2}\dot{\mathrm{C}}\mathrm{a})\ddot{\mathrm{C}}+2\frac{1}{2}\dot{\mathrm{H}}$	$\Theta\,\Theta\mid\Theta_2\mid(\frac{1}{2}\mathrm{Na_2}+\frac{1}{2}\Theta\mathrm{a})+2\frac{1}{2}\,\mathrm{aq}$

II. Containing lime or magnesia.

740. HYDROMAGNESITE	$\dot{\mathrm{Mg}}\,\ddot{\mathrm{C}}+\frac{1}{3}\dot{\mathrm{Mg}}\,\dot{\mathrm{H}}+\dot{\mathrm{H}}$	$\Theta\,\Theta\mid\Theta_2\mid\bar{\mathrm{Mg}}+\frac{1}{3}\bar{\mathrm{Mg}}\,\mathrm{H_2}\Theta_2+\mathrm{aq}$
741. HYDRODOLOMITE	$(\dot{\mathrm{C}}\mathrm{a},\dot{\mathrm{Mg}})\ddot{\mathrm{C}}+\frac{1}{3}\dot{\mathrm{H}}$	$\Theta\,\Theta\mid\Theta_2\mid(\Theta\mathrm{a},\bar{\mathrm{Mg}})+\frac{1}{3}\,\mathrm{aq}$
742. PREDAZZITE	$\dot{\mathrm{C}}\mathrm{a}\,\ddot{\mathrm{C}}+\frac{1}{2}\dot{\mathrm{Mg}}\,\dot{\mathrm{H}}$	$\Theta\,\Theta\mid\Theta_2\mid\Theta\mathrm{a}+\frac{1}{2}\bar{\mathrm{Mg}}\,\mathrm{H_2}\Theta_2$
743. PENCATITE		
744. HOVITE	$(\frac{1}{2}\dot{\mathrm{C}}\mathrm{a}+\frac{1}{2}\dot{\mathrm{H}})\ddot{\mathrm{C}}+\mathrm{aq}$	$\Theta\,\Theta\mid\Theta_2\mid(\frac{1}{2}\Theta\mathrm{a}+\frac{1}{2}\mathrm{H_2})+\mathrm{aq}$

III. Containing oxyd of cerium, lanthanum, or yttrium.

745. LANTHANITE	$\dot{\bar{\mathrm{L}}}\mathrm{a}\,\ddot{\mathrm{C}}+3\,\dot{\mathrm{H}}$	$\Theta\,\Theta\mid\Theta_2\mid\bar{\mathrm{L}}\mathrm{a}+3\,\mathrm{aq}$
746. TENGERITE	$\ddot{\mathrm{C}},\dot{\mathrm{Y}},n\,\dot{\mathrm{H}}$	

IV. Containing zinc, cobalt, nickel, copper.

747. ZARATITE	$\dot{\mathrm{Ni}}\,\ddot{\mathrm{C}}+2\,\dot{\mathrm{Ni}}\,\dot{\mathrm{H}}+3\,\dot{\mathrm{H}}$	$\Theta\,\Theta\mid\Theta_2\mid\bar{\mathrm{Ni}}+2\,\bar{\mathrm{Ni}}\,\mathrm{H_2}\Theta_2+3\,\mathrm{aq}$
748. REMINGTONITE	$\dot{\mathrm{C}}\mathrm{o},\ddot{\mathrm{C}},\dot{\mathrm{H}}$	
749. HYDROZINCITE	$\dot{\mathrm{Zn}}\,\ddot{\mathrm{C}}+2\,\dot{\mathrm{Zn}}\,\dot{\mathrm{H}}$	$\Theta\,\Theta\mid\Theta_2\mid\bar{\mathrm{Zn}}+2\,\bar{\mathrm{Zn}}\,\mathrm{H_2}\Theta_2$
750. AURICHALCITE	$\dot{\mathrm{Zn}}\,\ddot{\mathrm{C}}+\frac{3}{2}(\dot{\mathrm{C}}\mathrm{u},\dot{\mathrm{Zn}})\dot{\mathrm{H}}$	$\Theta\,\Theta\mid\Theta_2\mid\bar{\mathrm{Zn}}+\frac{3}{2}(\Theta\mathrm{u},\bar{\mathrm{Zn}})\mathrm{H_2}\Theta_2$
751. MALACHITE	$\dot{\mathrm{C}}\mathrm{u}\,\ddot{\mathrm{C}}+\dot{\mathrm{C}}\mathrm{u}\,\dot{\mathrm{H}}$	$\Theta\,\Theta\mid\Theta_2\mid\Theta\mathrm{u}+\Theta\mathrm{u}\,\mathrm{H_2}\Theta_2$
752. AZURITE	$\dot{\mathrm{C}}\mathrm{u}\,\ddot{\mathrm{C}}+\frac{1}{2}\dot{\mathrm{C}}\mathrm{u}\,\dot{\mathrm{H}}$	$\Theta\,\Theta\mid\Theta_2\mid\Theta\mathrm{u}+\frac{1}{2}\Theta\mathrm{u}\,\mathrm{H_2}\Theta_2$

V. Containing bismuth or uranium.

753. BISMUTITE	$\bar{\mathrm{Bi}}'\ \ddot{\mathrm{C}}^{3},\dot{\mathrm{H}}^{4}$
754. LIEBIGITE	$?\,\bar{\mathrm{U}}\,\ddot{\mathrm{C}}+\dot{\mathrm{C}}\mathrm{a}\,\ddot{\mathrm{C}}+20\,\dot{\mathrm{H}}$
755. VOGLITE	$\dot{\mathrm{U}},\dot{\mathrm{C}}\mathrm{a},\dot{\mathrm{C}}\mathrm{u}\,\ddot{\mathrm{C}},\dot{\mathrm{H}}$

735. TESCHEMACHERITE. Bicarbonate of Ammonia *E. F. Teschemacher*, Phil. Mag., xxviii. 548, 1846. Teschemacherite *Dana.*

In crystals having two brilliant cleavages meeting at 112°. G.=1·45. H.=1·5. Yellowish to white.

Comp.—$(\frac{1}{2} N H^4 O+\frac{1}{2} H O)\ddot{C}$=Ammonia 32·9, carbonic acid 55·7, water 11·4=100. Analysis: Phipson (J. Ch. Soc., II. i. 74):

	$\ddot{C}$	NH_4O	$\dot{H}$	$\dot{C}a$	
Chincha Islands	51·53	29·76	11·00	6·02,	$\dddot{P}$ 0·60, $\dot{M}g$, $\ddot{S}$, Cl *tr.*, alk. and uric acid 1·09=100 Phips.

The material analyzed by Phipson was white, compact, crystalline, and fragile, and had a strong odor of ammonia, from which he infers the presence either of free ammonia or of sesquicarbonate.

Pyr., etc.—In the closed tube for the most part volatilized, giving the odor of ammonia, a white sublimate of carbonate of ammonia, while an abundance of water condenses on the tube. Soluble in water, and heated with a fixed alkali gives a strong odor of ammonia. Effervesces with acids. Reacts alkaline to test paper.

Obs.—From guano deposits on the coast of Africa and Patagonia, and the Chincha Islands. Forms a bed several inches thick in the lowest parts of the guano deposits of Patagonia, as announced by Teschemacher; and similarly at the Chincha Islands, according to Phipson.

Bicarbonate of potash has been announced by Pisani (C. R., lx. 918, 1865) as found under a dead tree at Chypis in Valais, as a result of recent decomposition, and has been called by him Kalicine; he regarding it as a mineral as much as struvite. (Struvite has better claims, however, as it occurs in guano deposits, some of which date from the Post-tertiary at least.) He obtained for its composition Carbonic acid 42·20, potash 42·60, water 7·76, $\dot{C}a\,\ddot{C}$ 2·50, $\dot{M}g\,\ddot{C}$ 1·34, sand, etc. 3·60=100.

736. NATRON. Νιτρον, Nitrum, *of the Ancients.* Carbonate of Soda. Soude carbonatée.

Monoclinic: C=58° 52′, $I \wedge I$=76° 28′, $O \wedge 1\text{-}\grave{\imath}$=140° 9½′. Cleavage: O distinct; $i\text{-}\grave{\imath}$ imperfect; I in traces.

H.=1–1·5. G.=1·423. Vitreous to earthy. White, sometimes gray or yellow, owing to impurities. Taste alkaline.

Comp.—$\dot{N}a\,\ddot{C}+10\,\dot{H}$=Carbonic acid 26·7, soda 18·8, water 54·5. Effervesces strongly with nitric acid.

Obs.—Occurs in nature only in solution, or mixed with the other carbonates of soda. See under *Trona* and *Thermonatrite.*

737. THERMONATRITE. Νιτρον and Nitrum pt. *Vet.* Natron, Alkali orientale impurum terrestre, Jordblandadt Alkaliskt-salt, *Wall.*, Min., 174, 1747. Naturliches mineralisches Alkali *Wern.*; Thermonatrit *Haid.*, Handb., 487, 1845. Thermonitrit *Hausm.*, Handb., 1411, 1847. Soude carbonatée prismatique.

Orthorhombic. Observed planes: I, $i\text{-}\breve{2}$, $i\text{-}\bar{\imath}$, $1\text{-}\bar{\imath}$, $\frac{1}{2}$. $I \wedge i\text{-}\bar{\imath}$=138° 5′, $i\text{-}\breve{2} \wedge i\text{-}\breve{2}$, front,=58° 14′, lat.,=121° 46′, $1\text{-}\bar{\imath} \wedge 1\text{-}\bar{\imath}$, top,=107° 50, $i\text{-}\bar{\imath} \wedge 1\text{-}\bar{\imath}$ =126° 5′, $i\text{-}\bar{\imath} \wedge \frac{1}{2}$=109° 6′, $I \wedge \frac{1}{2}$=116° 5′, $I \wedge I$=96° 10′. In rectangular tables flattened parallel to $i\text{-}\bar{\imath}$, with sides bevelled by I and $1\text{-}\bar{\imath}$. Usual as an efflorescence.

H.=1–1·5. G.=1·5–1·6. Lustre vitreous. White, grayish, yellowish.

Comp.—$\dot{N}a\,\ddot{C}+\dot{H}$=Carbonic acid 35·5, soda 50·0, water 14·5=100. Analyses: 1, 2, Beudant (Tr., ii. 310); 3, Pfeiffer (Ann. Ch. Pharm., lxxxix. 219):

	$\dot{Na}\ddot{C}$	$\dot{Na}\dddot{S}$	Na Cl, etc.	$\dot{H}$
1. Debreczin	73·6	10·4	2·2	13·8=100 Beudant.
2. Egypt	74·7	7·3	3·1	13·5, earthy matter 4·1=100 Beudant.
3. E. Indies	52·89	11·44	0·77	28·25, $\dot{K}\ddot{C}$ 6·65=100 Pfeiffer.

Obs.—Crystals may be obtained from a solution at a temperature between 25° and 37° C. It occurs in various lakes, and as an efflorescence over the soil in many dry regions of the globe; also about some mines and volcanoes.

There appears to be also an *anhydrous* carbonate of soda in nature. Kayser obtained for a specimen from the Neue Margarethe mine, near Clausthal. $\dot{Na}\ddot{C}$ 92·07, $\dot{Mg}\ddot{C}$ 3·32, $\dot{Ca}\ddot{C}$ 1·81, $\dot{Fe}\ddot{C}$ 0·19, $\dot{H}$ 1·85. And Wackenroder gives for the composition of a substance from Debreczin, Hungary, $\dot{Na}\ddot{C}$ 92·30, $\dot{Na}\dddot{S}$ 1·67, $\dot{K}\dddot{S}$ 0·03, $\dot{Na}\dddot{P}$ 1·47, Na Cl 4·46=99·93; but it is said that the latter may be from an artificial product.

Crystals of the simple carbonate of soda (natron) become thermonatrite in efflorescing.

738. TRONA. Trona *Bagge*, Ac. H. Stockh., xxxv. 1773. Natrum von Tripole, Stralige Natrum, *Klaproth*, Beitr., iii. 83, 1802. Sesquicarbonate of Soda. Urao *Boussingault*, Ann. d. M., xii. 278.

Monoclinic. *O* ∧ *i-i*=103° 15′. Cleavage: *i-i* perfect. Often fibrous or columnar massive.

H.=2·5–3. G.=2·11. Lustre vitreous, glistening. Color gray or yellowish-white. Translucent. Taste alkaline. Not altered by exposure to a dry atmosphere.

Comp.—$\dot{Na}^2\ddot{C}^3+4\dot{H}=(\frac{2}{3}\dot{Na}+\frac{1}{3}\dot{H})\ddot{C}+\dot{H}$=Carbonic acid 40·2, soda 37·8, water 22·0. Analysis by Klaproth of the African (Beitr., iii. 83): Carbonic acid 38, soda 37, water 22·5, sulphate of soda 2·5=100; by Boussingault of the *urao* (l. c.): $\ddot{C}$ 39·00, $\dot{Na}$ 41·22, $\dot{H}$ 18·80=99·02. The African is often mixed with the simple carbonate of soda, thermonatrite, and common salt. A specimen of trona from an extensive bed in Churchill County, Nevada, gave on analysis by C. S. Rodman (priv. contrib.), $\ddot{C}$ 38·70, $\dot{Na}$ 39·97, $\dot{H}$ 19·42, Na Cl 1·88, $\dot{Na}\dddot{S}$ 0·39, $\dddot{Si}$ 0·13=100·49.

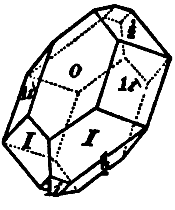
Pyr., etc.—In the closed tube yields water and carbonic acid. B.B. imparts an intensely yellow color to the flame. Soluble in water, and effervesces with acids. Reacts alkaline with moistened test paper.

Obs.—The specimen analyzed by Klaproth came from the province of Suckenna, two days' journey from Fezzan, Africa. It is found at the foot of a mountain, forming a crust varying from the thickness of an inch to that of the back of a knife-blade. To this species belongs the urao found at the bottom of a lake in Maracaibo, S. A., a day's journey from Merida. Efflorescences of trona occur near the Sweetwater river, Rocky Mountains, mixed with sulphate of soda and common salt.

739. GAY-LUSSITE. *Boussingault*, Ann. Ch. Phys., xxxi. 270, 1826.

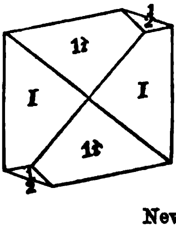
Monoclinic. *C*=78° 27′, *I* ∧ *I*=68° 50′ and 111° 10′, *O* ∧ 1-ì=125° 15′; *a* : *b* : *c*=0·96945 : 1 : 0·67137. Observed planes: *O*; vertical, *I*, *i-i*, *i-ì*; dome, 1-*i*, 1-ì; hemioctahedral, ½. Angles from Phillips.

606

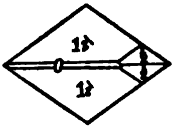


Maracaibo.

607



607A



Nevada.

O ∧ 1-*i*=130° 21′
O ∧ *i-i*=101 33
O ∧ ½=136 39
O ∧ *I*=96 30
I ∧ 1-ì=137 45
1-ì ∧ 1-ì, ov. *O*,=70 30
1-ì ∧ 1-ì, adj.,=109 30
½ ∧ ½=110 30
I ∧ *i-i*=124 25

Crystals often lengthened, and prismatic in the direction of 1-ì; also in that of ½; also (fr. Nevada) not elongate, but thin in the direction of the orthodiagonal, *O* being very narrow or wanting; surfaces usually uneven, being formed of minute subordinate planes. Cleavage: *I* perfect; *O* less so, but giving a reflected image in a strong light.

H.=2–3. G.=1·92–1·99. Lustre vitreous. Color white, yellowish-white. Streak uncolored to grayish. Translucent. Fracture conchoidal. Extremely brittle. Not phosphorescent by friction or heat.

Comp.—$\dot{\mathrm{Na}}\,\ddot{\mathrm{C}}+\dot{\mathrm{Ca}}\,\ddot{\mathrm{C}}+5\,\dot{\mathrm{H}}=(\frac{1}{2}\,\dot{\mathrm{Na}}+\frac{1}{2}\,\dot{\mathrm{Ca}})\,\ddot{\mathrm{C}}+2\frac{1}{2}\,\dot{\mathrm{H}}$=Carbonate of soda 35·9, carbonate of lime 33·8, water 30·3=100. Analysis by J. B. Boussingault (Ann. Ch. Phys., III. vii. 488, 1843):

$\dot{\mathrm{Na}}\,\ddot{\mathrm{C}}$ 34·5 $\dot{\mathrm{Ca}}\,\ddot{\mathrm{C}}$ 33·6 $\dot{\mathrm{H}}$ 30·4 Clay 1·5=100.

Pyr., etc.—Heated in a matrass the crystals decrepitate and become opaque. B.B. fuses easily to a white enamel, and colors the flame intensely yellow. With the fluxes it behaves like carbonate of lime. Dissolves in acids with a brisk effervescence; partly soluble in water, and reddens turmeric.

Obs.—Abundant at Lagunilla, near Merida, in Maracaibo, where its crystals are disseminated at the bottom of a small lake, in a bed of clay, covering *urao;* the natives call it *clavos* or *nails*, in allusion to its crystalline form.

Also abundant on a small island in Little Salt Lake, near Ragtown, Nevada, about 1½ m. S. of the main emigrant road to Humboldt. The lake is in a crater-shaped basin, and its waters are dense and strongly saline.

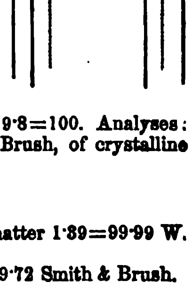
The Nevada crystals gave J. M. Blake (Am. J. Sci., II. xlii. 221), from whom f. 607, 607A, are taken, the following approximate angles, the planes, owing to the unevenness, not affording results nearer than a degree: *I* ∧ *I*=110° 35′ to 112° 30′, 69° 5′; 1-ì ∧ 1-ì=110° 30′, 110° 10′; *O* ∧ 1-ì=126° 10′, 125° 30′; *O* ∧ *i*-ì=79°; *O* ∧ *I*=96° 10′; *I* ∧ ½=127° 10′, 127° 55′.

Named after Gay Lussac.

Artif.—J. Fritzsche has produced artificial gay-lussite by mixing eight parts by volume of a saturated solution of carbonate of soda with one of a solution of chlorid of calcium of 1·130—1·150 specific gravity (J. pr. Ch., xciii. 339).

740. HYDROMAGNESITE. *T. Wachtmeister*, Ak. H. Stockh., 1827, 18. Hydromagnesit *v. Kobell*, J. pr. Ch., iv. 80, 1835. Hydrocarbonate of Magnesia. Lancasterite pt. *Silliman, Jr.*, Am. J. Sci, II. ix. 226, 1850. Magnesia alba *Pharm.*

608



Monoclinic. *C*=82°–83°, *I* ∧ *I*=87° 52′ to 88°, *O* ∧ 2-ì=137°; *a* : *b* : *c*=(nearly) 0·455 : 1 : 1·0973. Observed planes as in the annexed figure. 2-ì ∧ –2-ì, adj.,=143½° to 145°, *i*-*i* ∧ 2-ì=113½° to 112°, *i*-*i* ∧ –2-ì =105°. Culminant angle between edges *y*, *y* (or 2-ì ∧ 2-ì)=94°, edge *t* on edge *y* (or *i*-ì ∧ 2-ì)=133°. Crystals small, usually acicular or bladed, and tufted. Also amorphous; as chalky or mealy crusts.

H. of crystals 3·5. G.=2·145–2·18, Smith & Brush. Lustre vitreous to silky or subpearly; also earthy. Color and streak white. Brittle.

Comp.—3 $(\dot{\mathrm{Mg}}\,\ddot{\mathrm{C}}+\dot{\mathrm{H}})+\dot{\mathrm{Mg}}\,\dot{\mathrm{H}}$=Magnesia 43·9, carbonic acid 36·3, water 19·8=100. Analyses: 1, Wachtmeister (l. c.); 2, v. Kobell (J. pr Ch., iv. 80); 3, 4, Smith & Brush, of crystalline varieties (Am. J. Sci., II. xv. 214):

	$\ddot{\mathrm{C}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{H}}$	$\dddot{\mathrm{Si}}$
1. Hoboken	36·82	42·41	18·53	0·57, $\overline{\mathrm{Fe}}$ 0·27, earthy matter 1·39=99·99 W.
2. Negroponte	36·00	43·96	19·68	0·36=100 Kobell.
3. Texas, Pa., Wood's Mine	36·69	43·20	19·43	——, Fe and Mn *tr.*=99·72 Smith & Brush.
4. " Low's Mine	36·74	42·30	20·10	——, Fe and Mn *tr.*=99·14 Smith & Brush.

Pyr., etc.—In the closed tube gives off water and carbonic acid. B.B. infusible, but whitens and the assay reacts alkaline to turmeric paper. Soluble in acids; the crystalline compact varieties are but slowly acted upon by cold acid, but dissolve with effervescence in hot acid.

Obs.—Occurs at Hrubschitz, in Moravia, in serpentine; in Negroponte, near Kumi; at Kaiserstuhl, in Baden, impure. In the U. States, crystallized, with serpentine and brucite, nea Texas, Lancaster Co., Penn., at Wood's and Low's mines; also in a similar way at Hoboken, N. J., in acicular crystals like natrolite: at the latter place in earthy crusts. The brucite of Hoboken sometimes changes on exposure to an earthy hydromagnesite.

The above angles and figure were taken by the author from a Hoboken crystal $\frac{1}{50}$ in. broad, in which the summit planes were smooth and brilliant, the prismatic striated. The rhombic prism in one crystal gave the angles 95° 20′ and 84° 50′; but other crystals gave different results, and no constant value was obtained. The species is isomorphous with wollastonite (p. 156).

The *Lancasterite* of Silliman (l. c.) is shown by Smith and Brush to be a mixture of brucite and hydromagnesite.

Found pseudomorphous of brucite at Wood's mine.

741. HYDRODOLOMITE. Hydromagnesit *v. Kobell*, J. pr. Ch., xxxvi. 304, 1845. Kalkmagnesit *Hausm.*, Handb., 1404, 1847. Hydromanganocalcit *Hartmann*, Nachr., 299. Hydromagnocalcit pt. Hydrodolomit *Ramm.* Hydronickelmagnesite *Shep.*, Am. J. Sci., II. vi. 250, 1848. Pennite *Herm.*, J. pr. Ch., xlvii. 13, 1849.

Massive. In stalactitic and stalagmitic forms, and globular concretions and crusts.

G.=2·495, Ramm. Color yellowish-white, grayish, greenish.

Var.—(1) Hydrodolomite of Vesuvius is stalactitic or sinter-like; G.=2·495. (2) *Pennite* of Hermann, from Texas, Pa., is in apple-green to whitish crusts, having a surface of minute spherules; the color is due to nickel; G.=2·86.

Comp.—$(\dot{C}a, \dot{M}g)\ddot{C}+\frac{1}{2}\dot{H}$, Ramm., from his anal. of specimen received from Scacchi, of Naples; Hermann's analysis affords $(\frac{1}{3}\dot{C}a+\frac{2}{3}\dot{M}g)\ddot{C}+\frac{1}{3}\dot{H}$; von Kobell's, $\dot{R}^4\ddot{C}^3 4\dot{H}$. Analyses: 1, v. Kobell (l. c.); 2, Rammelsberg (Min. Ch., 234); 3, Hermann (l. c.):

	$\ddot{C}$	$\dot{C}a$	$\dot{M}g$	$\dot{N}i$	$\dot{F}e$	$\dot{M}n$	$\dot{H}$
1. Vesuvius	33·10	25·22	24 28	—	—	—	17·40 Kobell.
2. "	43·40	26·90	23·23	—	—	—	6·47 Rammelsberg.
3. *Pennite*	44·54	20·10	27·02	1·25	0·70	0·40	5·84, $\dddot{A}l$ 0·15=100 Hermann.

Pyr., etc.—Like dolomite, but yields water in the closed tube.

Obs.—The Vesuvian mineral is found on Mt. Somma. Pennite occurs on serpentine and chromic iron, with zaratite, at Texas, Pa., and seems to graduate into zaratite; also at Swinaness and Haroldswick, in Unst, Shetlands.

742. PREDAZZITE. *Petzholdt* pt., Beitr. Geogn. Tyrol, 194, 1843.

Massive, granular, as a fine-grained dolomite-like rock.

H.=3·5. G.=2·634. Lustre vitreous. White to grayish-white.

Comp.—$2\dot{C}a\ddot{C}+\dot{M}g\dot{H}$=Carbonic acid 34·1, lime 43·4, magnesia 15·5, water 7·0=100. Analyses by Roth (J. pr. Ch., lii. 346):

	$\ddot{C}$	$\dot{M}g$	$\dot{C}a$	$\dot{H}$
1. Predazzo	33·51	14·61	44·89	6·99=100.
2. "	34·25	14·16	42·97	7·06=98·44.

In the analyses some $\ddot{S}i$ and $\dddot{A}l$ were obtained.

Pyr., etc.—Like hydrodolomite.

Obs.—From Canzacoli, near Predazzo, in the southern Tyrol, where it occurs as a marble-like rock. The rock in some places contains brucite. May it be a mixture?

743. PENCATITE. *Roth*, ZS. G. Ges., iii. 140, 143.

Similar to the predazzite, and from the same region; G.=2·613, Roth;

2·57, Damour. Also as a bluish-gray limestone, somewhat yellowish, from Vesuvius; H.=3; G.=2·524, Roth; 2·534, in powder.

Comp.—$\dot{C}a\ddot{C}+\dot{M}g\dot{H}$=Carbonic acid 27·9, lime 35·4, magnesia 25·3, water 11·4=100. Analyses: 1, 2, Damour (Bull. Soc. G. Fr., II. iv. 1052, 1847); 3-5, Roth (J. pr. Ch., lii. 350, ZS. G., iii. 140):

	$\ddot{C}$	$\dot{M}g$	$\dot{C}a$	$\dot{H}$
1. Predazzo	25·00	24·82	35·42	10·89, $\dddot{\bar{F}}e$ 0·45, $\dddot{Si}$ 0·60=96·68 Damour.
2. "	26·40	24·64	35·47	10·50, " 0·50, " 0·55=98·06 Damour.
3. "	29·23	24·78	35·70	10·92=100·63 Roth.
4. "	28·10	24·47	35·97	10·97=97·51 Roth.
5. Vesuvius	29·66	23·68	35·45	[10·59], $\dddot{\bar{A}}l$, $\dddot{\bar{F}}e$ 0·62=100 Roth.

In two determinations Roth obtained for the last 11·75 $\dot{H}$, 10·78 $\dot{H}$. The Vesuvian mineral is the same that Klaproth analyzed (Beitr., v. 91) without finding the magnesia. Roth observes that, as the water is retained even to 360° and 400° C., the mineral must be regarded as a chemical compound. Damour observed pure hydromagnesite in clefts in the Predazzo rock.

Named after Marzari Pencati, of the Tyrol.

744. HOVITE.

Hovite, Native Carbonate of Alumina and Lime, *J. H. & G. Gladstone*, Phil. Mag., IV. xxiii. 462, 1862.

Soft, white, and friable; earthy in fracture.

Comp.—$(\frac{1}{2}\dot{C}a+\frac{1}{2}\dot{H})\ddot{C}+aq$=Carbonic acid 44·4, carbonate of lime 28·3, water 27·3=100.

The compound ordinarily called bicarbonate of lime.

The mineral is known only as a mixture in *collyrite*, a hydrous silicate of alumina.

J. H. & G. Gladstone state (l. c.) that there is carbonic acid enough in the collyrite to form a *bicarbonate* with the lime present; but this view of the composition is set aside because of the solubility of the so-called bicarbonate, and its being unknown in the solid state; and hence they suggest that the excess of carbonic acid may be combined in the mineral with alumina, making a *hydrous carbonate of alumina and lime*, or perhaps replaces part of the silica in the alumina-silicate.

But although the bicarbonate referred to is known only in solution, the most likely condition for finding it in the mineral kingdom is in one of the hydrous silicates of alumina, like collyrite, in which there is present much water, loosely held; the mineral, therefore, is most probably a carbonate of the formula above given; especially since a carbonate in which $\dddot{\bar{A}}l$ or $\dddot{\bar{F}}e$ enters is, as the authors admit, yet unknown to chemistry.

Analyses of the collyrite containing the carbonate, by J. H. & G. Gladstone (l. c.):

	$\dddot{Si}$	$\ddot{C}$	$\dddot{\bar{A}}l$	$\dot{C}a$	$\dot{H}$
1.	6·22	10·91	41·04	7·37	33·16=98·70.
2.	5·87	14·77	39·58	11·22	[28·56]
3.	5·41	18·15	36·32	11·62	[29·16]
4.	5·30	14·14	40·51	9·18	[30·87]

The excess of $\ddot{C}$ over that neutralizing the lime is in 1, 5·12 p. c.; in 2, 5·96; 3, 9·02; 4, 6·94 p. c.

Obs.—From Hove, near Brighton, in an old quarry in the upper chalk, in fissures that cut through layers of flint, along with collyrite.

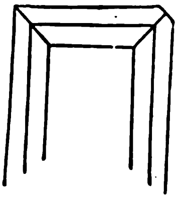
745. LANTHANITE.

Kohlensaures Cereroxydul *Berz.*, ZS. f. Min., ii. 209, 1825; Kohl. Ceroxydul *Hisinger*, Afh. Min. Geog. Schwed., 144, 1826. Carbonate of Cerium. Carbocérine *Beud.*, Tr., ii. 354, 1832. Lanthanit *Haid.*, Handb., 500, 1845. Hydrolanthanit *Glocker*, Synops., 248, 1847.

Orthorhombic. $I \wedge I=93°\ 30'-94°$, Blake, 92° 46′, v. Lang; $I \wedge 1=142°\ 36'$; $a:b:c=0·99898:1:1·0496$, v. Lang. In thin four-sided plates or minute tables, with bevelled edges, as in the annexed figures. Cleavage micaceous. Also fine granular or earthy.

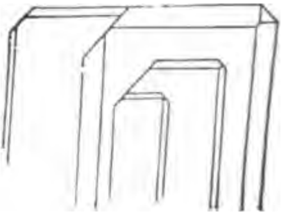
H $=2{\cdot}5-3$. G.$=2{\cdot}666$, (?) Blake; 2·605, Genth. Lustre pearly oi dull. Color grayish-white, delicate pink, or yellowish.

609



Saucon Valley, Pa.

610



Saucon Valley, Pa.

Comp.—$\dot{\mathrm{La}}\,\ddot{\mathrm{C}}+3\,\dot{\mathrm{H}}$=Lanthana 52·6, carbonic acid 21·3, water 26·1=100. Analyses: 1, 2, J L. Smith (Am. J. Sci., II. xvi. 230, xviii. 378); 3, F. A. Genth (ib., xxiii. 425):

		$\ddot{\mathrm{C}}$	$\dot{\mathrm{La}}$	$\dot{\mathrm{H}}$
1.	Saucon valley	22·58	54·90	24·09 Smith.
2.	" "	21·95	55·03	24 21 Smith.
3.	" "	21·08	54·95	[23·97] Genth.

There is some oxyd of didymium with the lanthana, according to Smith.

Blake obtained $\dot{\mathrm{La}}$ 54·27, 54·93, 54·64, $\ddot{\mathrm{C}}$ 19·13, $\ddot{\mathrm{C}}+\dot{\mathrm{H}}$ (by ign.) 45·07, 45·36.

Hisinger found in a Swedish specimen, probably impure, $\dot{\mathrm{La}}$ 75·7, $\ddot{\mathrm{C}}$ 10·8, $\dot{\mathrm{H}}$ 13·5, whence the formula $\dot{\mathrm{La}}^3\,\ddot{\mathrm{C}}+3\,\dot{\mathrm{H}}$.

Pyr., etc.—In the closed tube yields water. B.B. infusible; but whitens and becomes opaque, silvery, and brownish; with borax, a glass, slightly bluish, reddish, or amethystine, on cooling; with salt of phosphorus a glass, bluish amethystine while hot, red cold, the bead becoming opaque when but slightly heated, and retaining a pink color. Effervesces in the acids.

Obs.—Found coating cerite at Bastnäs, Sweden; also in Silurian limestone with the zinc ores of the Saucon valley, Lehigh Co., Pa., in masses consisting of aggregated minute tables; at the Sandford iron-ore bed, Moriah, Essex Co., N. Y., in delicate scales, and a thin scaly crust, in fissures in the ore, and on crystals of allanite. Reported by Shepard as occurring at the Canton mine, Ga., in pink-colored crystals, lining cavities of botryoidal white pyrite.

On cryst., W. P. Blake, Am. J. Sci., II. xvi. 228, 1853, and this Min., 1854, with the above figs.; v. Lang, Phil. Mag., IV. xxv. 43, 1863; both on Pennsylvania crystals.

746. TENGERITE. Kolsyrad Ytterjord *A. F. Svanberg* and *C. Tenger*, Arsb., xviii. 206, 1838. Ytterspath *Germ.* Tengerite *Dana.*

Pulverulent. In thin coatings. Sometimes an appearance of radiated crystallization.

Lustre dull, or like that of chalk. Color white.

Comp.—A carbonate of yttria, according to Svanberg and Tenger, but no analysis has been published.

Pyr., etc.—In the closed tube yields a considerable amount of water (Brush). Effervesces with acids.

Obs.—Occurs as a thin coating on gadolinite at Ytterby, and is evidently a result of its alteration.

747. ZARATITE. Hydrate of Nickel (fr. Texas, Pa.) *Silliman, Jr.*, Am. J. Sci., II. iii. 407, 1847; Emerald Nickel *id.*, ib., vi. 248, 1848. Nickel Smaragd *Germ.*; Texasit *Kenng.*, Min., 1853. Carbonato hidratado de Niquel (fr. Spain) *A. Casares*, A. M. Alcibar in Min. Revista of Madrid, 304, 1850; Zaratita *Casares*, ib., 176, March, 1851. Zamtit *wrong orthogr.*

Incrusting; often small stalactitic or minute mammillary; sometimes appearing prismatic with rounded summits. Also massive, compact.

H.=3—3·25. G.=2·57—2·693. Lustre vitreous. Color emerald-green. Streak paler. Transparent—translucent. Brittle.

Comp.—$\dot{\mathrm{N}}\mathrm{i}\ddot{\mathrm{C}}+2\dot{\mathrm{N}}\mathrm{i}\dot{\mathrm{H}}+4\dot{\mathrm{H}}$=Carbonic acid 11·7, oxyd of nickel 59·4, water 28·9=100. Magnesia seems to replace at times part of the oxyd of nickel, and, correspondingly, the color becomes paler; the mineral at Texas thus graduates toward pennite, which has the same concretionary aspect as much of the zaratite.

Analyses: 1, B. Silliman, Jr. (l. c.); 2, Smith and Brush (ib., xvi. 52):

	$\ddot{\mathrm{C}}$	$\dot{\mathrm{N}}\mathrm{i}$	$\dot{\mathrm{H}}$
1. Texas, Pa.	11·69	58·81	29·50=100 Silliman.
2. "	11·63	56·82	29·87, $\dot{\mathrm{M}}\mathrm{g}$ 1·68=100 S & B.

Pyr., etc.—In the closed tube yields water and carbonic acid, and leaves a grayish-black magnetic residue. B.B. infusible. With borax in O.F. gives a bead violet while hot and reddish-brown on cooling; in R.F. the bead becomes gray and opaque from reduced nickel. Dissolves easily with effervescence in heated dilute muriatic acid.

Obs.—Occurs on chromic iron at Texas, Lancaster Co., Pa., associated with serpentine; also at Swinaness in Unst, Shetland.

Also in Spain, near Cape Hortegal in Galicia, where it occurs as an incrustation on a magnetite in which there is some sulphid of nickel; it is in clear emerald-green, vitreous crusts, sometimes transparent, and also in stalactites. It proved to be a hydrated carbonate of nickel with a little carbonate of magnesia.

Named after Sen. Zarate of Spain. Casares's name antedates that of Kenngott.

748. REMINGTONITE. *J. C. Booth*, Am. J. Sci., II. xiv. 48, 1852.

A rose-colored incrustation, softy and earthy; opaque. Streak pale rose-colored.

Comp.—A hydrous carbonate of cobalt, but precise composition not ascertained. Dissolves in muriatic acid with a slight effervescence, making a green solution, the color due to iron. Cobalt reaction with borax.

Obs.—Occurs as a coating on thin veins of serpentine, which traverse hornblende and epidote, at a copper mine near Finksburg, Carroll Co., Maryland.

749. HYDROZINCITE. Calamine *Smithson*, Phil. Trans., 12, 1803. Zinkblüthe *Karst.*, Tabell., 70, 99, 1808 Hydro-carbonate of Zinc. Earthy Calamine. Zinconise *Beud.*, Tr., ii. 357, 1832. Zinc-Bloom. Hydrozinkit *Kenng.*, Min., 1853. Marionite *Elderhorst*, G. Rep. Arkansas, 153, 1858.

Massive, earthy or compact. As incrustations, the crusts sometimes concentric and agate-like. At times reniform, pisolitic, stalactitic.

H.=2—2·5. G.=3·58—3·8. Lustre dull. Color pure white, grayish or yellowish. Streak shining. Usually earthy or chalk-like.

Comp.—In part $\dot{\mathrm{Z}}\mathrm{n}\ddot{\mathrm{C}}+2\dot{\mathrm{Z}}\mathrm{n}\dot{\mathrm{H}}$=Carbonic acid 13·6, oxyd of zinc 75·3, water 11·1=100. Smithson's analysis gives 1 $\dot{\mathrm{H}}$ additional. For anal. 9, 10, 11, the O. ratio for $\dot{\mathrm{Z}}\mathrm{n}$, $\ddot{\mathrm{C}}$, $\dot{\mathrm{H}}$=13 : 5 : 9; whence $5\dot{\mathrm{Z}}\mathrm{n}\ddot{\mathrm{C}}+8\dot{\mathrm{Z}}\mathrm{n}\dot{\mathrm{H}}+\dot{\mathrm{H}}$, Goebel=Carbonic acid 15·3, oxyd of zinc 73·4, water 11·3=100. The analyses of Sullivan (Nos. 11, 12, 13) give the formula $3\dot{\mathrm{Z}}\mathrm{n}\ddot{\mathrm{C}}+5\dot{\mathrm{Z}}\mathrm{n}\dot{\mathrm{H}}$=Carbonic acid 15·2, oxyd of zinc 74·5, water 10·3=100, which agrees very well with several of the other analyses.

Analyses: 1, Smithson (l. c., the specimen a white chalky incrustation); 2, 3, Karsten (Syst. d. Met., iv. 429); 4, Reichert (Ramm. Min. Ch., 239); 5, Schnabel (Pogg., cv. 144); 6–8, Braun, Petersen, and Voit (Ann. Ch. Pharm., cviii. 48); 9, Koch (Ramm. Min. Ch., 239); 10, Terreil (C. R., xlix. 553); 11–13, Sullivan (Dublin Q. J. Sci., ii. 135); 14, Bonnet (B. H. Ztg., xxii. 164); 15, A. Goebel (Bull. Ac. St. Pet., v. 407); 16, Eldorhorst (l. c.):

	$\ddot{\mathrm{C}}$	$\dot{\mathrm{Z}}\mathrm{n}$	$\dot{\mathrm{H}}$
1. Bleiberg	13·5	71·4	15·1=100 Smithson.
2 "	14·79	72·75	12·25=99·79 Karsten.

		$\ddot{C}$	$\dot{Zn}$	$\dot{H}$
3.	Raibel	14·74	72·84	12·30=99·88 Karsten.
4.	Hollanthol	16·25	71·69	11·90=99·74 Reichert.
5.	Ramsbeck	12·30	64·04	15·61, $\dot{Ca}$ 0·52, $\dot{Cu}$ 0·62, $\dddot{Al}$, $\dddot{Fe}$, and insol. 6·36=99·458
6.	Santander	14·32	73·83	11·87=100·02 Braun; G.=3·252.
7.	"	15·1	73·1	11·8=100 P. & V.
8.	"	13·82	74·73	11·45=100 P. & V.
9.	"	13·50	74·46	12·04=100 Koch.
10.	"	14·05	72·72	13·23=100 Terreil.
11.	"	15·07	74·76	10·17=100 Sullivan.
12.	"	15·02	74·87	11·11=100 Sullivan.
13.	"	15·13	74·34	10·53=100 Sullivan.
14.	Guipuzcoa	15·01	73·88	11·11=100 Bonnet.
15.	Taft, Persia	(?) 15·17	73·35	11·13=99·65 Goebel.
16.	Arkansas	15·01	73·26	11·81=100·08 Elderhorst.

The compact mineral loses 2·04 p. c. of water and carbonic acid on heating to 130° C., and 14·42 p. c. more on heating for 6 h. to 150° to 180° C. (Sullivan).

Schönichen describes (B. H. Ztg., xxii. 164) a snow-white, massive, subtranslucent material from near La Nestosa in Guipuzcoa, Spain, which contained $\ddot{Si}$ 31·50, $\dddot{Al}$ 26·43—20·27, $\dot{Zn}$ 21·36—28·45, $\dot{H}$ 18·32—19·65. It is probably a mixture of hydrozincite and kaolinite.

Pyr., etc.—In the closed tube yields water; in other respects resembles smithsonite.

Obs.—Occurs at most mines of zinc, and is a result of the alteration of the other ores of this metal.

Found in great quantities at the Dolores mine, Udias valley, province of Santander, in Spain, along with calamine, smithsonite, and blende, covering the floor of an extensive cavern to a depth of a yard and a half, and hanging in dazzling white branching stalactites from the roof; part is concretionary, pisolitic, nodular; it is intimately mixed with silicate of zinc, and is pseudomorphous after it; and opal-like masses of silicate and hydrous carbonate are common, formed by the falling of drops of water holding the silicate in solution.

Also occurs in the neighboring province of Guipuzcoa, Spain, near La Nestosa, at the mines of Las Nieves and La Augustina; at Bleiberg and Raibel in Carinthia; near Reimsbeck, in Westphalia; in Hollenthal, on the Zugspitze in Bavaria; at Taft in the province of Jesd in Persia.

In the U States, at Friedensville, Pa.; at Linden, in Wisconsin, as a concretionary fibrous white crust on smithsonite; in Marion Co., Arkansas (*marionite*), in concentric and contorted laminæ and botryoidal crusts.

Beudant's name *zinconise*, from zinc and κόνις, powder, has priority, but is too badly formed to be retained.

Artif.—Deposited when hot solutions of zinc salts in water are decomposed by carbonates of the alkalies. The white substance formed on zinc, when moistened and exposed to the air, is a related compound, containing, according to Bonsdorff, $\ddot{C}$ 14·19, $\dot{Zn}$ 71·25, $\dot{H}$ 14·56=100, agreeing with Smithson's analysis above.

750. AURICHALCITE. Calamine verdâtre (containing "une bonne quantité de cuivre"), Mine de Laiton [=Brass-ore], *Patrin*, Aperçu d. Mines en Sibérie, in J. de Phys., xxxiii. 81, 1788. Mine de Laiton de Pise en Toscane, Aurichalcum of the ancients?, *Sage*, J. de Phys., xxxviii. 155, 1791. Messingblüthe *Germ.* Aurichalcit *Böttger*, Pogg., xlviii. 495, 1839. Buratite *Delesse*, Ann. Ch. Phys., III. xviii. 478, 1846. Orichalcit *Glocker*, Syn., 230, 1847.

In acicular crystals forming drusy incrustations; also columnar, divergent; plumose; granular; also laminated.

H.=2. Lustre pearly. Color pale green, verdigris-green; sometimes sky-blue. Streak pale greenish or bluish. Translucent.

Comp., Var.—A cuprous hydrozincite. For the original aurichalcite, O. ratio for $\dot{Cu}$, $\dot{Zn}$, $\ddot{C}$, $\dot{H}$=2 : 3 : 4 : 3. $2\dot{Cu}\ddot{C}+3\dot{Zn}\dot{H}$, Böttger; or $2\dot{Zn}\ddot{C}+3(\dot{Cu},\dot{Zn})\dot{H}$=Carbonic acid 16·2, oxyd of copper 29·2, oxyd of zinc 44·7, water 9·9=100.

For *buratite*, or the so-called lime-aurichalcite, according to Delesse, $\dot{R}\ddot{C}+\dot{R}\dot{H}$, in which $\dot{R}$=$\dot{Cu}$, $\dot{Zn}$, $\dot{Ca}$, in the ratio 10 : 14 : 1 in the Chessy mineral, and 7 : 8 : 3 in the Altai. But the lime is probably from mixed calcite, as suggested by Berzelius; and, this removed, the formula is that above given, as shown by Risse.

A Santander variety, analyzed by Risse, containing much less copper (anal. 6, 7), affords the formula $(\dot{C}u, \dot{Z}n)\ddot{C}+2\dot{Z}n\dot{H}$, with $\dot{C}u$ to $\dot{Z}n$ in the first member as 3 : 1, the O. ratio for $\dot{C}u$, $\dot{Z}n$, $\ddot{C}$, $\dot{H}$ being 3 : 9 : 8 : 8.

Analyses: 1, 2, Böttger (l. c.); 3, Connel (Ed. N. Phil. J., xlv. 36); 4, 5, Delesse (l. c.); 6, 7 H. Risse (Verh. nat. Ver. Bonn, 95, 1865):

	$\ddot{C}$	$\dot{H}$	$\dot{C}u$	$\dot{Z}n$	$\dot{C}a$
1. Altai, *Aurichalc.*	16·06	9·95	28·19	45·84	——=100·06 Böttger.
2. " "	16·08	9·93	28·36	45·62	——=99·99 Böttger.
3. Matlock, "	27·5		32·5	42·5	*tr.*=102·5 Connel.
4. Altai, *Buratite*	21·45	——	29·46	32·02	8·62=100 Delesse.
5. Chessy, "	19·88	——	29·00	41·19	2·16=99·85 Delesse.
6. Santander	14·08	10·80	18·41	55·29	——, gangue 1·86=100·44 Risse.
7. "	24·69		16·03	56·82	——, gangue 1·69=99·23 Risse.

Pyr., etc.—In the closed tube blackens, and yields water. B.B. infusible; colors the flame deep green. With soda on charcoal gives a coating of oxyd of zinc, yellow while hot and white on cooling; moistened with cobalt solution and heated in O.F. the coating becomes green; the fused mass removed from the coal and triturated in a mortar affords minute globules of copper. With the fluxes reacts for copper. Soluble in acids with effervescence.

Obs.—Aurichalcite occurs at Loktefskoi, at a copper mine of the Altai, where it is associated with calcite and limonite, sometimes forming a drusy covering upon these minerals; at Matlock, in Derbyshire, of a pale green color, laminated structure, and pearly lustre; at Roughten-Gill, in Cumberland; Leadhills, Scotland; zinc mines of the province of Santander, Spain. In the U. States, at Lancaster, Pa. (Taylor, Am. J. Sci., II. xx. 412).

The buratite comes from Loktefskoi; Chessy, near Lyons; Framont, Tyrol; Retzbanya, in Hungary, in microscopic rhombic or rhombohedral tables, and also oblong rectangular forms (a mineral lately proved to be calciferous); Campiglia in Tuscany.

The mineral aurichalcite was first described as a greenish variety of calamine by Patrin, in 1788 (l. c.), and called *Brass ore* (Mine de Laiton), "because," as he says, "the compound of copper and zinc is here made by nature." Among the brass or copper ores of the ancients, *aurichalcum* was reputed the best (Pliny, xxxiii. 2); and Sage was thence led to suggest (l. c., 1791) that the *cupriferous calamine* (which afforded, as he showed by experiment, the best of brass, without the addition of either copper or zinc) might be the ancient *aurichalcum*. As the ore is a scarce one, this is not at all probable. But the idea explains the use of the word for the species. In addition, it is to be said that brass (or an alloy related to it) was called *aurichalcum* by Virgil and Horace, and also in the middle ages.

The Latin word *aurichalcum* is regarded by some good authorities as derived from 'ορείχαλκος (=*mountain brass*); and, in fact, the Latin poets just mentioned wrote it *orichalcum*. But others regard it as a hybrid word (from the Latin *aurum*, *gold*, and χαλκός, *brass* or *bronze*), and the *o* of the poets as an example of the admissible change in Latin of *au* to *o*. Glocker, in view of the first of these derivations, changes aurichalcite to *orichalcite*; but, whatever the derivation, as the use of *aurichalcum* dates from before Pliny's time, we moderns may as well let it stand without correction.

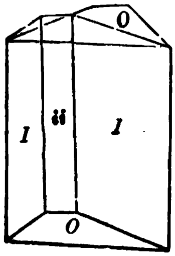
750A. ZINKAZURITE *Breith.*, B. H. Ztg., 1852, 101. A blue mineral in small crystals, having G.=3·49, from the Sierra Almagrera in Spain. Heated, it affords a little water, with the reactions of copper and zinc. According to Plattner, it consists of sulphate of zinc, carbonate of copper, and some water.

751. MALACHITE. Χρυσοκόλλα pt. *Theophr.*, *Dioscor.*, etc. Ψευδὴς Σμάραγδος [False Emerald of Copper Mines] pt., *Theophr.* Chrysocolla, Molochites, pt., *Plin.*, *Agric.* Berggrün, *Germ.* Molochit, *Agric.*, Interpr., 1546. Ærugo nativa, Viride montanum pt., Koppargrön, Bärggrönt pt., Malachit, *Wall.*, Min., 278, 279, 1747. Cuivre carbonaté vert *L'Abbé Fontana*, J. de Phys., ii. 509, 1778, proving the existence of a green carbonate. Green Carbonate of Copper; Green Malachite; Mountain Green pt. Berggrün pt. *Germ.* Atlaserz [fib. var.] *Germ.*

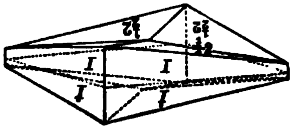
Monoclinic. $C=88° 32'$; $I \wedge I=104° 28'$, $i\text{-}i \wedge -1\text{-}i=118° 15'$, Zepharovich; $a:b:c=0·51155:1:1·2903$. Observed planes: O; vertical, I, $i\text{-}i$, $i\text{-}\grave{i}$; hemidomes, $-1\text{-}i$, $-\frac{7}{4}\text{-}i$, $\frac{1}{2}\text{-}i$, $\frac{1}{3}\text{-}i$, $\frac{1}{4}\text{-}i$; hemioctahedral, $\frac{1}{2}$, $\frac{1}{2}\text{-}2$, $\frac{3}{4}\text{-}3$. $O \wedge i\text{-}i=91° 28'$, $I \wedge i\text{-}i=142° 14'$; $I \wedge \frac{1}{2}=107°$, $\frac{1}{2} \wedge \frac{1}{2}\text{-}i=168°$, $\frac{1}{2}\text{-}2 \wedge \frac{1}{2}\text{-}2=157° 30'$—$156° 38'$ (obs. by Lang.), $-1\text{-}i \wedge -1\text{-}i$, reëntering angle in twin, f. 611,=123°

22′, Zeph. obs.; $\frac{1}{3}$-*i* ∧ $\frac{1}{3}$-*i*, reënt. in twin, 163° 20′—36′, Lang obs. Common form, f. 611; also same with other terminal planes; also with *i-ì* wanting; also with *i-i*, *i-ì* very large, making a rectangular prism; also with the vertical prism very short, as in f. 612. Crystals rarely simple. Twins: composition-face *i-ì*, f. 611; the reëntering angle varying with the terminating planes; often penetration twins, as in f. 612, in which the upper and lower halves in front are continued respectively in the lower and upper halves behind, as illustrated in f. 612A, a clinodiagonal vertical section of 612; also under the terminal planes of 611 in 613. Cleavage: basal, highly perfect; clinodiagonal less distinct. Usually massive or incrusting, with surface tuberose, botryoidal, or stalactitic, and structure divergent; often delicately compact fibrous, and banded in color; frequently granular or earthy.

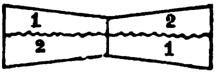
611



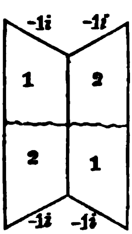
612



612A



613



H.=3·5–4. G.=3·7—4·01. Lustre of crystals adamantine, inclining to vitreous; of fibrous varieties more or less silky; often dull and earthy. Color bright green. Streak paler green. Translucent—subtranslucent—opaque. Fracture subconchoidal, uneven.

Comp.—$\dot{\mathrm{C}}\mathrm{u}^2\ddot{\mathrm{C}}+\dot{\mathrm{H}}=\dot{\mathrm{C}}\mathrm{u}\,\ddot{\mathrm{C}}+\dot{\mathrm{C}}\mathrm{u}\,\dot{\mathrm{H}}$=Carbonic acid 19·9, protoxyd of copper 71·9, water 8·2=100. **Analyses**: 1, Klaproth (Beitr., ii. 287, 1797); 2, Vauquelin (Ann. du Mus., xx. 1); 3, Phillips (J. Royal Inst., iv. 276); 4, J. L. Smith (Am. J. Sci., II. xx. 249):

	$\ddot{\mathrm{C}}$	$\dot{\mathrm{C}}\mathrm{u}$	$\dot{\mathrm{H}}$
1. Turjinsk, Ural	18·0	70·5	11·5=100 Klaproth.
2. Chessy	21·25	70·10	8·75=100·10 Vauquelin.
3. "	18·5	72·2	9·3=100 Phillips.
4. Phenixville	19·09	71·46	9·02, $\ddot{\mathrm{F}}\mathrm{e}$ 0·12=99·69 Smith.

Fontana, the first analyst of the species, obtained (l. c.) $\ddot{\mathrm{C}}$ 19·4, $\dot{\mathrm{H}}$ 5·6, leaving 75 p. c. for the copper. Other analyses: ores from the Urals and Finland, by A. E. Nordenskiöld (Act. Soc. Sc. Fenn., iv. 607); Ural, by Struve (Verh. Ges. St. Petersb., 1850-51, 103).

Pyr., etc.—In the closed tube blackens and yields water. B.B. fuses at 2, coloring the flame emerald-green; on charcoal is reduced to metallic copper; with the fluxes reacts like melaconite. Soluble in acids with effervescence.

Obs.—Green malachite accompanies other ores of copper. Perfect crystals are quite rare. Occurs abundantly in the Urals; at Chessy in France, in the old mine at Sandlodge, in Shetland at Schwatz in the Tyrol; in Cornwall and in Cumberland, England; Sandlodge copper mine, Scotland; Limerick, Waterford, and elsewhere, Ireland; at Grimberg, near Siegen, in Germany. At the copper mines of Nischne Tagilsk, belonging to M. Demidoff, a bed of malachite was opened which yielded many tons of malachite; one mass measured at top 9 by 18 ft.; and the portion uncovered contained at least half a million pounds of pure malachite. Also in handsome masses at Bembe, on the west coast of Africa; with the copper ores of Cuba; Chili; Australia.

Occurs in *Conn.*, at Cheshire. In *N. Jersey*, at Schuyler's mines, and still better at New Brunswick. In *Pennsylvania*, in the Blue Ridge, near Nicholson's Gap; near Morgantown, Berks County; at Cornwall, Lebanon Co., in good specimens; at the Perkiomen and Phenixville lead mines. In *Maryland*, between Taneytown and Newmarket, E. of the Monocacy; in the Catoctin Mts. In *Wisconsin*, at the copper mines of Mineral Point, and elsewhere. In *California*, at Hughes's mine, in Calaveras Co.

Green malachite admits of a high polish, and when in large masses is cut into tables, snuff-boxes, vases, etc.

Named from μαλαχή, *mallows*, in allusion to the green color.

Recent papers on cryst., v. Lang, Phil. Mag., IV. xxv. 432, xxviii. 502; v. Zepharovich, Ber. Ak. Wien, li. 112; Hessenberg Min. Not., Nos. iii. vi. vii.

751A. **Mysorin.** Massive. G.=2·62. Soft. Color blackish-brown, when pure; usually green or red, from mixture with malachite and red oxyd of iron. Fracture conchoidal.

Comp.—According to Thomson (Min., i. 601, 1836), Carbonic acid 16·70, oxyd of copper 60·75, sesquioxyd of iron (mechanically mixed) 19·50, silica 2·10, loss 0·95. Gives no water in a glass tube. Occurs at Mysore, in Hindostan. Although stated to be anhydrous, it may be an impure malachite.

751B. **Lime-Malachite** (Kalk-malachit *Zincken*, B. H. Ztg., i. 1842). Massive, reniform, botryoidal; structure fibrous and foliated. H.=2·5. Lustre silky. Color verdigris-green.

From Zincken's trials it is a hydrous carbonate of copper, with some carbonate and sulphate of lime and iron. From Lauterberg in the Harz.

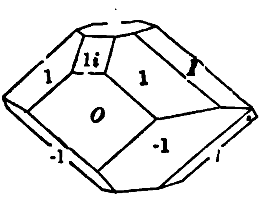
752. AZURITE. Cæruleum, Lapis armenius pt., *Plin.*, xxxiii. 57. Cæruleum, *Germ.* Lasur, Berglasur pt., *Agric.*, 217, etc. Koppar-Lazur, Cuprum lazureum, Cæruleum montanum, *Wall.*, Min., 280, 1747. Bleu de montagne, Cuivre azurée, *Fr. Trl.* Wall., i. 506, 1753. Kupferlasur *Wern.* Bergblau *Germ.* *Abbé Fontana*, J. de Phys., ii. 1778 (with anal. making it a carbonate). Blue Carbonate of Copper, Blue malachite. Chessy Copper. Azure Copper Ore. Cuivre carbonaté bleu *Fr.* Azurite *Beud.*, Tr., 417, 1824. Lasur *Haid.*, Handb., 508, 1845. Chessylite *B. & M.*, Min., 594, 1852. Lasurit *v. Kobell*, Tafeln, 32, 1853.

Monoclinic. *C*=87° 39′; *I* ∧ *I*=99° 32′, *O* ∧ 1-ì=138° 41′; *a* : *b* : *c*= 1·039 : 1 : 1·181. Observed planes: *O*; vertical, *I*, *i-i*, *i-ì*, *i*-2, *i*-$\frac{3}{2}$; *i*-2̀; clinodomes, $\frac{1}{8}$-ì, $\frac{1}{6}$-ì, $\frac{2}{5}$-ì, $\frac{1}{2}$-ì, $\frac{2}{3}$-ì, 1-ì, $\frac{3}{2}$-ì, 2-ì, 3-ì; hemidomes, 1-*i*, 2-*i*, −$\frac{1}{2}$-*i*, -1-*i*, −2-*i*; hemioctahedral, $\frac{2}{3}$, 1, 2, −1, −2; 2-2, 4-4; $\frac{2}{5}$-2̀, $\frac{4}{5}$-2̀, $\frac{4}{3}$-2̀, 4-2̀, −2-2̀, −$\frac{4}{5}$-2̀; $\frac{3}{4}$-3̀. *O* usually striated parallel with the clinodiagonal.

O ∧ *I*=91° 48′
O ∧ *i-i*=92 21
O ∧ 1-*i*=132 43
O ∧ 1=125 8
O ∧ 2=108 35
O ∧ −1=127 28
1 ∧ 1, front,=116 7
-1 ∧ −1, “ =118 16
i-i ∧ 1-*i*=134 56

i-i ∧ $\frac{1}{2}$-*i*=115° 35′
1-ì ∧ 1-ì, bas.,=82 38
2-ì ∧ 2-ì, “ =120 46
i-2 ∧ *i*-2=134 8
i-$\frac{3}{2}$ ∧ *i*-$\frac{3}{2}$=121 10
i-2̀ ∧ *i*-2̀=118 50
i-i ∧ 2-*i*=153 51
i-i ∧ *I*=139 46

614



Cleavage: 2-ì rather perfect; *i-i* less distinct; *I* in traces. Also massive, and presenting imitative shapes, having a columnar composition; also dull and earthy.

H.=3·5—4·25. G.=3·5—3·831. Lustre vitreous, almost adamantine. Color various shades of azure-blue, passing into berlin-blue. Streak blue, lighter than the color. Transparent—subtranslucent. Fracture conchoidal. Brittle.

Comp.—2 $\dot{\mathrm{C}}\mathrm{u}\,\ddot{\mathrm{C}}+\dot{\mathrm{C}}\mathrm{u}\,\dot{\bar{\mathrm{H}}}$=Carbonic acid 25·6, oxyd of copper 69·2, water 5·2=100. Analyses 1, Klaproth (Beitr., iv. 31, 1807); 2, Phillips (J. Roy. Institution, iv. 276); 3, Vauquelin (Ann. du Mus., xx. 1); 4, J. L. Smith (Am. J. Sci., II. xx. 250):

	$\ddot{C}$	$\dot{Cu}$	$\dot{H}$
1. Turjinsk	24	70	6=100 Klaproth.
2. Chessy	25·46	69·08	5·46=100 Phillips.
3. "	25·0	68·5	6·5 Vauquelin.
4. Phenixville	24·98	69·41	5·84=100·23 Smith.

Abbé Fontana obtained (l. c.) $\ddot{C}$ 31·42, $\dot{Cu}$ 68·573, with only 1·007 of water.

Pyr., etc.—Same as in malachite.

Obs.—Occurs in splendid crystallizations at Chessy, near Lyons, whence it derived the name *Chessy Copper*. Also in fine crystals in Siberia; at Moldawa in the Bannat; at Wheal Buller, near Redruth in Cornwall; also in Devonshire and Derbyshire, England; in small quantities at Alston-Moor and Wanlockhead, etc.; at Porto Cabello, S. A.

Occurs in *Penn.*, at the Perkiomen lead mine, in indifferent specimens, associated with galenite, blende, and cerussite: at Phenixville, in crystals; at Cornwall, in crystals on red shale; near Nicholson's Gap, in the Blue Ridge. In *N. York*, near Sing Sing. In *N. Jersey*, near New Brunswick. In *Wisconsin*, at the old copper diggings near Mineral Point, in good crystals; also at the Bracken mine, in small but fine crystals. In *California*, Calaveras Co., at Hughes's mine, in crystals.

When abundant, azurite is a valuable ore of copper. When ground to an impalpable powder, it forms a blue paint of a bright tint; but it is of little value as a pigment, on account of its liability to turn green.

Alt.—Azurite occurs altered to malachite through the addition of carbonic acid.

752A. **ATLASITE** *Breith.*, B. H. Ztg., xxiv. 310, 1865. A carbonate of copper from Chañarcillo in Chili, containing chlorine. It much resembles atacamite. It is coarse or fine columnar, with H.=3—4; G.=3·839—3·869; lustre vitreous to silky; color between celandine and emerald-green, nearer the first; streak verdigris-green. T. Erhard obtained for it (l. c.):

$\ddot{C}$ 16·48 $\dot{Cu}$ 70·18 $\dot{H}$ 9·30 Cl 4·14 gangue 0·70=100·80,

whence he derives the formula $7(\dot{Cu}^2\ddot{C}+\dot{H})+Cu\,Cl+3\dot{H}$, equivalent to 7 of malachite, 1 of a hydrous chlorid of copper.

According to this formula the mineral consists of 14 $\dot{Cu}$, 10 $\dot{H}$, 1 Cu Cl. If now the Cu Cl is from mixed atacamite, it is combined with 3 $\dot{Cu}\dot{H}$. The remainder, 11 $\dot{Cu}$, 7 $\ddot{C}$, 7 $\dot{H}$, corresponds, excepting an excess of water, very nearly to the composition of azurite; 11 $\dot{Cu}$, $7\frac{1}{3}$ $\ddot{C}$, $3\frac{2}{3}$ $\dot{H}$, would be precisely azurite. Atlasite may, therefore, be a mixture of about $3\frac{1}{2}$ parts of azurite with 1 part of atacamite.

753. BISMUTITE.

Bismutit *Breith.*, Pogg., liii. 627, 1841. Kohlensaures Wismuthoxyd, Wismuthspath, *Germ.* Bismuthite. Carbonate of Bismuth.

In implanted acicular crystallizations (pseudomorphous); also incrusting or amorphous; pulverulent.

H.=4—4·5; 3·5, specimens that have lost their lustre; earthy, 1·5. G.=6·86—6·909, Breith.; 7·67, from South Carolina, Rammelsberg. Lustre vitreous when pure; sometimes dull. Color white, mountain-green, and dirty siskin-green; occasionally straw-yellow and yellowish-gray. Streak greenish-gray to colorless. Subtranslucent—opaque. Brittle.

Comp.—According to Plattner's examinations (Pogg., liii. 727), it is a carbonate of bismuth, containing some iron and copper (perhaps a carbonate of each), and also sulphuric acid.

Rammelsberg examined specimens from South Carolina, probably of this species, and obtained the formula $3(\dddot{Bi}\ddot{C}+\dot{H})+\dddot{Bi}\dot{H}$ $(=\dddot{Bi}^4\ddot{C}^3\dot{H}^4)$=Oxyd of bismuth 90·1, carbonic acid 6·4, water 3·5=100. Analyses: 1, Rammelsberg (Pogg., lxxvi. 564, 1849); 2, 3, Genth (Am. J. Sci., II. xxiii. 427):

	$\ddot{C}$	$\dddot{Bi}$	$\dot{H}$
1. Chesterfield Dist.	6·56	90·00	3·44=100 Ramm.
2. " "	7·04	89·05	3·91=100 Genth.
3. " "	7·30	87·67	5·03=100 Genth.

Pyr., etc.—In the closed tube decrepitates and gives off water. B.B. fuses readily, and on charcoal is reduced to bismuth, and coats the coal with yellow oxyd of bismuth. Dissolves in nitric acid, with slight effervescence. Dissolves in muriatic acid, affording a deep yellow solution.

Obs.—Bismutite occurs at Schneeberg and Johanngeorgenstadt, with native bismuth, and near Hirschberg in Russian Voigtland, with brown iron ore, native bismuth, and bismuthinite; at Joachimsthal; near Baden; also in the gold district of Chesterfield, S. C., at Brewer's mine, in porous yellowish masses, sometimes reddish from oxyd of iron; surface of fracture white and vitreous, resembling somewhat calamine; in Gaston Co., N. C., in yellowish-white concretions.

753A. With the bismutite of Joachimsthal occurs another bismuth carbonate, in thin longish crystals, vitreous, siskin-green to clove-brown, translucent. It contains, according to Lindacker (Vogl's Min. Joach., 168), oxyd of bismuth, carbonic acid, water, silica: effervesces with acids, and B.B. gives bismuth reactions.

754. LIEBIGITE. *J. L. Smith*, Am. J. Sci, II. v. 336, 1848, and xi. 259. Uran-Kalk-Carbonat *Vogl*, Jahrb. G. Reichs., iv. 221, 1853.

In mammillary concretions, or thin coatings; cleavage apparent in one direction.

H.=2—2·5. Lustre of fracture vitreous. Color beautiful apple-green. Transparent.

Comp.—$\dddot{\bar{U}}\ddot{C}+\dot{Ca}\ddot{C}+20\dot{H}$=Carbonic acid 11·1, oxyd of uranium 36·2, lime 7·1, water 45·6; or $2\dot{Ca}\ddot{C}+\dddot{\bar{U}}^2\ddot{C}+36\dot{H}$, Ramm.,=$\ddot{C}$ 9·02, $\dddot{\bar{U}}$ 39·12, $\dot{Ca}$ 7·67, $\dot{H}$ 44·19=100. Analysis by J. L. Smith (l. c.):

$\ddot{C}$ 10·2 $\dddot{\bar{U}}$ 38·0 $\dot{Ca}$ 8·9 $\dot{H}$ 45·2

Pyr., etc.—In a matrass yields much water and becomes yellowish-gray. At redness it blackens, without fusing, and on cooling *returns to an orange-red* color. At a higher heat it blackens, and remains so on cooling. With borax it gives a yellow glass in the outer flame, and a green glass in the inner. Dissolves readily in dilute acids with effervescence, and affords a yellow solution, with the reaction of uranium and lime

Obs.—Occurs with medjidite on pitchblende, near Adrianople, Turkey; also at Johanngeorgenstadt and Joachimsthal. Dr. Smith states that both the lime and uranium of this salt are derived from the pitchblende.

A related mineral from Elias mine, near Joachimsthal, has been examined by Vogl and J. Lindacker (Jahrb. G. Reichs., iv. 221, 1853). It occurs in scaly aggregations on pitchblende, has a siskin-green color, and a pearly lustre on a cleavage-face; subtransparent to translucent; H.=2·5—3. B.B. on charcoal infusible; with borax and salt of phosphorus the reaction of uranium. Dissolves with effervescence in sulphuric acid, a white deposit being thrown down; solution in sulphuric and muriatic acids green, in nitric acid yellow.

Composition, according to J. Lindacker (l. c.), $\ddot{U}\ddot{C}+\dot{Ca}\ddot{C}+5\dot{H}$=$\ddot{C}$ 24·18, $\dot{U}$ 37·03, $\dot{Ca}$ 15·55, $\dot{H}$ 23·34=100. Mean of three analyses:

$\ddot{C}$ 23·86 $\dot{U}$ 37·11 $\dot{Ca}$ 15·56 $\dot{H}$ 23·34=99·87.

These carbonates are produced by the action of carbonated waters on the sulphates.

755. VOGLITE. Uran-Kalk-Kupfer-Carbonat *Vogl*, Jahrb. G. Reichs., iv. 222, 1853. Voglit *Haid.*, ib., 223.

In aggregations of crystalline scales. Scales rhomboidal somewhat like gypsum, with angles of 100° and 80°, Haid.

Lustre pearly. Color emerald-green to bright grass-green. Dichroic.

Comp.—$2\dot{U}\ddot{C}+2\dot{Ca}\ddot{C}+\dot{Cu}^3\ddot{C}^2+14\dot{H}$, Lindacker, from his analysis (Jahrb. G. Reichs., iv 222):

$\ddot{C}$ 26·41 $\dot{U}$ 37·00 $\dot{Ca}$ 14·09 $\dot{Cu}$ 8·40 $\dot{H}$ 13·90=100.

Pyr., etc.—In the closed tube blackens and yields water. B.B. in the platinum forceps infu sible, colors the flame deep green; if moistened with muriatic acid the flame is momentarily blue With soda on charcoal yields metallic copper. With borax in O.F. the bead is yellow while hot and reddish-brown on cooling; in R.F. green while hot and clouded when cold. Soluble in acids with effervescence.

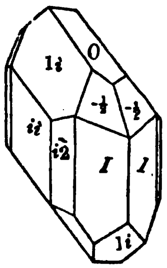
Obs.—From the Elias mine, near Joachimsthal, implanted on pitchblende.

---

8. OXALATES.

756. WHEWELLITE. Oxalate of Lime *H. T. Brooke*, Phil. Mag., III. xvi. 449, 1840. Oxacalcite *Shepard*, Min., 111, 1844. Whewellite *B. & M.*, Min., 623, 1852.

615



Monoclinic. $C=72°\ 41'$, $I \wedge I=100°\ 36'$, $O \wedge 1\text{-}\grave{i}=127°\ 25'$; $a:b:c=1{\cdot}5745:1:1{\cdot}1499$. Observed planes as in the annexed figure. $O \wedge I=103°\ 14'$, $O \wedge 1\text{-}i=109°\ 28'$, $O \wedge -\frac{1}{2}=141°\ 6'$, $I \wedge i\text{-}\grave{i}=129°\ 42'$. Cleavage parallel with O; less perfect parallel with I, and the longer diagonal. All the planes bright except I and $-\frac{1}{2}$, which are vertically striated. Twins: composition-face $1\text{-}\grave{i}$.

H.=2·5—2·75. Lustre like that of sulphate of lead. Very brittle. Fracture conchoidal.

This species, an oxalate of lime, was observed by Brooke in crystals from a tenth to a fourth of an inch broad on calc spar; the locality of the spar is not known.

The name *oxacalcite* proposed by Shepard is badly formed, and should yield to Brooke & Miller's, after Prof. Whewell of Cambridge.

757. **Thierschite** *Liebig*, Ann. Ch. Pharm., lxxxvi. 113, 1853. An oxalate of lime, occurring as a grayish, warty, and somewhat opaline incrustation, about a line thick, on the marble of the Parthenon, Athens. A complete analysis has not yet been made. Its origin is attributed to the action of some kind of vegetation on the marble. It is probably identical with whewellite. Named after F. v. Thiersch, the discoverer.

758. **HUMBOLDTINE.** Faser Resin (Honigsteinsaurer Eisen?) *Breith.*, Char., 75, 1820. Humboldtine, Oxalsaures Eisen, *M. de Rivero*, Ann. Ch. Phys., xviii. 207, 1821. Eisen-Resin *Breith.*, Gilb. Ann., lxx. 426, 1822. Oxalit *Breith.*, Char., 1823. Humboldtit *Leonh.*, Handb., 789, 1826.

In capillary forms; also botryoidal and in plates, or earthy; structure fibrous or compact.

H.=2. G.=2·13—2·489. Dull or slightly resinous. Color yellow. Fracture uneven, earthy. Acquires negative electricity by friction, when insulated.

Comp.—$2\,\dot{\mathrm{F}}\mathrm{e}\,\dddot{\mathrm{C}}+3\,\dot{\mathrm{H}}$=Oxalic acid 42·1, protoxyd of iron 42·1, water 15·8=100. Analysis by Rammelsberg (Pogg., xlvi. 283):

$\dot{\mathrm{F}}\mathrm{e}$ 41·13 Oxalic acid 42·40 (loss) 16·37=100.

Mariano de Rivero obtained (l. c.) Oxalic acid 46·14, and protoxyd of iron 53·86, with no water

Rammelsberg (Pogg.. liii. 631, 1841) has confirmed his former analysis, and shown that the iron is all protoxyd.

Pyr., etc.—In the closed tube yields water, turns black, and becomes magnetic. B.B. on charcoal is colored at first black, but later red, and with the fluxes reacts for oxyd of iron.

Obs.—Occurs in brown coal at Koloseruk, near Bilin, Bohemia; at Gross-Almerode, in Hessia, and according to T. S. Hunt, at Kettle Point, in Bosanquet, Canada, as an incrustation on black shales, soft, earthy, sulphur-yellow (Logan's Report, 1850, 1863).

VI. HYDROCARBON COMPOUNDS.

ARRANGEMENT OF THE SPECIES.

I. SIMPLE HYDROCARBONS.

1. Marsh-Gas Series.—*General formula* $Ɵ_nH_{2n+2}$.

1. NAPHTHA GROUP.—Liquids.

761. Tetrylic Hydrid	$Ɵ_4H_{10}$	764. Heptylic Hydrid	$Ɵ_7H_{16}$
762. Pentylic Hydrid	$Ɵ_5H_{12}$	765. Octylic Hydrid	$Ɵ_8H_{18}$
763. Hexylic Hydrid	$Ɵ_6H_{14}$	766. Nonylic Hydrid	$Ɵ_9H_{20}$

There are also in nature the gaseous members of the series, $ƟH_4$, or Marsh-gas (Methylic Hydrid); $Ɵ_2H_6$, or Ethylic Hydrid; $Ɵ_3H_8$, or Tritylic Hydrid.

2. BETA-NAPHTHA GROUP.—Probably polymeres of the species of the Naphtha group by a common multiple; boiling point 7°–8° higher than for corresponding species of the Naphtha group.

767.	$n\,Ɵ_4H_{10}$	769.	$n\,Ɵ_6H_{14}$	771.	$n\,Ɵ_8H_{18}$
768.	$n\,Ɵ_5H_{12}$	770.	$n\,Ɵ_7H_{16}$		

3. SCHEERERITE GROUP.—Solid, or butter-like, and tasteless.

772. Scheererite	$n\,ƟH_4$	773. Chrismatite	$n\,Ɵ_2H_6$

2. Ethylene Series or Olefines.—*General formula* $Ɵ_nH_{2n}$.

4. PITTOLIUM GROUP.—Liquids.

774. Decatylene	$Ɵ_{10}H_{20}$	776. Dodecatylene	$Ɵ_{12}H_{24}$
775. Endecatylene	$Ɵ_{11}H_{22}$	777. Decatritylene	$Ɵ_{13}H_{26}$

5. PARAFFINE GROUP.—Solids, wax-like; tasteless.

778. Urpethite	780. Ozocerite
779. Hatchettite	781. Zietrisikite
Appendix.—782. Elaterite	783. Settling Stones Resin

3. Camphene Series.—*General formula* $Ɵ_nH_{2n-4}$.

6. FICHTELITE GROUP.—Solid; without taste or smell; easily crystallizable.

784. Fichtelite	$n\,Ɵ_{10}H_{18}$	786. Dinite
785. Hartite	$n\,Ɵ_{12}H_{20}$	787. Ixolyte

4. Benzole Series.—*General Formula* $\Theta_n H_{2n-6}$.

7. BENZOLE GROUP.—Liquids.

788. Benzole	$\Theta_6 H_6$	791. Cumole	$\Theta_9 H_{12}$
789. Toluole	$\Theta_7 H_8$	792. Cymole	$\Theta_{10} H_{14}$
790. Xylole	$\Theta_8 H_{10}$		

8. KÖNLITE GROUP.—Solid.

793. Könlite	n $\Theta_n H_n$

5. Naphthalin Series.—*General formula* $\Theta_n H_{2n-12}$.

794. Naphthalin	$\Theta_{10} H_8$

Appendix.—795. Idrialite.

II. OXYGENATED HYDROCARBONS.

1. GEOCERITE GROUP.—Ratio of Θ, H = 1 : 2. Wax-like.

796. Geocerite	$\Theta_{28} H_{56} \Theta_2$	797. Geomyricite	$\Theta_{34} H_{68} \Theta_2$

2. SUCCINITE GROUP.—Ratio of Θ, H = 5 : 8 to 5 : 8½. Insoluble in alcohol and ether.

[Below, the ratio of Θ, H, Θ is given for the species, and for better comparison the carbon is made 40, without writing out a formula.]

798. Copalite	40 : 64 : 1	802. Ambrite	40 : 66 : 5
799. Succinite	40 : 64 : 4	803. Bathvillite	40 : 68 : 4
800. Walchowite	40 : 64 : 3½ ?	804. Torbanite	? 40 : 68 : 2
801. ? Bucaramangite	40 : 66 : 2½		

3. XYLORETINITE GROUP.—Ratio of Θ, H = 5 : 8 to 5 : 8½. Largely soluble in ether, and some species in alcohol.

805. Xyloretinite	40 : 64 : 4	806. Leucopetrite	40 : 67½ : 2¾
807. Euosmite	40 : 68 : 2½		

4. SCLERETINITE GROUP.—Ratio of Θ, H = 5 : 7. Insoluble in alcohol and ether.

808. Scleretinite	40 : 56 : 4

5. PYRORETINITE GROUP.—Ratio of Θ, H = 5 : 7 to 5 : 6½. Soluble in alcohol or ether.

809. Jaulingite (p. 800)	40 ? : 60 : 4½	811. Rochlederite	40 : 56 : 6
810. Pyroretinite	40 : 56 : 4	812. Schlanite	40 : 52 : 3½
810A. Reussinite	40 : 56 : 3	813. Guyaquillite	40 : 52 : 6

6. Ratio of Θ, H = 5 to 5½ or less. Insoluble in alcohol or ether.

814. Middletonite	40 : 44 : 2	815. Stanekite	? 40 : 44 : 6
816. Anthracoxenite	40 : 38 : 7½		

7. **DYSODILE GROUP.**—Containing sulphur in place of part of the oxygen.

817. **Tasmanite** 40 : 64 : 3 818. **Dysodile**

Appendix.—819. **Hircite.** 820. **Baikerinite.**

III. ACID OXYGENATED HYDROCARBONS.

821. **Butyrellite**	$\text{Ꞓ}_{32}\text{H}_{64}\text{Ɵ}_4$
822. **Geocerellite** (Geoceric acid)	$\text{Ꞓ}_{26}\text{H}_{50}\text{Ɵ}_4$
823. **Brücknerellite** (Georetinic acid)	$\text{Ꞓ}_{24}\text{H}_{44}\text{Ɵ}_6$
824. **Succinellite** (Succinic acid)	$\text{Ꞓ}_4\text{H}_6\text{Ɵ}_4$
825. **Retinellite**	$\text{Ꞓ}_{21}\text{H}_{28}\text{Ɵ}_2$
826. **Dopplerite**	? $\text{Ꞓ}_{10}\text{H}_{12}\text{Ɵ}_6$
827. **Melanellite**	$\text{Ꞓ}_{12}\text{H}_{10}\text{Ɵ}_4$

IV. SALTS OF ORGANIC ACIDS.

828. **Mellite**	$\overset{\cdots}{\text{Al}}\,\overline{\text{M}}^3+18\,\dot{\text{H}}$	$\text{Ꞓ}_4\text{Ɵ}_2\|\text{Ɵ}_2\|\beta\text{Ⱥl}+6\text{ aq}$
829. **Pigotite**		
829A. Organic salts of iron		Undetermined

V. NITROGENOUS HYDROCARBONS.

Species undetermined.

Appendix to Hydrocarbons.

830. **Asphaltum** 831. **Mineral Coal**

The formulas above are all written on the new system. If the number connected with H is halved in each case, and the barred capitals are replaced by common capitals, they will then conform to the old system.

The *native* hydrocarbons are very imperfectly known. Most of the kinds hitherto recognized in mineralogy are more analogous to rocks than minerals. *Amber*, for example, instead of being a species, is a mixture of four or more species, as Berzelius long since pointed out, and only two of the number have thus far been investigated. The presence of *succinic acid*, one of these two, is spoken of as an essential constituent and distinguishing feature of amber: and this it is; but only in the way that feldspar is a constituent of granite. Petroleum, Asphaltum, and the various kinds of mineral resins and wax are similar mixtures, in the light of chemistry, as has been shown by many investigators. But still the true line of investigation is so little appreciated that new resins or asphalts are from time to time brought forward as species in mineralogy upon characters that only prove them to be mixtures. And chemistry, while working toward a better state of this department of mineralogy, often fails in its researches to distinguish educts (native ingredients) from products.

The facts in the case, and the true idea of the science, sustain the course of the author in here removing amber from mineralogical species, and calling, not amber, but the insoluble resin which constitutes four-fifths of its mass, *succinite;* and in endeavoring to apply the same method throughout the hydrocarbon section. Much more investigation is demanded before satisfactory results can in all cases be attained. But by pursuing the subject in the way here recognized, the section will ultimately become an exhibition of the actual *species* of hydrocarbons in nature, and thus be elevated to the same level with other parts of the science.

I. SIMPLE HYDROCARBONS.

NAPHTHA AND BETA-NAPHTHA GROUPS.

SYN. OF NAPHTHA AND PETROLEUM. Νάφθα *Strabo*, xvi. i. § 15, *Dioscor.*, i. 101. Naphtha, Bitumen liquidum candidum, *Plin.*, ii. 109, xxxv. 51. Naphtha flos bituminis *Agric.* Ort. Caus. Subt., 45, 1544. Liquidum bitumen, nunc vocatur Petroleum, *Agric.*. Nat. Foss., 222, 1546. Erdöl, Bergöl, Steinöl, *Germ.* Mineral Oil. Kerosene. Bitume liquide *Fr.*

The liquids or oils of the Naphtha and Beta-naphtha groups occur as constituents of the lighter kinds of *petroleum*. The other native constituents, and the most abundant, are the oils of the Ethylene series and the paraffins; and the proportion of ethylenes increases with the increase of density or viscidity. (See PITTOLIUM GROUP, and PARAFFIN.)

The general formula is $\Theta_n H_{2n+2}$, or that of the Marsh-gas series. The specific gravities, boiling points, and vapor densities increase with the increase in the atomic number, or the value of *n* in the above formula, as shown in the following table, which contains also the percentage composition:

NAPHTHA GROUP.

		C	H	Boiling T.	G.	Vapor Density found.
761.	TETRYLIC HYDRID	$\Theta_4 H_{10}=82{\cdot}80$	17·20	0°0?	0·600	2·110
762.	PENTYLIC HYDRID	$\Theta_5 H_{12}=83{\cdot}33$	16·67	30·2	0·640	2·538
763.	HEXYLIC HYDRID	$\Theta_6 H_{14}=83{\cdot}72$	16·28	61·3	0·676	3·053
764.	HEPTYLIC HYDRID	$\Theta_7 H_{16}=84{\cdot}0$	16·0	90·4	0·718	3·547
765.	OCTYLIC HYDRID	$\Theta_8 H_{18}=84{\cdot}21$	15·79	119·5	0·737	3·992
766.	NONYLIC HYDRID	$\Theta_9 H_{20}=84{\cdot}38$	15·62	150·8	0·756	4·460

BETA-NAPHTHA GROUP.

		Boiling T.	G.	Vapor Density.
767.	$\Theta_4 H_{10}$	8—9°	0·611	
768.	$\Theta_5 H_{12}$	37·0	0·645	2·514
769.	$\Theta_6 H_{14}$	68·5	0·689	3·038
770.	$\Theta_7 H_{16}$	98·1	0·730	3·551
771.	$\Theta_8 H_{18}$	127·6	0·752	3·990

The names *Amylic Hydrid*, *Caproylic*, *Œnanthylic*, *Caprylic*, *Pelargonylic*, are often used for the above 762 to 766. Those in the table are derived from the Greek for 4, 5, 6, 7, 8, 9, and were proposed by Gerhardt.

The constitution of petroleum has been investigated by various chemists, among whom the most prominent are Pelouze and Cahours (C. R., liv. 124, lvi. 505, lvii. 62), and C. M. Warren (Mem. Am. Ac. Boston, II. ix. x., Am. J. Sci., II. xl. xlv. xlvi.). Pelouze and Cahours continue the naphtha series to $\Theta_{16} H_{32}$, and state evidence of the existence of still higher members. But Warren arrived at the conclusion that the naphtha or marsh-gas series terminates with $\Theta_9 H_{20}$, and that the oils of higher density and atomic numbers belong to the ethylene series ($\Theta_n H_{2n}$). Moreover, Warren brought out the fact that there was a *second* naphtha group, differing from the other in its higher boiling points—the *Beta-naphtha* group above. This chemist also determined with great exactness the boiling points of the two groups, and found that in both there was the common difference of about 30°C. for successive terms in the series (or for a difference of $ȻH_2$); but that the boiling points in the second series were about 8° higher correlatively than those of the 1st series, as the tables show.

The specific gravities and vapor densities for 761 are from Ronalds. Those of the others, 762 to 772, are from Warren, excepting the vapor densities of 762, 763. The vapor density of 767 has not yet been determined. Warren's specific gravities were taken at 0° C.

Ronalds has observed that the gaseous compounds of the marsh-gas series $Ȼ_2H_6$ and $Ȼ_3H_8$ (2d and 3d terms in the marsh-gas series) also exist in connection with petroleum. *Marsh-gas* itself, the *first* term in the series $ȻH_4$, is a very common gas of coal beds and bituminous deposits, as well as of modern marshes.

Petroleum passes by insensible gradations into *pittasphalt* or *maltha* (viscid bitumen); and the latter as insensibly into *asphalt* or solid bitumen.

Petroleum occurs in rocks or deposits of nearly all geological ages, from the Lower Silurian to the present epoch. It is associated most abundantly with argillaceous shales and sandstones, but is found also permeating limestones, giving them a bituminous odor, and rendering them sometimes a considerable source of oil. From these oleiferous shales and limestones the oil often exudes, and appears floating on the streams or lakes of the region, or rises in oil springs. It also exists collected in subterranean cavities in certain rocks, whence it issues in jets or fountains whenever an outlet is made by boring. These cavities are situated mostly along the course of gentle anticlinals in the rocks of the region; and it is therefore probable, as has been suggested, that they originated for the most part in the displacements of the strata caused by the slight uplift. The oil which fills the cavities has ordinarily been derived from the subjacent rocks; for the strata, in which the cavities exist, are frequently barren sandstones. The conditions required for the production of such subterranean accumulations would be therefore (as others have explained) a bituminous oil-bearing, or else oil-producing, stratum at a greater or less depth below; cavities to receive the oil; an overlying stratum of close-grained shale or limestone, not allowing of the easy escape of the naphtha vapors.

If the oil exists ready formed in the rocks, only a slight heat above that common to the rocks would be needed to expel the oil slowly from below. And, without heat, as Hunt states, the oil might be expelled through the pressure of superincumbent waters from the oil-bearing shales or clays, and would rise and occupy the cavities because so light as to float on the waters.

But if the oil-producing bed contained not the oil ready made, but only hydrocarbonaceous matters that may afford it on destructive distillation, the oil would have required considerable heat for its production.

In the Caspian and Rangoon naphtha regions the oleiferous clayey deposits are nearly or quite superficial, and the oil, a viscid kind, exudes readily into pits made for collecting it.

In the United States liquid oil occurs in the *Lower Silurian*, in the "Bird's-eye" limestone of Rivière à la Rose (Montmorenci), Canada, and of Watertown, N. Y., in drops in fossil coral; and in the Trenton limestone at Pakenham, Canada, the cavities of large Orthocerata sometimes hold several ounces (T. S. Hunt, Am. J. Sci., II. xxxv. 166, 1863); on Grand Manitoulin Id., where a spring affording it arises from the Utica shale, the source possibly the subjacent limestones; at Guilderland, near Albany, from the Hudson River group, as observed in a spring by Beck; quite freely in limestone and shale near Chicago; far more so in Kentucky, in the Cumberland oil region, the wells, "from which tens of thousands of barrels of oil have flowed" (Newberry), descend 200 ft. into the Blue Limestone, in which there are bituminous shaly strata overlaid by sheets of thin-bedded compact limestone; these features prevail from Lincoln and Casey Cos., through Adair and Russell, Cumberland and Clinton Cos., Ky., and Overton and Jackson Cos., Tenn.

In the *Upper Silurian* traces have been observed in the Niagara limestone and the Medina red shales; at Gaspé, Canada, in a Lower Helderberg limestone, on Silver Brook, etc; near Chicago, so abundant in a limestone as to ooze out, and the rock may be made to burn, owing to its presence.

In the *Lower Devonian*, the Corniferous limestone is regarded by Hunt as the source of the oil of Enniskillen, Canada, where there are large areas covered by the half-inspissated bitumen. Hunt states (l. c.) that at Rainham, Canada, on L. Erie, shells of *Pentamerus aratus* are sometimes filled with petroleum; and that in other places in the region imbedded corals, *Heliophyllum* and *Favosites*, have, in certain of the layers, their cells full of oil (while in other layers it is absent from the corals), and in quarrying, the oil flows out and collects on the water of the quarry; and at Gaspé, Lower Devonian sandstones afford oil springs and give rise to beds of thickened petroleum, and the chalcedonic geodes of a trap dyke, intersecting the sandstone, sometimes contain petroleum. In the *Middle Devonian*, the Black shale, or Genesee slate, is supposed by many geologists to be the principal source of the oil of Pennsylvania, the Kenawha valley, and other parts of eastern Virginia, and of Ohio and Michigan; but J. P. Lesley attributes much of the oil of western Pennsylvania to the Subcarboniferous. Near Fredonia, Chatauque Co., and at Rockville, Alleghany Co., oil is found in connection with Chemung rocks, or the Upper Devonian (Hall).

A little oil has been observed in connection with Triassic shales at Southbury, Conn. The oil of southern California proceeds from Tertiary shales. On Trinidad a thick oil, with asphalt, occurs in connection with lignite and other vegetable remains in the shales constituting the upper part of the Tertiary; and specimens of the vegetable material, partly changed to oil and penetrated by it, and having its cells looking as if they had been corroded, as a result of the change, are described by Wall (Q. J. G. Soc, xvi. 460).

Noted foreign localities are 3 m. from Ye-nan-gyoung (*Fetid-water-rivulet*), Burmah (and exported from Rangoon), where there are about 100 wells, from 180 to 306 feet deep, each lined with horizontal timber, but not all now worked (Oldham); the peninsula of Apcheron on the western shore of the Caspian, at Bakee, where naphtha exudes from argillaceous and calcareous beds, especially the former, of the Middle Tertiary (Abich), and where it has long been used for burning in lamps and for cooking; near the centre of the region the light and pure naphtha oil is obtained, while along its borders the oil is a thicker petroleum, or passes into an asphalt, and solid masses of this asphalt are often seen floating in the Caspian; on the island of Tschelcken, near the eastern coast of the Caspian, in Balkan Bay; on the banks of the Kuban, promontory of Taman, east side of isthmus between the Azof and Black Sea; near the river Betchora, in the government of Archangel, Russia; near the village of Amiano, in Parma, Italy, whence enough was formerly obtained to light the streets of Genoa; at Zante, one of the Ionian islands (ancient Zacynthus), which has furnished oil for more than 2,000 years, its petroleum spring having been mentioned by Herodotus. Pliny mentions the oil of a spring at Agrigentum, Sicily, and states that it was collected and used for burning in lamps, as a substitute for oil. He distinguishes this oil from naphtha, which he says was too light and inflammable for such a use. Of naphtha, he mentions a locality in "Parthia" (about the sources of the Indus). Oil is found also near the city of Mexico, and on the river Lagun.

The oil spring of Cuba, Alleghany Co., N. Y., called the Seneca Oil Spring, long known, was described by Prof. Silliman in 1833 (Am. J. Sci., xxiii. 97) as a dirty pool, about 18 ft. across, covered with a film of oil, which was skimmed off from time to time for medicinal purposes. The so-called "Seneca oil," sold at the time in the shops (and from which he often distilled naphtha for preserving potassium), he observes was not from this spring (around which the Seneca Indians then had a reserve of a square mile), but, as he was told, from Oil Creek, Venango Co., Pa., about 100 m. from Pittsburg. *Seneca Lake* has oil on its surface in some parts, and it is said to have given the name to the oil; but whether this is the true source, or whether it came from its being collected and sold by the Seneca Indians, is not clear. Hildreth in 1833 (ib., xxiv. 63), and later in 1836 (ib., xxix. 86, 121, 129), gave an account of the salt wells of the Little Kenawha valley, which then afforded, he says, 50 to 100 gallons a year. He also speaks, in 1833, of a well 475 ft. deep, 30 m. N. of Marietta, Ohio, which, when first opened, discharged at intervals of 2 to 4 days, for 3 to 6 hours each time, throwing out 30 to 60 gallons of oil at each "eruption," but was then yielding only a barrel a week. In 1840 a *spouting* well of oil, at Burksville, Kentucky, was described (ib., xxxix. 195); the well was bored for salt, and 200 ft. down a "fountain of pure oil was struck, which was thrown up more than 12 ft. above the surface of the earth," emitting, according to the estimate, 75 gallons a minute; it "continued to flow for several days successively," but then failed; and efforts to bring it into action again, or find another, were not successful. The petroleum of Enniskillen, Canada, was mentioned in 1844 by Mr. Murray, in the Canada Geological Report for 1846; and in 1857 wells were sunk for the collection of it. In 1859, on Oil Creek, Venango Co., Pa., a boring for salt, but 75 feet deep, let out the first *fountain* of oil of that now famous oil-region. For many weeks it discharged 1,000 gallons per day.

The *origin* of petroleum, including the lighter as well as heavier kinds, has been attributed by some to the decomposition of vegetable substances alone (Bischof, etc.); but it is now generally admitted that it has come from animal as well as vegetable, as urged by Dufrénoy (Min., iv. 602, 1859), J. S. Newberry (Ohio Agric. Rep., 1859), and T. S. Hunt (Can. Nat., vi. 241, 1861, Am. J. Sci., II. xxxv., Ch. News, 1863).

The conditions favorable to the formation of naphtha, as shown by the characteristics of the deposits in which it is found native, are the following: (1) the diffusion of organic material through a fine mud or clay; (2) the material in a very finely divided state; and (3), as a consequence of the preceding, the atmosphere excluded as far as possible from the material undergoing decomposition. There is reason to believe that no more heat was required than what was afforded by the natural climate or temperature of the region and the process of fermentation.

Shales, the most common oil-bearing rocks, were originally the fine mud of deep or shallow seas; and the limestones were the same, only the mud was calcareous in nature, like the coral mud of many a coral lagoon, as the author has elsewhere described after personal examination. These shales ordinarily contain few fossils of any kind, and very rarely distinct vegetable remains. It may be questioned whether tough fucoids (sea-weeds), or the branches and leaves of ordinary plants imbedded in such clays, would ever become so subdivided or disorganized as to make the requisite emulsion with the mud free from any vegetable forms; and it is more probable that the vegetable material present was either delicate water-plants, or was derived from abundant infusorial or microscopic vegetable life. The limestones, on the contrary, are sometimes full of fossils, but these are animal; and, as the solid parts which make the fossils are to a large extent ground up to make the mud that becomes the limestone, the organic material these hard parts contain, as well as that of the fleshy parts and oils, would be diffused through the mud or earth in the very condition demanded.

The light native oils do not occur in coal beds, which were made from thick beds of vegetable debris.

In the above-mentioned circumstances, with the deposits under pressure from superincumbent beds, the atmospheric air almost totally excluded, the organic material might undergo decomposition through the reactions of its own elements alone. (See on this subject, and the reactions mentioned below, Bischof, Chem. G., ii. 1853, T. S. Hunt, Can. Nat. and Ch. News, l. c.) The average composition of dry wood (the ash and nitrogen excluded) is represented by $Ȼ_6 H_9 Θ_4$= Carbon 49·66, hydrogen 6·21, oxygen 44·13=100. Taking two parts, we have $Ȼ_{12} H_{18} Θ_8$. If now the oxygen combines with carbon to form carbonic acid, $4\,Ȼ Θ_2$ will thus be removed, leaving $Ȼ_8 H_{18}$, which is the composition of one of the species of the naphtha group, the fifth, on p. 720. But $Ȼ_8 H_{18}$, or $Ȼ_{32} H_{72}$, its multiple by 4, corresponds also to $3\,(Ȼ_6 H_{14}) + Ȼ_8 H_{18} + \frac{1}{2}\,(Ȼ_{12} H_{24})$, the first two members light naphtha oils, and the last an ethylene, a composition much like that of Pennsylvania petroleum. The decomposition might not be as simple as here taken, as $\frac{1}{2}$ to 1 p. c. of nitrogen is also present, and there would also be some animal material. But the illustration is still satisfactory. That no water ($H_2 Θ$) would be formed from the elements of the organic material is apparently indicated by the fact that this would make an excess of carbon or a deficiency of hydrogen. From Chevandier's numerous analyses (Ann. Ch. Phys., III. x. 129), the average composition of dry wood is carbon 51·21, hydrogen 6·24, oxygen 41·45, nitrogen 1·10, corresponding, if the nitrogen is not counted, to $Ȼ_{12} H_{17\cdot5} Θ_{7\cdot5}$; from which the resulting oils might be nearly the same as above.

Were there less confinement by superincumbent beds or earthy material, part of the hydrogen might be lost by combining with the carbon and escape as marsh gas ($Ȼ H_4$), and thus determine the formation of the thicker oils; or else of the solid insoluble hydrocarbons, more or less oxygenated, which make many shales a rich source of oil on distillation.

With the air not well excluded, as in the case of all thick beds of vegetable debris, such as have formed peat and the various kinds of coal, the decompositions would be more complex: outside oxygen carrying off, it may be, part of the hydrogen (as water), and of the carbon (as carbonic acid). Thus $Ȼ_{12} H_{18} Θ_8$ (composition of wood) may change to $Ȼ_{12} H_{14\cdot5} Θ_5$, the average composition of *peat;* or to $Ȼ_{12} H_{12} Θ_{3\cdot5}$=Carbon 67·92, hydrogen 5·66, oxygen 26·42=100, a medium brown coal (or lignite); or $Ȼ_{12} H_{9\cdot75} Θ_{0\cdot87}$=Carbon 85·88, hydrogen 5·82, oxygen 8·30=100, Wigan cannel coal, etc.

Marsh-gas ($Ȼ H_4$) is a common gas of marshy places and of Artesian wells, and so also, though less abundantly, carbonic acid (Bischof). The distillation of wood will afford the solid hydrocarbons of the paraffin group; Reichenbach, in his discovery of paraffin, obtaining it from the wood of the *Fagus sylvatica.* Dr. J. S. Newberry states (priv. contrib.) that off the shores of Lake Superior, at Marquette, he observed bubbles of gas coming from the bottom to the surface, which proved to be carburetted hydrogen; and also, now and then, drops of oil slowly rising, and finally spreading over the surface, which oil proved on examination to be a kind of petroleum. Although the *vegetable* origin of the oil was not certain, it seemed to be altogether probable. On the island of Trinidad the oil-producing beds are clayey beds in the Tertiary, containing remains of plants, and Wall states (Q. J. G. Soc., xvi. 460) that there is full evidence that the liquid and solid bitumen was produced at the ordinary temperature and condition of climate in the occurrence of numerous specimens of the vegetable matter in process of transformation, which have, as a consequence, the organic structure more or less obliterated.

In the change of animal matters to oil, there is more nitrogen present to give complexity to the mutual reactions. But when the material is animal oils, there are only carbon, hydrogen, and oxygen, as in the case of vegetation. In such oils there are nearly the proportions $Ȼ_{18} H_{34} Θ_2$. In the case of such a compound (oleic acid), the forming of carbonic acid from the oxygen would separate $Ȼ Θ_2$, and leave $Ȼ_{17} H_{34}$, of the ethylene ratio; in that of $Ȼ_{17} H_{34} Θ_2$ (margaric acid) the same would leave $Ȼ_{16} H_{34}$, or a combination of marsh-gas oils. Warren and Storer have obtained (Mem. Am. Ac. Boston, ix. 177, Am. J. Sci., II. xlii. 250) from the destructive distillation of a fish-oil, after its saponification by lime, all the compounds above enumerated of the Naphtha group, besides others of the ethylene and benzole series.

Dr. Newberry has observed that cannel coal sometimes shows by its animal fossils that part of its oily products may be of animal origin (Am. J. Sci., II. xxiii. 212, 1857), instancing a case in Ohio in which the coal contained fossil fishes. He also remarks on the disagreeable smell of some limestone oil, and attributes it to its animal origin. Dufrénoy, in his Mineralogy (iv. 602, 1859), gives prominence to the fact that remains of fishes are common in oil-producing shales and to the view that they are the source of the oil, mentioning as examples the black shales in the Coal formation at Saarbruck in Prussia, and Ygornay near Autun in France; the Permian (Zechstein) at Mansfeld; grayish limestone, in the Lias, at Doubs; and grayish shale, in the

Middle Tertiary, at Menat, 30 m. from Clermont, France; all of which abound in the remains of fishes. The shales adjoining the Albertite of Nova Scotia have been mentioned as another example of this kind. The black semibituminous or coaly shales of the Triassic of the Connecticut valley contain numerous fossil fishes, and these are the only fossils.

Lesquereux derives petroleum (Trans. Am. Phil. Soc. Philad., xiii. 313) mainly from the decomposition of fucoids and other marine plants, arguing for it on the ground of its occurrence so largely in rocks of marine origin. S. F. Peckham, in a recent communication to the author, sustains the idea that the light naphtha oils are solely of animal origin.

It is to be noted that wherever marsh or water plants have grown in past time there must have been also a profusion of minute animal life to afford nitrogen and sulphur to the accumulating debris; and, conversely, vegetable life of microscopic, if not also of larger kinds, is present wherever there is animal life.

The word naphtha is from the Persian *nafata*, signifying to *exude;* and petroleum from πέτρος, rock, and *oleum*, oil (the latter from the Greek *ἔλαιον*, *oil*), dating only from the middle ages (see SYN.).

Alt.—Petroleum undergoes alteration of condition in two ways:

1. *The evaporation of its lighter oils.* When exposed to the air the petroleum is free from pressure, except the ordinary atmospheric, and open to the heat and winds of the region. As a consequence the lighter naphtha oils pass off, leaving only the heavier, and the substance becomes gradually viscid, or even a solid consisting largely of solid hydrocarbons; and the so-called *asphalts*, which may thus result, will be ordinary bitumens of one kind or another, or largely paraffin, according as paraffin is present or not in the native oil.

In most oil regions, when the oil occurs at the surface open to the air, more or less of solid bitumen is to be found. Hunt speaks of the large "gum-beds" of half-dried bitumen in the oil region of Enniskillen; and Winchell says that in the neighboring but less productive district in Michigan, masses of inspissated oil are common, and some are as hard as asphalt. At the naphtha island of Tschelekän there are large quantities of *Neft-gil*, as it is there called, which is nearly pure paraffin. The hot climate of the Caspian is favorable for such a result.

2. *The oxydation of some or all of the ingredients constituting the petroleum.* In the process of oxydation there is first a loss of some of the hydrogen by its union with oxygen to form water, which escapes. Thus the oils of the Marsh-gas series ($\Theta_n H_{2n+2}$) may pass to the less stable ethylenes ($\Theta_n H_{2n}$); or, by further loss of hydrogen, to species of the Benzole series ($\Theta_n H_{2n-6}$), or of the Naphthalin series ($\Theta_n H_{2n-12}$). The last two appear to occur sparingly in nature. *Secondly*, there is *oxygenation;* that is an absorption of, and union with, oxygen. These oxygenated substances have been yet but little investigated (see ASPHALTUM). They are probably all solid at the ordinary temperature.

Hard bitumen or asphalt may hence consist either (1) of unoxygenated, or (2) partly of unoxygenated and partly oxygenated, the usual fact; or (3) solely of oxygenated hydrocarbons (very rarely, if ever, true in nature). The state of solidity is not proof that any part of the bitumen is oxygenated.

SCHEERERITE GROUP.

Wax-like, or butter-like. General formula that of the Marsh-gas series, or $\Theta_n H_{2n+2}$. The two species here included are, according to the analyses (which need verification), polymeres of the first two species of the Marsh-gas series, ΘH_4, and $\Theta_2 H_6$.

The *Paraffins* belong here if members of the Marsh-gas series. See p. 730.

772. SCHEERERITE. Scheererit *Stromeyer*, Kastn. Arch., x. 113, 1827; Naphthaline résineuse prismatique *Könlein*, Bibl. Univ., xxxvi. 316, 1827; Macaire-Prinsep, Bibl. Univ., xl. 68, 1829, Ann. Phys. Ch., xv. 294.

Monoclinic. Crystals mostly thin tabular, rhomboidal or six-sided, often flattened parallel to *i-i*, with also the planes *I*, −1, 1-*i*; edge I/I on $-1/-1=123\frac{1}{2}°$, edge $-1/-1$ on $1\text{-}i=135°$, edge I/I on $1\text{-}i=101\frac{1}{2}°$, Kenngott. Also acicular. Also in loosely aggregated crystalline grains and folia.

Soft. G.=1−1·2. Lustre pearly or resinous; feebly shining. Color whitish, gray, yellow, green, pale reddish. More or less translucent to transparent. Easily frangible. Tasteless. Inodorous. Feel not greasy. Soluble easily in alcohol, and also in ether. Melts at 44° C., and then resembles a fatty oil, and like it penetrates paper; these spots, however, may be removed by heat. On cooling, the mineral crystallizes in acicular crystals. May be distilled without decomposition; boiling point near 100° C. (92°, Prinsep).

Comp., etc.—According to an imperfect analysis by Prinsep (Pogg., xv. 294), consists of Carbon 73, hydrogen 24=97, which corresponds nearly to the ratio for Θ, H=1 : 4, or the composition of marsh-gas=Carbon 75, hydrogen 25=100; whence, if the results may be trusted, it is a polymero of marsh-gas.

Soluble in sulphuric or nitric acid, and not in alkalies. Takes fire easily and burns without residue, giving out much smoke and a feeble aromatic odor.

Found by Capt. Scheerer, in the year 1822, in the coal of a bed of brown coal in the Tertiary, at Uznach, near St. Gallen, in Switzerland. The bed of coal is two to three feet thick, and the pine stems in it are almost unchanged. Among the species of pine there is the *P. sylvestris;* and the birches and firs are those of modern species. The age is the same with that of the peat beds of Redwitz. Besides scheererite it affords also fichtelite and könlite. On cryst., Kenng., Ber. Ak. Wien, xiv. 272, and Min. der Schweiz, 418, Leipzig, 1866.

773. CHRISMATITE. Chrismatin (fr. Wattin) *Germar*, ZS. G., i. 40, 1849. Ozokerit (fr. ib.) *Breslau*, Karst. u. Dech. Arch., xxiii. 749, 1850. Hatchettin (fr. ib.) *Wagner*, Jahrb. Min. 1864, 687; *H. Fleck*, Steinkohlen Deutschl., i. 37, 4to, München, 1865.

Butter-like, or of semifluid consistence. Soft at 55° to 60° C. G. below 1. Lustre greasy to silky. Color greenish to wax-yellow. Slightly translucent. Tasteless. Melts at a very low temperature to an oil, which is dark red by transmitted light, and apple-green by reflected.

Comp.—H. Fleck obtained (l. c.), 34 p. c. of ash being removed:

Carbon 78·512 Hydrogen 19·191 Oxygen 2·297=100.

Excluding the oxygen as water, as done by Fleck, it leaves C 80·51, H 19·49=100, corresponding to $\Theta_2 H_6$=Carbon 80, H 20; making it thus a polymere of $\Theta_2 H_6$, or the second member of the Marsh-gas series. Fleck adopts the formula $\Theta_{18} H_{38}$. If the oxygen is an essential constituent, either view of the constitution is wholly at fault. Burns with a flame, without smell.

Obs.—Occurs in cavities of calcite and quartz crystals in an argillaceous sandstone of the Carboniferous formation at Wettin, Saxony.

Named from χρῖσμα, *ointment*.

PITTOLIUM GROUP.

SYN. OF PITTASPHALT. Πιττασφάλτος *Dioscor.*, i. 100. Pissasphaltus *Plin.*, xxiv. 25, xxxv. 51 Maltha *Plin.*, ii. 108. Bergtheer *Germ.* Bitume visqueux, Bitume glutineux, Poix minerale, Mineral graisse, *Fr.* Petroleum pt. Mineral Tar.

The species of this group are liquids like the naphtha oils, but are of higher specific gravity and atomic weight. They enter into the constitution of all free-flowing petroleum, but are especially characteristic of the denser kinds, and viscid bitumens, and exist largely also in many asphalts. They belong to the Ethylene series, and therefore have the general formula $\Theta_n H_{2n}$=(alike for all) Carbon 85·71, hydrogen 14·29. G.=0·75—0·84.

The species ascertained to be native by C. M. Warren (Mem. Am. Ac.

Boston, ix., Am. J. Sci., II. xl.), and occurring in the Pennsylvania petroleum, Rangoon tar, etc., and the boiling temperatures, as ascertained by Warren, are the following:

	Formula.	Boiling T.
774. **Decatylene** (Rutylene)	$\Theta_{10}H_{20}$	174·9°
775. **Endecatylene** (Margarylene)	$\Theta_{11}H_{22}$	195·8
776. **Dodecatylene** (Laurylene)	$\Theta_{12}H_{24}$	216·2
777. **Decatritylene** (Cocinylene)	$\Theta_{13}H_{26}$	235

The average increase in the boiling point for the successive members in the series (or the addition of ΘH_2), as follows from Warren's results, is 20°·6, or only *two-thirds* of the average in the Naphtha group. Other higher *native* species of the above series have not yet been clearly defined.

These compounds are made members of the Marsh-gas or Naphtha series by Pelouze and Cahours, who write the formulas as follows, and give the annexed specific gravities, vapor densities, and boiling points:

	G.	Vapor Density.	Boiling Temp.
$\Theta_{10}H_{22}$	0·757	5·040	160°—162°
$\Theta_{11}H_{24}$	0·766	5·458	180 —184
$\Theta_{12}H_{26}$	0·776	5·972	196 —200
$\Theta_{13}H_{28}$	0·792	6·569	216 —218

They also add the compounds $\Theta_{14}H_{30}$, $\Theta_{15}H_{32}$. Warren, by his superior methods, proves that the species obtained by them were not pure (l. c.).

Each of the four ethylene compounds above mentioned have been obtained from Rangoon tar, besides some species of the Naphtha group (at least Θ_7H_{16} and Θ_8H_{18}), traces of some of the Benzole series, and also naphthalin.

The name *pittolium* is from πιττα, *pitch*, and *oleum*, oil, analogous to *petroleum*; and *pittasphaltum*, from the Greek for *pitch* and *asphalt*.

The word *maltha* is from the Greek μαλθη, *soft wax*; it was also used sometimes for a mixture of wax and pitch, employed for making the surface of writing-tablets, and for some kinds of cements. But Pliny (ii. 108) describes under this name an inflammable mud flowing from a pool at Samosata in North Syria on the Euphrates, which he says (ii. 109) was similar in nature to naphtha; and this use of the word has led to its later application to viscid bitumens.

Petroleum in cavities in crystals. Davy, in his examinations of the fluids in crystals (Phil. Trans., 1822, 367, and postscript), found only water, except in the case of quartz from Dauphiny. The liquid in this case was about as viscid as linseed oil; brownish in color; became solid and opaque at 13° C. (56° F.); had a smell resembling naphtha; acted like a fixed oil when heated, the temperature of ebullition being high; and burned with flame, producing a white smoke. The cavity was ½ in. across, but only a sixth of it was occupied by the fluid. Davy made his investigations of the fluids in crystals by having the crystals bored through to the cavity by a lapidary, and was the first to use this method.

Petrolene. Boussingault obtained from the viscid bitumen and asphalt of Bechelbronn an oil which he called *Petrolene*, and announced it as the *liquid* ingredient of all asphalt, the *solid* one being named by him *Asphaltene* (see Asphaltum). It was separated by heating in an oil bath to a temperature of 300° C. None of it passed over at a temperature below 100° C. He obtained for its composition (Ann. Ch. Phys., lxi. 141, lxxiii. 442):

Carbon	87·36	86·78	87·45	86·98	(⅔) 88·4.
Hydrogen	11·90	12·20	12·30	12·70	12·5.

He writes for it the formula $\Theta_{10}H_{16}$, making it of the camphene series, Θ_nH_{2n-4}. It boiled at 280° C. The vapor density is stated at 9·415, or "double that of oil of turpentine."

There can be no doubt that the petrolene was a mixture of oils. Warren states (priv. contrib.) that from Boussingault's data, as given in his article, the vapor density should have been 8·49 instead of 9·415; and also that his own researches on various hydrocarbon oils, including the products from the destructive distillation of albertite, lead him to believe that petrolene probably consists mainly of oils of the *Ethylene* series; that $Є_{16}H_{32}$ would have for its boiling point 295° C., and vapor density 7·745; but that the liquid is made up of oils of both less and greater density.

The Bechelbroun tar and that similar from Lobsann (both in the Dept. of Bas-Rhin, France) are called also *Mineral Graisse* and *Graisse de Strasbourg.*

Völckel has subjected a viscid bitumen from Travers, near Neufchatel, to distillation in iron cylinders (Ann. Ch. Pharm., lxxxvii. 143, 1862), and obtained the following as his successive results:

	C	H	Temp. of vaporization.	G.
1.	87·56	12·34= 99·90	90°—120° C.	0·784 at 15° C.
2.	87·59	12·30= 99·89	120 —150	0·790
3.	87·31	12·59= 99·99	150 —180	0·802
4.	87·34	12·69=100·03	180 —200	0·817
5.	87·48	12·60=100·08	200 —220	0·845
6.	87·40	12·40= 99·80	220 —250	0·867

The analyses afford for all of the compounds the ratio for Є, H, 6 : 10, and Völckel regards them as polymeres of $Є_{12}H_{20}$, and hence of the camphene series and similar to petrolene. But (as Warren observes) with such a mode of distillation *artificial* products were likely to have been obtained, and among them benzole or naphthalin; and the presence of either of these compounds would account for the divergence from the ethylene series.

The composition is compared by Völckel to that of *oil of amber* (an admitted product of distillation, and not native to amber). Döpping obtained for the oil of amber passing over at 200° C., C 87·48, 87·32, H 12·06, 11·98=99·54, 99·30. The ratio for Є, H, is 5 : 8, which is also that for amber itself; and the formula is $Є_{10}H_{16}$, or that arrived at by Boussingault for his petrolene.

SOLID PETROLENE. The asphalt of Peklenicza (Muraköz), Austria, affords a *solid* portion, soluble in ether and hardly at all so in alcohol (in this respect like the asphaltene of Boussingault), which, according to Nendtvich (Haid. Ber., iii. 271, Jahrb. G. Reichs., vii. 743), has the *same composition with petrolene.*

The observations thus far made *seem* to point to a Camphene series of Hydrocarbons as characteristic of many viscid bitumens, and of some, if not many, asphalts. But the investigations have not been sufficiently exact to sustain satisfactorily the conclusion.

PARAFFIN GROUP.

Wax-like in consistence; white and translucent. Sparingly soluble in alcohol, rather easily in ether, and crystallizing more or less perfectly from the solutions. G. about 0·85—0·98. Melting point for the following species, 33°—90°.

General formula $Є_n H_{2n}$, or that of the ethylene series, according to many authors,=Carbon 85·71, hydrogen 24·29=100; $Є_n H_{2n+2}$, according to others. The peculiar inertness of the paraffins with regard to chemical combination is urged by Watts and Frankland as favoring the latter formula. Whichever the series, they are regarded as species of high atomic weight, *n* not being less than 28. The different species, varying in the value of *n*, vary also in boiling point, and other characters. Those here recognized have not been studied with that care which is demanded for full confidence in their stated composition, or in their purity as simple species.

Paraffins occur in the Pennsylvania petroleum, a freezing mixture reducing the temperature being sufficient to separate it in crystals. Also in the naphtha of the Caspian, in Rangoon tar, and many other liquid bitumens. It is a result of the destructive distillation of peat, bituminous coal, lignite, coaly or bituminous shales, most viscid bitumens, wood-tar (from which it was first obtained by Reichenbach), and many other substances.

The name is from the Latin *parum*, *little*, and *affinis*, alluding to the feeble affinity for other substances, or, in other words, its chemical indifference.

778. URPETHITE. Part of Ozocerite (fr. Urpeth Colliery) *J. F. W. Johnston*, Phil. Mag., III. xii. 389, 1838. Urpethite *Dana*.

Consistence of soft tallow. G.=0·885, Johnston. Color yellowish-brown to brown. Adheres to the fingers, and stains paper. Melting point 39° C. Soluble readily in cold ether.

Comp.—Analysis: Johnston (l. c.):

Carbon 85·83 Hydrogen 14·17=100.

Ethereal solution brown by transmitted light, but with a greenish opalescence by reflected, deposits the wax in brown flocks. Melts at 39° C. to a yellow-brown liquid.

Obs.—Constitutes about *four-fifths* of the Urpeth Colliery ozocerite, and is separated from the latter through its solubility in *cold* ether. The crude wax, as found, was soft enough to be kneaded in the fingers; had a greasy feel, and gave a greasy stain to paper; was subtransparent; of a brownish-yellow color by transmitted light, but yellowish-green and opalescent by reflected; and had an odor slightly fatty, which was stronger when melted. It occurred in cavities near a fault in the coal measures, and part in the solid sandstone.

Laurent obtained a variety of paraffin by the dry distillation of the bituminous shale of Autun, which *melted at* 33° C., was very soluble in ether and insoluble in alcohol, and which consisted of Carbon 85·746, hydrogen 14·200=99·945. It may be identical with the above. It is quite probable that the urpethite obtained by Johnston was not free from mixture with the second paraffin separated by him from the Urpeth mineral by means of boiling ether, which is here referred to ozocerite (p. 732); and such a mixture might account for the divergence of the melting point from that of Laurent's paraffin. Taking 33° C. as the true melting point, the several paraffins here described, urpethite, hatchettite, ozocerite, Johnston's *third* from the Urpeth wax, and zietrisikite, have nearly a common difference in melting points of 13°—17°, the temperatures being respectively 33°, 46°, 60°, 73° 90°. The mean difference is about 14°; this would make the melting points 33°, 47°, 61°, 75°, 89°.

779. HATCHETTITE. Hatchetine (fr. Merthyr-Tydvil) *Conybeare*, Ann. Phil., i. 136, 1822. Mineral Adipocire, Mountain Tallow (fr. Loch Fyne), *Brande*, Ed. Phil. J., xi. 1824. Hatchetine (fr. Glamorganshire) *J. F. W. Johnston*, Phil. Mag., III. xii. 338.

In thin plates, or massive. Reported as sometimes occurring as large crystals in fresh specimens.

H. like that of soft wax. G.=0·916, Johnston; 0·983, fr. Loch Fyne, after melting and excluding air bubbles, Brande; 0·608, same before melting, id. Lustre slightly glistening and pearly. Color yellowish-white, wax-yellow, greenish-yellow; blackens on exposure. Subtransparent to translucent; but opaque on exposure. Feel greasy. Without odor. Melting point 46° C., fr. Merthyr-Tydvil, Johnston; 47° C., fr. Loch Fyne, Brande. Polarizes light in patches, Brewster.

Comp., etc.—Ratio of C, H=nearly 1 : 1, from Johnston's analysis,=Carbon 85·55, hydrogen 14·45=100. Analysis: Johnston (l. c.):

Glamorganshire Carbon 85·91 Hydrogen 14·62=100·53.

Very sparingly soluble in boiling alcohol, and precipitated from the solution on cooling. Also soluble sparingly in cold ether, and more largely in boiling; and from the latter deposited in a mass of minute fibres or prisms. After repeated boiling with ether there remains only a minute portion undissolved, mixed with particles of charcoal derived from the blackened surface of the specimen. Charred and decomposed by concentrated and boiling sulphuric acid. No apparent change in boiling nitric acid. Conybeare (l. c., 1822) stated that the Merthyr-Tydvil hatchettite "melts in warm water under 170° F., whereas true bitumen does not in boiling water;" and this loose remark is the only ground for the statement that 76·6° C. is the melting point of one variety of the mineral.

Obs.—From the crevices of iron-stone septaria, and often in geodes containing also quartz crystals, in the coal-measures near Merthyr-Tydvil in Glamorganshire (and, Johnston adds, in some of the midland counties of England); also in a bog on the borders of Loch Fyne in Argyleshire, Scotland. The latter has not yet been analyzed. Also reported from Rossitz in Moravia (Jahrb. G. Reichs., 1854, 898), in the Segen Gottes mine, with spherosiderite, as a thin coating on calcite, having H.=1, G.=0·892, Patera.

This species (or at least the bog variety from Loch Fyne) is probably identical with the kind of paraffin that fuses at 45°—47° C.; and which has been obtained by the destructive distillation of Boghead coal and peat, and from other sources. Anderson obtained in his analyses of this paraffin:

	C	H	Melting T.
1. From Boghead coal, *cryst.*	85·1	15·1—15·3	45·5°
2. " " " *granular*	85·0—85·3	15·4	52
3. From peat	(½) 85·09	15·10	46·7

The Boghead coal (from Boghead and Torbane Hill, near Bathgate in Linlithgowshire) affords on destructive distillation a very large amount of different oils and paraffin, 70 p. c. of the dried mass being volatile. See BATHVILLITE beyond (p. 742).

Named after C. Hatchett.

780. OZOCERITE. Part of Native Paraffin. Ozokerit (brought by v. Meyer fr. Slanik, Moldavia) *Glocker*, Schw. J., lxix. 215, 1833; *Magnus*, Ann. Ch. Phys., lv. 217, 1834. Cire fossile *Fr.* Erdwachs *Germ.*

Like wax or spermaceti in appearance and consistency.

G.=0·85—0·90. Colorless to white when pure; often leek-green, yellowish, brownish-yellow, brown; and when brown sometimes greenish by transmitted light. Often having a greenish opalescence. Translucent. Greasy to the touch. Fusing point 56° to 63° C.

Comp., etc.—The original ozocerite, from Slanik in Moldavia, as described by Glocker (l. c., and Arsb., 1834, 208), was wholly soluble in ether, and gave a yellow solution; also soluble in oil of turpentine and naphtha; and a little soluble in boiling alcohol. G. of the mass 0·955, Glocker; 0·953, Schrötter. Melting point 62° C., Schrötter.

The mineral wax of Urpeth Colliery, after the separation of what was soluble in cold ether (see URPETHITE, p. 731), afforded Johnston (l. c.) another portion through its solubility in boiling ether; and this is apparently identical with true ozocerite. While soluble in boiling ether it is sparingly so in boiling alcohol. As obtained from the ether solution it was yellow, and had the consistence of soft wax.

A kind from Boryslaw in Galicia, examined by Hofstädter (Ann. Ch Pharm., xci. 326, 1854), resembled the preceding in its appearance, but was darker colored, being blackish-brown; in thin pieces reddish-brown to leek-green by transmitted light; G.=0·944; melting point 60°. By fractional crystallization it was separated into parts varying in fusibility from 60° to 65° 5 C. That from Truscawitz, Galicia, examined by Walter (J. pr. Ch., xxii. 181) appears to be similar.

Analyses: 1, Schrötter (Baumg. ZS., iv. 2, 1836, Bibl. Univ. de Genève, iii. 184, 1836); 2, Johnston (l. c.); 3, Walter (l. c.); 4, 5, Hofstädter (l. c.):

	C	H	Melting T.	Boiling T.	G.	
1. Slanik	84·43	13·69=98·12	62°—63° C.	210°	0·953	Schrötter
2. Turpeth C.	86·80	14·06=100·86	58	?		Johnston.
3. Truscawitz, *crude*	84·62	14·29=98·91	59	ov. 300		Walter.
4. Boryslaw, A.	84·94	14·87=99·81	61		0·944	Hofstädter.
5. " B.	85·78	14·29=100·07	65·5			Hofstädter.

The A of Hofstädter was the portion separated by fractional crystallization which had 61° C. as the melting point, and the B that which had for this point 65·5°.

The above results agree closely, and probably the ozocerite in the specimens examined was but little impure from mixture with other paraffins.

Hermann has described a wax-like mixture from seams in a rock in the vicinity of Lake Baikal which he calls *Baikerite* (J. pr. Ch., lxxiii. 230). About 60·18 p. c. of it was soluble in boiling alcohol, 100 parts dissolving 1; and this portion appears to be ozocerite. It was tasteless and inodorous; melting point 59° C.; G.=0·90. The rest (29·82 p. c.) of the baikerite consisted as follows: 7·02 wax-like substance insoluble in alcohol; 32·41 viscid resin; 0·39 earthy impurities.

The same compound has been obtained from mineral coal, peat, and petroleum, mineral tar, etc., by destructive distillation. The following are examples: 1, Anderson (Rep. Brit. Assoc., 1856, J. pr. Ch., lxxii. 379); 2, Hofstädter (l. c.):

	C	H	Melting Point.	
1. Rangoon Tar	85·15	15·29=100·44	61°	Anderson.
2. From Bitum. shale, Bonn.	86·16	14·36=100·52	61°	Hofstädter.

Ozocerite occurs at each of the localities mentioned, in beds of coal, or associated bituminous deposits; that of Slanik, Moldavia, beneath a bed of bituminous clay shale; in masses of sometimes 80 to 100 lbs., at the foot of the Carpathians, not far from beds of coal and salt; that of Boryslaw in a bituminous clay associated with calciferous beds in the formation of the Carpathians, in masses. Reported also from near Gaming in Austria; in Transylvania, near Moldavia, in the Carpathian sandstone; at Uphall in Linlithgowshire.

Named from ὄζω, *I smell*, and κηρός, *wax*, in allusion to the odor.

781. ZIETRISIKITE. Cire fossile de Moldavie *Magnus*, Ann. Ch. Phys., lv. 217, 1833. Ozockerite (fr. Zietrisika) *Malaguti*, C. R., iv. 410, 1837, Ann. Ch. Phys., lxiii. 390, Pogg., xliii. 147. Zietrisikite *Dana*.

Like ozocerite in nearly all physical characters.

Hardness like that of beeswax, or harder. G.=0·9; 0·946, Malaguti. Color brown. Melting point 90° C.; 82°—84° in the crude or impure mineral. Insoluble in ether.

Comp., Var., etc.—The almost complete insolubility of this fossil wax in ether distinguishes it decisively from ozocerite.

1. Magnus, who made the first examination of the fossil wax brought by v. Meyer from Slanik. Moldavia, appears to have had a different substance in hand from that examined by Glocker (by whom *ozocerite* was named) and by Schrötter, as he states that only a very little of it was dissolved by alcohol or ether, and the rest, after the action of these solvents, was eroded with holes, showing the presence of insoluble and soluble constituents. The insoluble was soluble in oil of turpentine, and of this part the melting point was 82°, and the composition as given below.

2. The wax from Zietrisika, Moldavia, examined by Malaguti, is regarded by him as identical with that of Magnus. It was foliated, conchoidal in fracture, pearly in lustre, deep red-brown in color with a greenish reflection, but in very thin pieces brown, and a little harder than beeswax. It was very slightly soluble in alcohol or boiling ether, and very soluble in oil of turpentine and naphtha, with no action from alkalies or cold sulphuric acid. It melts at 84° C., and boils at above 300°. On subjecting it to boiling alcohol, a small portion was dissolved, whose melting point was 75°; by a second treatment another portion was obtained, having for the melting point 78°; and at the fourth, the portion dissolved was found to have the same melting point as that of the undissolved mass, which was 90°. This then, which he calls *brown* ozocerite, appears to be the point of fusion of the true zietrisikite, and this alone was analyzed; as the rest, his *yellow* ozocerite, he says, "est un mélange, j'ai jugé inutile d'en faire l'analyse."

Analyses: 1, Magnus (l. c.); 2, 3, Malaguti (l. c.):

	C	H	Melting T.	Boiling T.	
1. Moldavia	84·61	15·30=99·91	82° C.		Magnus.
2. Zietrisika, Mold.	84·53	14·22=98·75	90	Above 300° C.	Malaguti.
3. " "	84·78	14·37=99·15	90	"	Malaguti.

The wax from Zietrisika, in Moldavia, occurs in large masses, and under similar circumstances with that of Slanik.

781A. Johnston, in his examination of the Urpeth Colliery wax (see URPETHITE and OZOCERITE), after separating by ether (first cold, and then boiling) about five-sixths of the mass, obtained for the remaining sixth a *third* portion, almost insoluble in ether, having G.=0·955; color dark brown consistence like that of wax; melting point 73° C., and boiling point above 260° C. It may be identical with the above, but its melting point would imply that it was distinct. He obtained for its composition C 83·81, H 13·65=97·46.

781B. NEFT-GIL (Naphtdachil, Nèphatil, Jahrb. Min. 1846, 84. Naphthadil *Kenng.*, Ueb. 1844–'49, 254. Neftdegil *Herm.*, J. pr. Ch., lxxiii. 220. Neft-gil *Fritzsche*, ib., 321). A very abundant material in the naphtha region on Tscheleken I., in the Caspian. It is a mixture of paraffins and a resin, but appears to be most nearly related to zietrisikite. G.=0·956; color chocolate-brown; melting point 75° C. Hermann found 66 p. c. of a wax-like substance insoluble in alcohol, and 18 p. c. of another soluble in alcohol, besides 13·33 p. c. of a resin. In ether a large part was insoluble; and this portion may be identical with the zietrisikite, or the insoluble paraffin from the Urpeth wax (p. 731).

781C. PYROPISSITE *Kenng.*, Ueb. 1850–'51, 148. Kenngott has thus named an earthy, friable, coaly substance, of grayish-brown color, and without lustre, and having G.=0·493–0·522, which forms a layer 6 to 9 in. thick in brown coal at Weissenfels, near Halle. It is a mixture of species instead of a mineral, and has not yet been properly investigated. A small part is soluble in alcohol, especially in boiling, and this, precipitated by adding water, is a wax-like substance, paraffin-like in aspect. But whether true paraffin, or whether an oxygenated wax, related to geocerite (a species derived from a similar earthy brown coal from Gersterwitz, near Weissenfels), has not been ascertained. It melts easily to a pitch-like mass, and hence the name, from πῦρ, *fire*, and πίσσα, *pitch*. It affords 62 p. c. of paraffin on dry distillation. On the composition of the related Gersterwitz earthy coal, see pp. 757, 758; also, *C. Karsten*, ZS. G., ii. 71. And for other papers on a similar material from Helbra, between Mansfeld and Eisleben, see *Voigt*, Brennbarer Fossil fr. Helbra, Vers. Gesch. Steinkohle, etc., 188, 1802, J. d. M., xv. 77, 1804; G. Heine. id., Jahrb. Min. 1845, 149. Such coals are sometimes called *Paraffin coal*, and in German *Wachskohle*. Kenngott refers here also an earthy brown substance from Mettenheim, which melts similarly to an asphalt-like substance; no other evidence of identity is stated. It occurs incrusting massive limestone.

782. ELATERITE. Subterranean Fungus (fr. Derbyshire) *Lister*, Phil. Trans., 1673. Elastic Bitumen. Mineral Caoutchouc. Bitume élastique *Delaméth.*, J. de Phys., xxxi. 31, 1787. Elastic Bitumen *Hatchett*, Linn. Trans., iv. 146, 1797. Elastiches Erdpech *Klapr.*, Beitr., iii. 107, 1802. Elastisches Erdharz *Germ.* Elaterit, Fossiles Erdharz, *Hausm.*, Handb., i. 87, 1813.

Massive, amorphous.

G.=0·905–1·233, fr. Derbyshire. Soft, elastic, sometimes adhering to the fingers (*a*); also moderately soft and elastic; much like india-rubber (*b*); and occasionally hard and brittle (*c*), imbedded in the softer kinds. Color brown, usually dark brown. Subtranslucent; sometimes dark orange-red by transmitted light.

Comp., etc.—Johnston analyzed the three kinds, *a*, *b*, *c*, separately. He mentions the action of ether only on the *b*, from which it separated but 18 p. c. of the mass; and the two analyses given are those of the undissolved material. Analyses:

	C	H
1 (*a*)	85·474	13·283=98·757.
2 (*b*)	84·385	12·576=96·961.
3 (*b*)	83·671	12·535=96·206.
4 (*c*)	85·958	12·342=98·300.
5 (*c*)	86·177	12·423=98·600.

He states that the loss in *a* and *c* may be partly or wholly oxygen, and that in the case of *c*, o the insoluble residue, 3–3·8 p. c. is oxygen. He thus leaves the constitution of elaterite in doubt. It appears to be partly a carbohydrogen near ozocerite, and partly an oxygenated insoluble material. Mr. Henry, Jr., found 36 to 40 p. c. of oxygen (J. de Ch. Médicale, i. 18): but his results, as Johnston observes, are evidently untrustworthy.

It is found at Castleton in Derbyshire, in the lead mine of Odin, along with lead ore and calcite, in compact reniform or fungoid masses, and is abundant. Also reported from St. Bernard's Well, near Edinburgh: Chapel quarries in Fifeshire; a coal mine at Montrelais, at the depth of 230 feet; and, according to Hausmann (Handbuch, iii. 273), at Neufchatel, and on the island of Zante. A similar material in external characters has been met with at Woodbury, Ct.

783. **Settling Stones Resin** (New Mineral Resin (fr. Settling Stones) *J. F. W. Johnston*, Edinb. J. Sci. II. iv. 122, 1831, Phil. Mag., III. xiv. 88, 1839. Elaterite?) In the form of drops, more or less rounded. or flattened, as if once fluid or soft, and found incrusting the rocky walls of a vein at an old lead mine in Northumberland, known by the name of Settling Stones, resting on and occasionally covered by calcite and pearl spar; the rock is the Mountain limestone (Subcarboniferous). It is hard, brittle under the hammer, but difficult to reduce to powder; G =1·16—1·54; color from pale yellow to deep red; a pale green opalescence; *does not melt at* 205° C. Burns in the flame of a candle. Very slightly acted upon by alcohol.

Comp., etc.—O. ratio for Θ, H=nearly 2 : 3 (?); an analysis affording Johnston (l. c.):

Carbon 85·133 Hydrogen 10·853 Ash 3·256=99·242.

But Johnston adds: "It is therefore *doubtful whether this resinoid substance contains oxygen or not.* It may be only an impure carbo-hydrogen." It is very slightly acted upon by alcohol. Gives empyreumatic products when fused in a closed tube. It has close relations to elaterite.

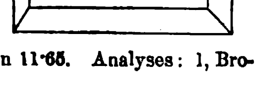
FICHTELITE GROUP.

The Fichtelite group, according to the analyses, belongs to the Camphene series of hydrocarbons, the general formula for which is $\Theta_n H_{2n-4}$.

Petrolene, or more correctly the petrolene group of oils, has been referred to the Camphene series; and should constitute a group preceding the Fichtelite group, if the analyses were made on pure species, and are to be credited. See p. 729.

784. **FICHTELITE.** Tekoretin *Forchh.*, Vid. Selsk. Afh. Copenh., 1840, J. pr. Ch., 459, 1840 Fichtelit *Bromeis*, Ann. Ch. Pharm., xxxvii. 304, 1841; *T. E. Clark*, Ann. Ch. Pharm., ciii. 236, 1857, Am. J. Sci., II. xxv. 164.

616



Monoclinic. $C=53°$, $I \wedge I=83°$ and 97°; $I \wedge i\text{-}i=131° 30'$, $O \wedge i\text{-}i=127°$, $O \wedge 1\text{-}i=105°$, $i\text{-}i \wedge 1\text{-}i=128°$, Clark. Crystals lengthened in the direction of the orthodiagonal.

H.=1. Lustre somewhat greasy. Color white. Translucent. Brittle. Without taste or smell. Distils over without decomposition. Solidifying temperature 36° C. Easily soluble in ether; less so in alcohol.

Comp., Var., etc.—Ratio of Θ, H=5 : 8=Carbon 88·35, hydrogen 11·65. Analyses: 1, Bromeis (l. c.); 2, Clark (l. c.); 3, Forchhammer (l. c.):

		C	H	Melting T.	Boiling T.	
1. Redwitz		87·95	10·70=98·65	46°		Bromeis.
2. "	(⅔)	87·13	12·86=99·99	46	above 320°	Clark.
3. *Tecoretin*		85·89	12·81=98·70	45	360	Forchh.

Decomposed by anhydrous sulphuric acid; also by heated fuming nitric acid; soluble in cold nitric.

Clark, after a revision of the investigations on fichtelite and the related resins, concludes that there is no doubt of the identity of the substance analyzed by him with Bromeis's *fichtelite*, and deduces the empirical formula $\Theta^5 H^8$.

The mineral occurs in the form of shining scales, flat crystals, and thin layers between the rings of growth and throughout the texture of pine wood (identical in species with the modern *Pinus sylvestris*) from peat beds in the vicinity of Redwitz, in the Fichtelgebirge, North Bavaria. The crystals described by Clark (f. 616) were obtained artificially by means of ether and alcohol.

An *oily* substance was extracted by Schrötter by means of ether from wood of the same peat bed which afforded the fichtelite; and this solution yielded two substances, one of which was an oil, regarded by him as identical with fichtelite in ratio; it gave on analysis, Carbon 88·58, hydrogen 11·34=99·42. The other substance was crystallized and contained oxygen.

Tecoretin was obtained from pine trees of the same species in marshes near Holtegard in Denmark. The resin from the wood, first observed by Steenstrup, was found by Forchhammer, after dissolving it in boiling alcohol, to contain two substances crystallizing from the solution at different temperatures. The *tecoretin* was the least soluble of the two, or that which crystallized out first (the other was his *phylloretin*, see p. 737); its crystallization was *monoclinic*, and its fusing point 45°. From the analysis Clark writes the empirical formula Ȼ H^2; but states that the mineral resembles fichtelite in every other respect.

785. HARTITE. Hartit *Haid.*, Pogg., liv. 261, 1841. Branchite *Savi*, Cimento, i. 342, Jahrb Min. 1842, 459.

Monoclinic. Resembling fichtelite in crystalline form, lustre, color, translucency, and the reactions with alcohol, ether, and the acids. But melts at 74°–75° C. Boiling temperature very high.

Comp., etc.—Ratio of Ȼ, H=12 : 20=Carbon 87·8, hydrogen 12·2. Analyses: 1, Schrötter (Pogg., lix. 37); 2, Piria (Cimento, i. 346, Jahresb. 1855, 984):

	C	H
1. *Hartite*	87·47	12·04=99·51 Schrötter.
2. *Branchite*	87·0	13·4=100·4 Piria.

Piria's analysis corresponds nearly with the ratio 9 : 16.

Obs.—*Hartite* is found in a kind of pine, like fichtelite, but of a different species, the *Peuce acerosa* Unger, belonging to an earlier geological epoch. It is from the brown coal beds of Oberhart, near Gloggnitz, not far from Vienna. Reported also from Rosenthal near Köflach in Styria, and Prävali in Carinthia. It occurs among the layers or tissues of the wood, and also in clefts in the coal or lignite.

Branchite is colorless and translucent, with G.=1·0442, and comes from the brown coal of Mt. Vaso in Tuscany. It is soluble in alcohol, like hartite.

786. DINITE *Meneghini* (Gaz. Med. Italiana, Firenze, Toscana, July, 1852). Occurs as an aggregation or druse of crystals; cleavage none; with the appearance of ice, but with a yellow tinge due to a foreign substance. Inodorous; tasteless; fragile, and easily reduced to powder.

Insoluble in water; little soluble in alcohol, very soluble in ether and in sulphuret of carbon. The ethereal solution on standing deposits large crystals of the dinite. Fuses with the warmth of the hand; heated in a close vessel distils over without undergoing any sensible decomposition. When melted it looks like a yellowish oil; crystallizes in large transparent crystals on cooling.

From a lignite deposit at Lunigiana, Tuscany, where it was found by Prof. Dini.

787. IXOLYTE (Ixolyt *Haid.*, Pogg., lvi. 345, 1842). Amorphous. H.=1. G.=1·008. Lustre greasy. Color hyacinth-red. Pulverized in the fingers, it becomes ochre-yellow and yellowish-brown. Thin fragments subtranslucent. Fracture imperfect conchoidal in the purer varieties.

Softens at 76° C., but is still tenacious at 100° C., whence the name, from ἰξός, *gluey, like birdlime*, and λύω, *to dissolve*.

This species is said to resemble hartite, though differing in the temperature of fusion and other characters. It occurs in a coal bed at Oberhart, near Gloggnitz; pieces sometimes half an inch thick, associated with hartite.

BENZOLE GROUP.

Oily fluids at the ordinary temperature. General formula $Ɵ_n H_{2n-6}$. Soluble in alcohol and ether. The species observed in nature, which include all those known of the Benzole series, are the following:

		C	H	G.	Boiling T.
788. **Benzole**	$Ɵ_6 H_6$	=92·31	7·69=100	0·85 at 15·5° C.	82° C.
789. **Toluole**	$Ɵ_7 H_8$	=91·30	8·70=100	0·88 at 5	111
790. **Xylole**	$Ɵ_8 H_{10}$	=90·57	9·43=100	0·86 at 19	139
791. **Cumole**	$Ɵ_9 H_{12}$	=90·00	10·00=100	0·87	148
792. **Cymole**	$Ɵ_{10} H_{14}$	=89·55	10·45=100	0·86 at 14	175

W. de la Rue and H. Müller detected in 1856, in Rangoon tar, the first three of the above species, with another designated pseudocumole (isocumole). In 1860 Bussenius and Eisenstuck (Ann. Ch. Pharm., cxiii. 151) announced xylole as present in the petroleum of Sehnde in Hanover; and the same year (ib., cxv. 19) Pebal and Freund detected all the above five species of the series in the naphtha of Boroslaw in Galicia. Warren and Storer also (Mem. Am. Ac. Boston, ix. 216) have detected xylole and "isocumole" in the Rangoon tar. None of the series were detected by Pelouze and Cahours in the Pennsylvania petroleum.

These oils are produced in the destructive distillation, at high temperatures, of bituminous coals, fatty substances, etc.

793. KÖNLITE. (Fr. Uznach) *Kraus*, Pogg., xliii. 141, 1838. Könlit (fr. ib.) *Schrötter*, ib., lix. 37, 1843; (fr. Redwitz) v. Trommsdorff, Ann. d. Pharm., xxi. 126. Könleinit *Hausm.*, Handb., 1487, 1847; *Kenngott*, Ber. Ak. Wien, xiv. 272, Min. d. Schweiz, 419, Leipzig, 1866.

In folia and grains; amorphous; stalactitic.

Soft. G.=0·88, Trommsdorff. Color reddish-brown to yellow. Melting point 114° C., Kraus; 107½°, Trommsdorff. Distils at 200°, undergoing decomposition at the same time, and leaving a brown residue. Very slightly soluble in cold and hot alcohol; much more soluble in ether; the latter solution affording wax-like folia.

Comp.—Ratio of Ɵ, H=1 : 1; $n(Ɵ_6 H_6)$ or a polymere of benzole. Fritzsche makes the formula $Ɵ_{18} H_{18}=3(Ɵ_6 H_6)$. (Bull. Ac. St. Pet., iii. 88, 1860.) Analyses: 1, Kraus (l. c.); 2, v. Trommsdorff (l. c.):

	C	H
1. Uznach, Switz.	92·429	7·571=100 Kraus.
2. Redwitz, Bavaria	90·90	7·58=98·48 Trommsdorff.

The Redwitz mineral may be a different species. Könlite, unlike scheererite, is changed by distillation, yielding a substance which melts by the *warmth* of the hand. For this product Krauss proposed the name *pyroscheererite.*

In brown coal at Uznach, at the same locality with scheererite; near Redwitz, Bavaria, in the Fichtelgebirge, with fichtelite; reported by Kenngott from the brown coal of Fossa in the Eger valley (Ueb., 1850–'51, 147).

Named after Könlein, formerly superintendent of the coal works at Uznach.

Phylloretin of Forchhammer (J. pr. Ch., xx. 459, 1840) is near the above, and is made identical with it by Fritzsche. It was obtained from an alcoholic solution of a resin from the marshes near Holtegard in Denmark; the more soluble of the two resins obtained (see p. 736) being the *phylloretin.* Fusing point 86°–87°. Dissolves easily in alcohol. Forchhammer obtained Carbon 90·22, 90·12, hydrogen 9·22, 9·26; and deduces for the ratio of Ɵ, H, 8 : 10

794. NAPHTHALIN.

Orthorhombic. Commonly, as artificially prepared, in rhombic tables of 122° and 78° with the acute angles truncated, or hexagonal tables.

Lustre brilliant. Color white. G.=1·153 at 18° C.; 0·9778, at 79·2° C., Kopp.; at which temperature it melts. Boiling point 218° C. Dissolves readily in alcohol, ether, oil of turpentine, fatty oils, etc.

Comp., etc.—$\Theta_{10}H_8$=Carbon 93·75, hydrogen 6·25=100. The first of the *Naphthalin* series, the general formula for which is $\Theta_n H_{2n-12}$. Burns with a dense smoking flame.

Obs.—Found sparingly in Rangoon tar, by De la Rue and Müller, and by Warren and Storer.

Artif.—Formed easily from petroleum, coal-naphtha, essential oils, on passing them through red-hot tubes.

795. IDRIALITE. Quecksilberbranderz pt. Idrialine (fr. Idria) *Dumas*, Ann. Ch. Phys., l. 360, 1832. Idrialite *Schrötter*, Baumg. ZS., iii. 245, iv. 5.

In the pure state crystalline in structure. Color white. In nature found only impure, being mixed with cinnabar, clay, and some pyrite and gypsum in a brownish-black earthy material, called, from its combustibility and the presence of mercury, *inflammable cinnabar* (*Quecksilberbranderz*).

Comp., etc.—Dumas separated the idrialite by treatment with oil of turpentine. **Analyses:** 1, Dumas (l. c); 2, 3, Schrötter (l. c.):

	1	2	3
Carbon	94·9	94·50	94·80
Hydrogen	5·1 D.	5·19 Schr.	5·49 Schr.

Corresponding to the ratio for Θ, H about 3 : 2=Carbon 94·74, hydrogen 5·26=100. Insoluble in water, and little so in alcohol or ether. Fuses at 205° C. Schrötter found in one specimen of the crude mineral 77·32 idrialite, 17·85 cinnabar, and 2·75 of other impurities.

Bödecker (Ann. Ch. Pharm., lii. 100, 1844) obtained for the composition of a substance he derived from the crude material, ($\frac{4}{4}$) Carbon 91·83, hydrogen 5·30, oxygen 2·87=100, corresponding to $C^{42}H^{14}O$ (or an oxydized idrialite). He derived it from the ore by sublimation in an atmosphere of carbonic acid. Bödecker states that a black material obtained from the condensation-chambers at Idria afforded a substance which has the composition of Dumas's idrialite; and this he calls *Idryl*, supposing it to be the radical of his own idrialite.

II. OXYGENATED HYDROCARBONS.

796. GEOCERITE. Geocerain *L. Brückner*, J. pr. Ch., lvii. 14, 1852.

Wax-like. Color white. Not observed to crystallize from its solution in alcohol. Melting point near 80° C.; after fusion solidifies as a yellowish wax, hard but not very brittle. Soluble in alcohol of 80 p. c. Not acted upon by a hot solution of potash.

Comp.—$\Theta_{28}H_{56}\Theta_2$, Brückner=Carbon 79·24, hydrogen 13·21, oxygen 7·55=100. **Analyses** Brückner (l. c.):

C	H	O
79·06	13·13	[7·81]=100.
79·16	13·01	[7·83]=100.

Obs.—From the same *dark-brown* brown coal of Gesterwitz that afforded the geomyricite (p.

739), and from the same solution. The solution, after yielding the geomyricite, and next, on adding a hot solution of acetate of lead, a precipitate of a salt of lead and "geocerinsäure," finally afforded, on filtering the hot solution, the *geocerite* in the state of a jelly, which on drying became a white foliated mass.

The distillation product obtained from the same dark-brown brown coal, tallow-like in consistence (but in pearly crystals from a subsequent alcoholic solution) afforded Carbon 83·82, hydrogen 14·01, oxygen [2·17], corresponding to the formula $\Theta_{55} H_{110} \Theta$, as if derived, as follows, as Brückner states, from the above: $2 (\Theta_{28} H_{56} \Theta_2) - (\Theta \Theta_2 + H_2 \Theta) = \Theta_{55} H_{110} \Theta$. It is identical with the distillation product from the *yellowish-brown* brown coal of the same locality.

Named from γη, *earth*, and κηρος, *wax*.

797. GEOMYRICITE. Geomyricin *L. Brückner*, J. pr. Ch., lvii. 10, 1852.

Wax-like. Obtained in a pulverulent form from a solution, the grains consisting (as apparent under a microscope) of acicular crystals. Color white. Melting point 80°—83° C. After fusion has the aspect of a yellowish brittle wax. No action in a solution of potash. Soluble easily in hot absolute alcohol and ether, but slightly in alcohol of 80 p. c.

Comp., etc.—$C_{34} H_{68} O_2$, Brückner, = Carbon 80·59, hydrogen 13·42, O 5·99 = 100. **Analyses:**

		C	H	O
1.	G. = 83°	80·33	13·50	[6·17]
2.	G. = 83	79·97	12·85	[7·18]
3.	G. = 80	80·21	13·24	[6·55]

Burns with a bright flame.

Brückner observes that the composition is very near that of the Chinese wax, Palm wax (from the S. A. palm, *Ceroxylon andicola*), Carnauba wax (from the S. A. palm, *Corypha cerifera*), for which Lewy obtained $C_{36} H_{72} O_2$ = Carbon 80·59, hydrogen 13·42, oxygen 5·99 = 100.

Obs.—Occurs at the Gesterwitz brown coal deposit, in a *dark brown* layer, similar in most respects to the *yellowish-brown* which afforded the leucopetrite. Its very slight insolubility in alcohol of 80 p. c. enabled Brückner to separate resins and other soluble ingredients present in the mass. L. Lesquereux states (priv. contrib.) that the brown coal beds of the basin in which Gesterwitz lies has afforded the palms *Flabellaria latania* and *Phœnicites Giebelianus*, and perhaps others, though none has yet been reported from the particular bed at Gesterwitz.

798. COPALITE. Fossil Copal, Highgate Resin, *Aikin*, Min., 64, 1815. Retinite pt. *Glock.*, Min., 372, 1831, *Haid.*, Handb., 574, 1845. Fossil Copal *J. F. W. Johnston*, Phil. Mag., III. xiv. 87, 1839. Copaline *Hausm.*, Handb., 1500, 1847.

Like the resin copal in hardness, color, lustre, transparency, and difficult solubility in alcohol. Color clear pale yellow to dirty gray and dirty brown. Emits a resinous aromatic odor when broken.

G. = 1·010, Johnston; 1·05, Bastock; 1·053, fr. E. Indies, Kenngott.

Comp.—Ratio for Θ, H, Θ = 40 : 64 : 1 = Carbon 85·7, hydrogen 11·4, oxygen 2·9 = 100. **Analyses:** 1, 2, Johnston (l. c.); 3, Duflos (Min. Unters., ii. 183):

	C	H	O	Ash	
1. *Yellow trp.*	85·677	11·476	2·847	——	= 100 Johnston.
2. *Gray*	85·408	11·787	2·669	0·136	= 100 Johnston.
3. E. Indies	85·73	11·50	2·77	——	= 100 Duflos.

Volatilizes in the air by a gentle heat. Burns easily with a yellow flame and much smoke, and hardly any perceptible ash. Slightly acted upon by alcohol.

Kenngott's mineral closely resembles the Highgate copalite in its honey-yellow color, and its action with heat and alcohol.

Obs.—From the blue clay (London clay) of Highgate Hill, near London, from whence it is called Highgate resin. It occurs in irregular pieces of a pale honey-yellow color.

799. SUCCINITE. Ἤλεκτρον *Homer*, etc. ? Λυγ ύριον *Theophr.*, *Demostr.* Λυγγούριον *Dios.* etc. Succinum, Electrum, Lyncurium, *Plin.*, xxxvii. 11, 12, 13. Amber. Succin, Ambre, *Fr* Bernstein *Germ.* Succinite pt. *Breith.*, Char., 75, 1820, 140, 1823.

In irregular masses, without cleavage.

H.=2—2·5. G.=1·065—1·081. Lustre resinous. Color yellow, sometimes reddish, brownish, and whitish, often clouded. Streak white. Transparent—translucent. Tasteless. Electric on friction. Fuses at 287° C., but without becoming a flowing liquid.

Comp.—Ratio for C, H, O=40 : 64 : 4=Carbon 78·94, hydrogen 10·53, oxygen 10·53=100. Analysis: Schrötter (Pogg., lix. 64):

C 78·824 H 10·228 O 10·9=100.

But amber is not a simple resin. According to Berzelius (Lehrb., viii. 431, Pogg., xii. 419), it consists mainly (85 to 90 p. c.) of a resin which resists all solvents (properly *the species* succinite), along with two other resins soluble in alcohol and ether, an oil, and 2½ to 6 p. c. of succinic acid. Schrötter and Forchhammer state that after removing these soluble ingredients, true succinite has the ratio 40 : 32 : 4, which is the ratio deduced from the analyses of the whole mass, and which indicates that the mixed resins are polymerous with succinite. Their nature has not been investigated. Amber is hardly acted on by alcohol.

Burns readily with a yellow flame, emitting an agreeable odor, and leaves a black, shining, carbonaceous residue.

Obs.—Amber occurs abundantly on the Prussian coast of the Baltic; occurring from Dantzig to Memel, especially between Pillau and Dorfe Gross-Hubnicken. It occurs also on the coast of Denmark and Sweden; in Galicia, near Lemberg, and at Miszau; in Poland; in Moravia, at Boskowitz, etc.; in the Urals, Russia; near Christiania, Norway; in Switzerland, near Bâle; in France, near Paris, in clay, in the department of the Lower Alps, with bituminous coal, also in the department of l'Aisne, de la Loire, du Gard, du Bas-Rhin. In England, near London, and on the coast of Norfolk, Essex, and Suffolk. It also occurs in various parts of Asia. Also near Catania, on the Sicilian coast, sometimes of a peculiar blue tinge.

It has been found in various parts of the Green sand formation of the United States, either loosely imbedded in the soil, or engaged in marl or lignite, as at Gay Head or Martha's Vineyard, near Trenton and also at Camden in New Jersey, and at Cape Sable, near Magothy river in Maryland.

In the royal museum at Berlin there is a mass weighing 18 lbs. Another in the kingdom of Ava, India, is nearly as large as a child's head, and weighs 2¼ lbs.; it is intersected by veins of carbonate of lime, from the thickness of paper to one-twentieth of an inch.

It is now fully ascertained that amber is a vegetable resin altered by fossilization. This is inferred both from its native situation with coal, or fossil wood, and from the occurrence of insects incased in it. Of these insects, some appear evidently to have struggled after being entangled in the then viscous fluid; and occasionally a leg or wing is found some distance from the body, which had been detached in the effort to escape. Göppert has shown (Ber. Ak. Berlin, 1853, 450, Q. J. G. Soc., x., Am. J. Sci., II. xviii. 287) that at least 8 species of plants besides the *Pinites succinifer* have afforded this fossilized resin, and he enumerates 163 species as represented by remains in amber. Besides pines, species of the family *Abietineæ* and *Cupressineæ* have probably contributed to it.

Amber was early known to the ancients, and called *ἤλεκτρον*, *electrum*, whence, on account of its electrical susceptibilities, we have derived the word *electricity*. It was named by some lyncurium, though this name was applied by Theophrastus also to a stone, probably to zircon or tourmaline, both minerals of remarkable electrical properties.

Pliny mentions, as one proposed derivation of *electrum*, the fable, as he regards it, that the sisters of Phaëthon, changed into poplars, shed their tears on the banks of the Eridanus (or Padus), and that these tears were called *electrum*, from the fact that the sun was usually called *elector*; as another, that it comes from *Electrides*, the name of certain islands in the Adriatic: or another *electrides*, the name of certain stones in Britannia, from which it exudes. He gives it as his opinion that "amber is an exudation from trees of the pine family, like gum from the cherry, and resin from the ordinary pine;" and, as proof that it was once liquid, alludes to the gnats, etc., in it. He observes that it had been long called *succinum*, because of this origin, "quod arboris succum prisci nostri credidere." He says that in his time it was "in request among women only." But "it had been so highly valued as an object of luxury that a very diminutive human effigy, made of amber, had been known to sell at a higher price than living men, even in stout and vigorous health."

799A. **Krantzite** (Fossiles Harz (fr. Nienburg), Krantzit, *C. Bergemann*, J. pr. Ch., lxxvi. 65). Essentially succinite. Occurs in small grains and masses of a light yellow or greenish-yellow color, but reddish or brownish externally. G.=0 968. Rather tender. Sectile and somewhat elastic. The exterior has G.=1·002.

Comp.—Analysis by Landolt (l. c.) afforded:

Carbon 79·25 Hydrogen 10·41 Oxygen 10·34=100.

Corresponding nearly to the formula $\Theta_{40}H_{64}\Theta_4$.

Only 4 p. c. soluble in alcohol, and 6 p. c. in ether; and only softens in turpentine. In sulphuric acid gives a brown solution. Fuses at 225° C., and becomes perfectly fluid at 288°; and at a higher temperature yields gas and products of distillation. The ether solution affords a brownish amorphous substance, which is elastic like caoutchouc at 12°, and fuses at 150°.

800. **WALCHOWITE.** Bergpech pt. (fr. Walchow) *Estner*, Min., iii., 1te Abth., 114, 1800. Retinit von Walchow *Schrötter*, lix. 37, 1843. Walchowit *Haid.*, Ueb., 1843, 99, Handb., 574, 1845.

In yellow translucent masses, often striped with brown. Lustre resinous. Fracture conchoidal. Translucent to opaque.

H.=1·5—2. G.=1·0—1·069; an opaque variety 1·035.

Comp.—Ratio for Θ, H, Θ=40 : 64 : 3½, Schrötter (Pogg., lix. 61)=80·41 C, 10·66 H, 8·93 O. Fuses to a yellow oil at 250° C., and burns readily; becomes transparent and elastic at 140° C. But it is a mixture, as alcohol takes up 1·5 p. c., and ether 7·5 p. c.; the *insoluble* part may be identical with the preceding. Forms a dark brown solution in sulphuric acid.

Obs.—Occurs in brown coal at Walchow, in Moravia, and formerly called *Retinite*.

Estner also mentions a honey-yellow resin from Uttigshof in Moravia (called *Bernstein* in the Abh. böhm. Ges., iii. 8), and another of a similar color, but a little greenish, from Litezko in Moravia.

801. **Bucaramangite.** Resine de Bucaramanga *Boussingault*, Ann. Ch. Phys., III. vi. 507, 1842. Resembles amber in its pale yellow color. G. above 1.

Comp.—Ratio for Θ, H, Θ=42 : 66 : 2½=Carbon 82·7, hydrogen 10·8, oxygen 6·5=100.

Insoluble in alcohol. In ether softens and becomes opaque. Fuses easily, and burns with a little smoky flame, leaving no residue. Yields no succinic acid.

802. **AMBRITE.** Ambrit (fr. N. Zealand) *Hochstetter*, *v. Hauer*, Verh. G. Reichs., Wien, 1861, 4.

Amorphous. In large masses.

H.=2. G.=1·034. Lustre greasy. Color yellowish-gray. Subtransparent. Strong electric on friction. Fracture conchoidal.

Comp., etc.—Ratio deduced for Θ, H, Θ=40 : 66 : 5=Carbon 76·88, hydrogen 10·54, oxygen 12·77. Von Hauer makes the ratio 32 : 26 : 4, which is not nearer the analysis than the above. Analysis: R. Maly (l. c.):

C	H	O	Ash
(⅔) 76·53	10·58	12·70	0·19

Wholly insoluble in alcohol, ether, oil of turpentine, benzole, chloroform, and dilute acid. Burns with yellow smoking flame. The ash contains iron, lime, and soda.

Obs.—Occurs in masses as large as the head in the province of Auckland, N. Zealand. It much resembles the resin of the *Dammara Australis*, which abounds on the island, and is often exported with it

803. BATHVILLITE. Bathvillite *C. Gr. Williams*, Ch. News, vii. 133, 1863. Torbanite pt

Amorphous. Dull, and of a fawn-brown color, looking somewhat like wood in the last stage of decay. Opaque.

G., after removing air of pores by air-pump, about 1·01. Very friable, but this characteristic may not be essential to the species. Insoluble in benzole. Torbanite has H.=2·25; G.=1·18, Heddle; color clove-brown; powder yellowish; tough.

Comp.—Ratio for C, H, O, from the analyses, 40 : 68 : 4, or near that of succinite,=Carbon 78·48, hydrogen 11·11, oxygen 10·46=100. The ratio 40 : 66 : 4 is less near, giving the percentage C 78·7, H 10·5, O 10·8=100. Analyses: 1, Williams (l. c.); 1A, same with ash excluded; 2, Miller; 2A, same with ash excluded:

	C	H	O	Ash
1. *Bathvillite*	58·89	8·56	7·23	25·32=100.
1A. "	78·86	11·46	9·68	——=100.
2. *Torbanite*	63·10	8·91	8·21	19·78=100.
2A. "	78·67	11·11	10·22	——=100.

Williams refers here the torbanite analyzed by Miller. Other analyses of torbanite give less oxygen. The oxygen includes a little nitrogen and sulphur. Williams makes the formula $C_{36}H_{60}O_{3}$=Carbon 78·60, hydrogen 10·92, oxygen 10·48, agreeing hardly as well with the analyses as the above.

Does not melt when heated. In a platinum crucible affords a fatty odor, and burns with a dense smoky flame. No action with moderately dilute nitric acid; completely carbonized by concentrated sulphuric acid.

Obs.—Bathvillite occurs in the torbanite or Boghead coal (of the Carboniferous formation), adjoining the lands of Torbanehill, in the grounds of Bathville, Scotland. It forms lumps which fill cavities in the torbanite. Other cavities are occupied by calcite, pyrite, etc. It may be an altered lump of resin; or else material which has filtrated into the cavity from the surrounding torbanite.

The analysis of Miller shows that some of the torbanite has the same composition. As proof of the absolute purity of the substances analyzed could not be had, the results are open to some doubt, as Williams observes. Yet the mode of occurrence of the bathvillite, and the nearness in composition of this insoluble substance to the equally insoluble succinite, favors the view that it is essentially a good species, and that its composition is not far from that above given.

804. TORBANITE. Torbanite, although related to cannel coal, has a very nearly uniform composition, according to all analyses thus far made, excepting that of Miller, and this composition is like that of bathvillite, excepting less oxygen. It corresponds very nearly with the formula $C_{40}H_{68}O_{2\cdot25}$=Carbon 82·19, hydrogen 11·64, oxygen 6·17. The mean of five analyses (see p. 757) is, Carbon 81·15, hydrogen 11·48, with oxygen about 6·0, nitrogen 1·37=100; excluding the nitrogen, C 82·28, H 11·54, O 6·08=100. Taking the oxygen at 5·40 instead of 6·0 (see anal., l. c.), the formula would become $C_{40}H_{68}O_{2}$. The nitrogen is without doubt in combination with portions of the other ingredients. But, allowing for this, the close relation to the amber group still holds, both as regards composition and insolubility. Less than 1½ p. c. of torbanite is soluble in naphtha (Fyfe). Although the above formula cannot be taken as the formula of the species at the basis torbanite, it is probably not far from it. Torbanite may contain bathvillite as mixture

805. XYLORETINITE. Xyloretin *Forchhammer*, J. pr. Ch., xx. 459, 1840. Hartin *Schrötter* Pogg., liv. 45, 1843. Psathyrit *Glocker*, Syn., 8, 1847.

Massive, but crystallizes from a naphtha solution in needles of the orthorhombic system.

G.=1·115, hartine. Color white. Pulverizes in the fingers. Without taste or smell. Soluble in ether.

Comp., etc.—Ratio for C, H, O=40 : 64 : 4=Carbon 78·51, hydrogen 9·05, oxygen 12·44

$C^{20}H^{17}O^{4}$, deduced by Schrötter, corresponds better with the analyses. Analyses · 1–3, Schrötter (l. c.); 4, 5, Forchhammer (l. c.):

	C	H	O	Fusing T.
1. *Hartine*	78·26	10·92	10·82=100.	210° C.
2. "	78·46	11·00	10·54=100.	
3. "	78·38	10·85	10·82=100.	
4. *Xyloretinite*	79·09	10·93	9·98=100.	165° C.
5. "	78·57	10·81	10·62=100.	

The *hartine* is a white resin separated by ether from a resin obtained from the brown coal of Oberhart. No. 1 is *hartine* as separated in an amorphous condition by means of naphtha; and 2, 3, crystallized from an ether solution. (Besides the hartine, two amorphous brown resins were also obtained from the solution.) *Xyloretinite* was derived by Forchhammer through the action of alcohol on fossil pine-wood from the marshes of Holtegaard in Denmark.

806. LEUCOPETRITE.

Leucopetrin *L. Brückner*, J. pr. Ch., lvii. 1, 1852, in art. entitled Ueber einige eigenthümliche wachshaltige Braunkohlen.

Between a resin and wax in characters. Crystallizable in needles from solution.

Color of crystals white. Melting point above 100° C.; and after fusion brown and partly decomposed, and hence the exact melting point not easily determinable. Soluble in ether; also 1 part in 268 of boiling absolute alcohol; but not at all in alcohol of 80 p. c.

Comp.—$\Theta_{50}\,H_{84}\,\Theta_{3}$, Brückner, =Carbon 81·97, hydrogen 11·47, oxygen 6·56=100; very nearly $\Theta_{40}\,H_{67}\,\Theta_{2\cdot4}$. Not at all acted upon by a hot solution of potash, or cold nitric acid.

Obs.—From a layer ½–2 ft. thick, in an earthy *yellowish-brown* brown coal, at Gesterwitz, near Weissenfels. The material of the layer is of loam-like aspect, but gives a shining wax-like streak, has G.=1·297, Wackenroder, and loses 22 p. c. of water at 100° C. The dried mass is nearly half sand and other earthy materials. The leucopetrite is associated in the coaly layer, according to Brückner, with other organic compounds, soluble in alcohol of 80 p. c., including two resins, two wax-like substances (p. 738), and an acid which Brückner calls *Georetinic acid* (p. 748). By a distillation of the mass of the brown coal, 28 p. c. of the whole passes over as a butter-like mass, which is related to the paraffins, but, according to Brückner, contains 2 p. c. of oxygen. It afforded (⅔) Carbon 84·04, hydrogen 14·10, oxygen [1·86], and he writes the formula $\Theta_{55}\,H_{110}\,\Theta$. It is soluble easily in hot absolute alcohol and ether, and very sparingly in alcohol of 80 p. c.; crystals in pearly hexagonal plates from the alcoholic solution; melts at 50° C.

Named after the locality, Weissenfels (=white rock), from λευκός, *white*, and πετρος, *rock*.

807. EUOSMITE.

Erdharz, Kampferharz, Euosmit, *C. W. Gumbel*, Jahrb. Min. 1864, 10.

Amorphous, in masses of a brownish-yellow color, or like that of cherry gum, and looking like common pitch.

H.=1·5. G.=1·2–1·5. Brittle. In thin pieces transparent. Fracture conchoidal. Strongly electric on friction. Has an odor between that of rosin and camphor. Dissolves easily in cold alcohol or ether, and hot oil of turpentine.

Comp., etc.—Ratio of Θ, H, Θ=34 : 29 : 2=40 : 68 : 2⅓=50 : 85 : 2⅚=Carbon 81·89, hydrogen 11·73, oxygen 6·38=100. Afforded 0·84 of ash. The ratio is almost identical with that of leucopetrite. Melts at 77° C., and burns with a bright flame and very aromatic odor. Solutions of the alkalies dissolve only a little of it, after long action.

Obs.—From clefts in brown coal, at Baiershof, near Thumsenreuth, in the Fichtelgebirge, and derived probably from a kind of Conifer, and one resembling the *Cupressinoxylon subæquale* Göppert.

808. SCLERETINITE. *J. W. Mallet*, Phil. Mag., IV. 4, 261, 1852.

In small drops or tears, from the size of a pea to that of a hazel-nut. H.=3. G.=1·136. Translucent in thin splinters. Color black, but by transmitted light reddish-brown; streak cinnamon-brown. Lustre between vitreous and resinous, rather brilliant. Brittle; fracture conchoidal. Insoluble in alcohol, ether, alkalies, and dilute acids.

Comp.—Analyses by J. W. Mallet (l. c.):

	C	H	O	Ash
1.	76·74	8·86	10·72	3·68
2.	77·15	9·05	10·12	3·68

Affords the ratio for Ꞓ, H, Θ=40 : 56 : 4=Carbon 77·05, hydrogen 8·99, oxygen 10·28, ash 3·68.

Heated on platinum foil it swells up, burns like pitch, with a disagreeable empyreumatic smell, and a smoky flame, leaving a coal rather difficult to burn, and finally a little gray ash. In a glass tube yields a yellowish-brown oily product of a nauseous empyreumatic odor. Even strong nitric acid acts slowly upon it.

From the coal measures of Wigan, England.

809. PYRORETINITE. Part of Pyroretin of *A. E. Reuss*, Ber. Ak. Wien, xii. 551, 1854, J. pr. Ch., lxiii. 155; *J. Stanek*, ib. Pyroretinite *Dana*.

Resin-like. Deposited in powder from a hot alcoholic solution of pyroretin as it cools.

Comp.—Ratio of Ꞓ, H, Θ=40 : 56 : 4=Carbon 80·00, hydrogen 9·33, oxygen 10·67=100. Analysis: Stanek (l. c.):

C 80·02 H 9·42 O [10 56]=100.

Approaches, as Stanek states, the beta-resin of the resin of *Pinus abies* (Johnston)=$\text{Ꞓ}_{40}\ \mathrm{H}_{58}\ \Theta_{5}$, and also copaivic acid (fr. copaiba balsam) $\text{Ꞓ}_{40}\ \mathrm{H}_{60}\ \Theta_{4}$, and other related compounds, showing that it is probably from coniferous trees.

Obs.—Pyroretin of Reuss, the resin which affords the above, occurs in the brown coal, between Salesl and Proboscht, near Aussig in Bohemia. It occurs in masses from the size of a nut to that of a man's head, and also in plates an inch thick. It is brittle; of brownish-black color; greasy-resinous lustre; wood-brown powder; H.=2·5; G.=1·05—1·18; and resembles much brown coal. It burns with a reddish-yellow flame, and a strong odor like that of burning amber, and leaves a black coal. It melts easily, decomposing and giving off white fumes, and leaves an asphalt-like mass. Reuss states evidence showing that it has probably been formed by the action of the heat of a basaltic dike on a bed of brown coal.

810. **Reussinite.** Part of Pyroretin of *A. E. Reuss*. Resin-like. Color fine reddish-brown. Soluble in boiling alcohol and in ether, and not deposited from the alcoholic solution on its cooling. Stanek (l. c.) found for the composition of the resin thus obtained, C 81·09, H 9·47, O 9·44=100; corresponding to $\text{Ꞓ}_{40}\ \mathrm{H}_{56}\ \Theta_{3\cdot5}$; and he regards the substance as a mixture of the above *pyroretinite*, $\text{Ꞓ}_{40}\ \mathrm{H}_{56}\ \Theta_{4}$, with another resin (here designated *reussinite*) of the formula $\text{Ꞓ}_{40}\ \mathrm{H}_{56}\ \Theta_{3}$.

811. ROCHLEDERITE. *Part of* Substanz Bituminose *Rochleder*, Ber. Ak. Wien, vi. 53, 1851; =Melanchym *Haid.*, Lotos, i. 85, 216, vi. 86, viii., Heft 3; *Kenng.*, Ueb. 1850, 147, 1853, 134. Rochlederite *Dana*.

Resin-like. Color reddish-brown. Transparent or translucent. Melting point 100° C. Soluble in alcohol.

Comp.—Ratio of Ꞓ, H, Θ=40 : 56 : 6. Analysis: Rochleder (l. c.):

C 76·79 H 9·06 O 14·15=100.

Burns with a yellow smoking flame, something like amber.

Obs.—The part soluble in alcohol of a bituminous substance called melanchyme by Haidinger, and found in masses as large as the head in the brown coal of Zweifelsreuth, near Neukirchen in Eger, Bohemia. A similar substance, of somewhat lighter color, occurs at Cehnitz, near Strakonitz, in Bohemia.

The rest of the substance insoluble in alcohol is the species melanellite, p. 750.

812. SCHLANITE. Part of Anthracoxen of *Reuss* (see p. 746). Schlanite *Dana.*

A dark or light brown powder, obtained through solution by ether from anthracoxene.

Comp.—Ratio for Ɵ, H, Θ=40 : 52 : 3½=Carbon 81·63, hydrogen 8·85, oxygen 9·52=100. **Analysis:** Laurenz (l. c., p. 746):

(⅔) C 81·47 H 8·71 O 9·82=100.

This resin oxydizes slowly when wet and exposed to the air.

Obs.—For locality and description of the material affording the schlanite, see p. 746.

813. GUYAQUILLITE. *Johnston*, Phil. Mag., xiii. 329, 1838.

Amorphous. In large masses or layers.

Yields easily to the knife, and may be rubbed to powder. G.=1·092. Color pale yellow. Lustre not resinous, or imperfectly so. Slightly soluble in water, and largely in alcohol, forming a yellow solution, which is intensely bitter.

Comp., etc.—Ratio for Ɵ, H, Θ=40 : 52 : 6=Carbon 76·665, hydrogen 8·174, oxygen 15·161 =100, Johnston. Begins to melt at 69½° C., but does not flow easily till near 100° C. As it cools becomes viscid, and may be drawn into fine tenacious threads. Soluble in cold sulphuric acid, forming a dark reddish-brown solution. A few drops of ammonia put into the alcoholic solution darken the color, and finally change it to a dark brownish-red.

It is said to form an extensive deposit near Guyaquil in South America. Evidently a mixture.

814. MIDDLETONITE. *J. F. W. Johnston*, Phil. Mag., III. xii. 261, 1838.

In rounded masses, seldom larger than a pea, or in layers a sixteenth of an inch or less in thickness, between layers of coal.

Brittle. G.=1·6. Lustre resinous. Color reddish-brown by reflected light, and deep red by transmitted; powder light brown. Transparent in small fragments. No taste or smell. Blackens on exposure. Only a trace dissolved by boiling alcohol, ether, or oil of turpentine. Not altered at 210° C.

Comp., etc.—Ratio for Ɵ, H, Θ=40 : 44 : 2, Johnston,=Carbon 86·33, hydrogen 7·92, oxygen 5·75=100. Johnston obtained (⅔) Carbon 86·21, hydrogen 8·03, oxygen 5·76=100.

On a red cinder burns like resin. Softens and melts in boiling nitric acid, with the emission of red fumes; a brown flocky precipitate falls on cooling. Soluble in cold concentrated sulphuric acid.

Obs.—Occurs between layers of coal about the middle of the Main coal or Haigh Moor seam, at the Middleton collieries, near Leeds, in thin layers and masses, rarely thicker than $\frac{1}{16}$ in., and little rounded masses seldom larger than a pea; also at Newcastle.

815. STANEKITE. Part of Pyroretin of *A. E. Reuss*, Ber. Ak. Wien, xii. 551, 1854, J. pr. Ch., lxiii. 155; *J. Stanek*, ib. Stanekite *Dana.*

Resin-like. Not soluble in any fluid without decomposition, and not at all in a solution of potash. Separated from the pyroretin of Reuss by boiling alcohol, which leaves it behind.

Comp.—Ratio of Ꞓ, H, Ɵ=39 : 44 : 6, Stanek,=Carbon 76·97, hydrogen 7·24, oxygen 15·79 =100. Perhaps Ꞓ, H, Ɵ=40 : 44 : 6=Carbon 77·42, hydrogen 7·09, oxygen 15·48=100. Analysis: Stanek (l. c.):

$(\frac{3}{2})$ C 76·71 H 7·80 O 15·99=100.

When heated gives off the odor of succinic acid.

Obs.—For locality and characters of the pyroretin of Reuss, affording the above, see p. 744.

816. ANTHRACOXENITE. Part of Anthracoxen (fr. Brandeisl) *Reuss*, *T. Laurenz*, Ber. Ak. Wien, xxi. 271, 1856, J. pr. Ch., lxix. 428, 1856. Anthracoxenite *Dana*.

Obtained as a black powder from a resin, by separating the remainder by means of ether, the anthracoxenite being insoluble in ether.

Comp.—Ratio of Ꞓ, H, Ɵ=40 : 38 : 7½. **Analysis:** Laurenz (l. c.):

$(\frac{3}{2})$ C 75·274 H 6·187 O 18·539.

11 p. c. of ash were separated. Not soluble in menstrua without decomposition.

Obs.—From a resin-like material, constituting layers 2½ in. thick between layers of coal, in the coal beds of Brandeisl, near Schlan in Bohemia; the mass is amorphous, and has H.=2·5; G.=1·181; lustre externally weak adamantine; color brownish-black, hyacinth-red in thin splinters by transmitted light; streak dull, yellowish-brown; fracture small-conchoidal; easily rubbed to a fine powder; fuses easily; burns with a yellow smoking flame, and an odor not disagreeable. This substance was named *anthracoxene* by Reuss. The name is here appropriated to the part insoluble in ether. The soluble part is named schlanite (p. 745).

---

817. TASMANITE. Resiniferous Shale (fr. Tasmania), Catal. Internat. Exhib., 1862. Tasmanite *A. H. Church*, Phil. Mag., IV. xxviii. 465, 1864.

In disks or scales thickly disseminated through a laminated shale; average diameter of scales about ·03 in.

H.=2. G.=1·18. Lustre resinous. Color reddish-brown. Translucent. Fracture conchoidal. Not dissolved at all by alcohol, ether, benzole, turpentine, or bisulphid of carbon, even when heated.

Comp., etc.—No action with muriatic acid. Slowly oxydized by nitric. Readily carbonized by sulphuric acid, with evolution of sulphuretted hydrogen. Alkalies in solution without action. Burns readily with a smoky flame and offensive odor; fuses partially, yielding oily and solid products, having a disagreeable smell. Ratio of Ꞓ, H, Ɵ, S=40 : 62 : 2 : 1=Carbon 79·21, hydrogen 10·23, sulphur 5·28, oxygen 5·28=100, corresponding nearly to succinite, in which part of the oxygen is replaced by sulphur. Analysis: Church (l. c.), after rejecting 8·14 p. c. of ash:

C 79·34 H 10·41 S 5·32 O 4·93

Obs.—From the river Mersey, north side of Tasmania. The rock is called *combustible shale*.

A caking bituminous coal from New Zealand, analyzed by C. Tookey in the laboratory of Prof. Percy (see anal. 18, p. 757), contained 2·37 p. c. of sulphur and *no* iron, the ash being peculiarly white; and Percy remarks (Met., 101, 102) that the sulphur may have been present in a state similar to that in fibrine. The existence of a sulphur-bearing resin like the above from Tasmania renders it probable that the New Zealand coal is impregnated with a similar insoluble resin; 2·37 p. c. of sulphur would correspond to the presence of about 44 p. c. of such a resin.

818. DYSODILE. (fr. Melili, Sicily) *Paulo Boccone*, Recherches et Obs. Nouv., etc., Amsterd., 1674. Dysodile *Cordier*, J. d. M., xxiii. 275, 1808. Merda di Diavolo *Ital.* Stinkkohle *Germ.* Houille papyracée, Tourbe papyracée, *Fr.*

In very thin leaves or folia, flexible, slightly elastic.
G.=1·14—1·25. Color yellow or greenish-gray. Streak shining.

Comp., etc.—Very inflammable, burning with a bright flame and an odor like that of asafœtida, leaving an ash in the form of laminæ, consisting largely, as shown by Ehrenberg, of the siliceous shells of infusoria, especially of Naviculæ. Delesse found (Thèse anal. Chim., 1, 1843) a variety from Glimbach, near Giessen, to afford water and volatile matters 49·1, carbon 5·5, ash 45·4; of the last, 17·4 were soluble silica, 11·0 sesquioxyd of iron, and 10·0 clay. Very probably neat tasmanite, as Church suggests.

Obs.—Originally from Melili, Sicily, forming a coaly deposit, made up of very thin paper-like leaves, which had evidently been derived from the joint decomposition and alteration of vegetable and animal matter. Reported also from the lignite deposits of Westerwald near Rolt; of Siegberg to the north of Sept Montagnes; of Saint Armand in Auvergne; Glimbach near Giessen; but the real nature of none of these substances has been investigated.

819. HIRCITE. Hircine *Piddington*, Arch. Pharm., lxxiv. 318, Kenng. Ueb., 1853, 134.

Amorphous.
G.=1·10. Color exteriorly brown, within yellowish-brown. Subtranslucent to opaque. Fracture conchoidal. Softens in boiling water, and then has the odor of a resin. In cold alcohol a little soluble; in boiling about one-half, and the solution, which is gold-yellow, affords white flocks on cooling.

Pyr., etc.—In the flame of a candle fuses and burns with a yellowish flame, like a bituminous coal, and leaves a tough coaly globule of a peculiarly strong animal odor (whence the name, from *hircus, a goat*). After complete combustion, leaves an ash. In sulphuric acid soluble, and color of solution blood-red.

820. BAIKERINITE. Part of Baikerit, Dickflussiges Harz, *Hermann* (see p. 733). A thick tar-like fluid at 15° C., and a crystalline granular deposit in a viscid honey-like mass at 10° C. Color brown. Translucent. Odor balsamic. Taste like that of wood-tar. Easily and perfectly soluble in alcohol and ether. The alcoholic solution becomes milky when diluted with water.
Constitutes 32·61 p. c. of the baikerite. No analysis yet made.

820A. DOPPLERITE of *J. C. Deicke*, B. H. Ztg., xvii. 383. (Not Dopplerite according to *Kenng.*, Ueb. 1858, 141.) Grayish, earthy, plastic in the fingers when fresh; becoming dark reddish-brown to black on drying.
Yields after drying, combustible substance 83·25, water 12·5, ash 4·25. Burns with a bright flame and intense heat, and differs from dopplerite in this respect, and also in containing much less water.
From a peat bed at Finkenbach in the Canton of St. Gall, Switzerland.

III. ACID HYDROCARBONS.

821. BUTYRELLITE. Bog Butter *Williamson*, Ann. Ch. Pharm., liv. 125, 1845. Butyrit *Glocker*, Syn., 9, 1847. Butyro-limnodic Acid *Brazier*, Chem. Gaz., 1852, 375. Butyrellite *Dana*.

Crystallizable in needles. Butter-like in consistence. Color white. Melting point of impure native material 47°, Brazier; but of material after solution in alcohol 51°, Luck; 52°—52·7°, Brazier. Easily soluble in alcohol or ether.

Comp.—$Ɵ_{32}H_{64}Ɵ_4$, Brazier=Carbon 75·0, hydrogen 12·5, oxygen 12·5=100, and like palmitic acid in ratio. Williamson gives the less probable formula $\text{Ȼ}_{33}\,\mathrm{H}_{66}\,\Theta_4$. The following are Williamson's analyses (l. c.): Nos. 1, 2, were the uncrystallized butyrite; 3, that obtained by combination with potash (with which it forms a kind of soap) and a separation afterward by acid:

	C	H	O
1. *Uncrystallized*	73·78	12·50	13·72=100.
2. "	73·89	12·37	13·74=100.
3. From potash solution	75·05	12·56	12·39=100.

Obs.—From the peat-bogs of Ireland.

The name butyrite being used in chemistry for another substance, it is here changed to the form above.

822. GEOCERELLITE. Geocerinsäure *Brückner*, J. pr. Ch., lvii. 10, 1852. Geoceric Acid. Geocerellite *Dana*.

Color white. Brittle, and easily pulverized. No crystallization observed. Soluble freely in hot alcohol, and deposited from the solution as a jelly on cooling, with nothing crystalline under the microscope. Melting point 82° C.

Comp.—$\text{Ȼ}_{28}\,\mathrm{H}_{56}\,\Theta_4$, Brückner; =Carbon 79·24, hydrogen 13·21, oxygen 7·55=100. Analysis: Brückner (l. c.):

(?) Carbon 78·61 Hydrogen 12·70 Oxygen 18·69=100.

The acid was separated by combination with lead by action with a hot solution of acetate of lead.

Obs.—Separated from the *dark brown* brown coal of Gesterwitz. See GEOCERITE, p. 738.

823. BRÜCKNERELLITE. Georetinsäure *Brückner*, J. pr. Ch., lvii. 5, 1852. Georetinic Acid. Brücknerellite *Dana*.

Crystallizable in white needles from an alcoholic solution. Dissolves easily in boiling alcohol; and, if the solution is a concentrated one, crystallizes out more or less completely on cooling.

Comp.—$\text{Ȼ}_{24}\,\mathrm{H}_{44}\,\Theta_8$, Brückner, =Carbon 62·61, hydrogen 9·56, oxygen 27·83=100. The lead salt afforded Carbon 43·36, hydrogen 6·59, oxyd of lead 34·58, oxygen [15·47]=100.

Obs.—Separated from the yellowish-brown brown coal of Gesterwitz. See LEUCOPETRITE, p. 743.

824. SUCCINELLITE. [Succinum] vertitur [by distillation] partim in oleum sui coloris, partim denique in *candidum quiddam et tenue* quod similitudinem quandam gerit speciemque salis, *Agric.*, Nat. Foss., 233, 1546. Flos Succini *Libav.*, Alchem. Tract., 399, 1597. Succinic Acid. Succinellite *Dana*.

Orthorhombic. $I \wedge I = 120°\ 18'$, $O \wedge 1 = 129°\ 45'$; $a : b : c = 1{\cdot}0425 : 1 : 1{\cdot}7425$, Ramm. $1 : 1$, bas., $=100°\ 30'$, macr., 135°, brach., 96° 22′.

H.=1. G.=1·55. Lustre vitreous. Colorless or white. An aromatic odor. Soluble in water.

Comp.—$\text{Ȼ}_4\,\mathrm{H}_6\,\Theta_4$=Carbon 40·7, hydrogen 5·1, oxygen 54·2=100. Evaporates at a low temperature, and on cooling condenses in crystals.

Obs.—Exists in amber, constituting 2½ to 6 p. c. of the mass, and easily obtained from it by distillation. Its presence ready formed in this resin is shown by the fact that it may be separated either by water, ether, or alkalies, the amber being left after the treatment without its succinic acid.

825. RETINELLITE. *Part of* Bright Yellow Loam (fr. Bovey) so saturated with petroleum that it burns like sealing-wax, *J. Milles*, Phil. Trans., li. 536, 1760; Bitumen from Bovey, Retin asphaltum, *Hatchett*, ib., 1804, 402; Retinite. Resin of Retin Asphalt, Retinic Acid, *J. F. W. Johnston*, Phil. Mag., III. xii. 560, 1838. Retinellite *Dana*.

Resin-like. Light brown. Begins to melt at 121° C., is perfectly fluid at 160°, and gives off a resin-like odor at 100° C. Soluble in alcohol, still more freely in ether.

Comp.—O. ratio for Ꞓ, H, Ɵ=21 : 28 : 3. **Analysis:** Johnston (l. c.):

C 76·86 H 8·75 O 14·39=100.

Johnston describes salts of retinic acid with silver, lead, and lime.

Obs.—The retinasphalt of Hatchett, from the Tertiary coal of Bovey in Devonshire, from which alcohol separates the above species, occurs in roundish masses, having H.=1—2·5; G.=1·135, Hatchett; lustre slightly resinous in the fracture, often earthy externally; color light yellowish-brown, sometimes green, yellow, reddish, or striped; and is subtransparent to opaque; often flexible and elastic when first dug up, though brittle on drying. Johnston, after drying the retinasphalt at 300° C., obtained (l. c.) 53·92 p. c. of resin soluble in alcohol, 27·45 of insoluble organic matter, and 18·23 of ash=100. The insoluble portion has not been investigated.

Hatchett found (l. c.) vegetable resin 55, bitumen 41 (the insoluble part, which he regarded as asphalt, and alludes to in the name retinasphalt), and earthy matter 3=99.

A retinite from Halle afforded Bucholz (Schweig. J., i. 290, 1811) 91 parts soluble in absolute alcohol, and 9 parts insoluble. The *former* gives a yellowish-brown deposit on dilution, and is more soluble in boiling dilute alcohol than in cold; and it is insoluble in pure ether and turpentine. The *latter* is also insoluble in ether. Both are soluble in alkalies, which would seem to indicate that they are acid in their relations.

The resin fuses with more difficulty than most resins, blackens in the heat, and gives out a strong aromatic odor. By distillation yields a brown thick oil, some water containing a little acetic acid, besides carbonic acid and carburetted hydrogen.

826. DOPPLERITE. Dopplerit *Haid.*, Ber. Ak. Wien, ii. 287, 1849, lii. 281.

Amorphous. In elastic or partly jelly-like masses. When fresh, brownish-black, with a dull brown streak and greasy subvitreous lustre; and when in thin plates reddish-brown by transmitted light.

H.=0·5. G.=1·089, Fœtterle. After drying, H.=2—2·5, G.=1·466, and lustre somewhat adamantine. Becomes elastic on drying from exposure to the air. Tasteless. Insoluble in alcohol or ether.

Comp., etc.—Ratio for Ꞓ, H, Ɵ, nearly 10 : 12 : 5, from analyses 2, 3. An acid substance, or mixture of different acids, related to humic acid. Analyses: 1, Schrötter (Ber. Ak. Wien, ii. 287, 1849); 2, 3, F. Mühlberg (Jahrb. G. Reichs., xv. 283, 1865):

	C	H	O	N	
1. Aussee	51·09	5·29	42·59	1·03	=100 Schrötter.
2. "	55·94	5·20	38·86		=100 Mühlberg.
3. Obbürg (§)	56·63	5·58	37·79		=100 Mühlberg.

From No. 1, 5·86 of ash are excluded; from No. 2, 5·18; from 3, 5 to 14·2 p. c. All were dried. Schrötter found the loss of water 78·5 p. c.; and Mühlberg, at 110° C, for No. 2, 20·04 p. c. for an air-dried specimen; for 3, 81·8 p. c. for a jelly-like specimen, and 19·7 for an air-dried. In caustic potash soluble, with a residue of earthy matters.

Obs.—Found in peat-beds, near Aussee in Styria; and in Gontin in Appenzell, and Obbürg, near Stansstad in Unterwalden, Switzerland.

Named after Bergrath Doppler, who was the first to bring the substance to notice.

C. W. Gümbel has referred here (Jahrb. Min. 1858, 278) a substance from a peat-bed near Berchtesgaden. It is soft, plastic, elastic, black, of waxy lustre, tasteless; on drying in the air it resembles compact coal, is brittle and velvet-black, and has H.=2·5, G.=1·439, lustre vitreous, with powder brownish-black. The air-dried material loses, at 80° C., 12 p. c. of water. Unlike dopplerite, it burns with a bright yellow flame, is partially soluble in alcohol, and the alcoholic solution affords a resin (Kenng. Ueb., 1858, 142).

A pitch-black coal-like substance from the peat-beds at Kolbenmoor, near Berchtesgaden, the same that are described by Gümbel, related to dopplerite in composition, and in *not burning* with a flame when inserted in fragments in the flame of a candle, has been analyzed by C. Gilbert Wheeler (priv. contrib., dated Nuremberg, Jan. 23, 1866). It afforded him:

C 50·98 H 5·36 N 3·74 O 36·14 ash 3·78=100.

It appears to be the same substance that is here partially described by Gümbel.

Mr. Wheeler observes that it is found imbedded in, and entirely surrounded by, the peat; and specimens show well the transition from peat to the coal-like substance.

827. MELANELLITE. Part of Melanchym of *Haid.* (see p. 744). Melanellite *Dana.*

Black and gelatinous, as obtained by Rochleder. Separated from rochlederite, or the resinous ingredient of melanchyme, by dissolving the latter out by means of alcohol.

Comp., etc.—The jelly-like mass gave on analysis, Carbon 67·14, hydrogen 4·79, oxygen 28·07=100, corresponding to the ratio 48 : 40 : 15=Carbon 67·3, hydrogen 4·7, oxygen 28·0=100. The ratio 48 : 40 : 16=12 : 10 : 4 affords the percentage C 66 1, H 4·6, O 29·3=100. The substance is regarded by Rochleder as an acid related to ulmic acid. But, as it was not combined with a base before analysis, there is no proof of its purity.

On the locality and material affording this acid, see ROCHLEDERITE, p. 744.

IV. SALTS OF ORGANIC ACIDS.

828. MELLITE. Honigstein (fr. Thuringia) *Wern.*, Bergm. J., 1789, i. 380, 395. Honigstein *Karst.*, Mus. Lesk., ii. P. 1, 335, 1789. Succin transparent en cristaux octaèdres, Pierre de miel, *v. Born*, Cat. de Raab, ii. 90, 1790. Mellites *Gmelin*, Linn. Syst., iii. 282, 1793. Mellilite *Kirwan*, Min., ii. 68, 1796. Mellite *H.*, iii. 1801. Honigstein, Melilithus,=Honigsteinsäure (Acidum melilithicum)+Alaunerde+Wasser, *Klapr.*, Ak. Berlin, 1799, Beitr., iii. 114, 1801.

Tetragonal. *O* ∧ 1=33° 29′; *a*=0·745445, Kokscharof. Occurs in octahedrons, with often the planes *i-i* truncating the basal angles, and sometimes the terminal angle and basal edges truncated, the occurring planes being *O*, *I*, *i-i*, 1. 1 ∧ 1, pyr.,=118° 16′, basal,=93° 1¼′; 1 ∧ *i-i*=121° 52′. Cleavage: octahedral, very indistinct. Also in massive nodules, granular in structure.

H.=2—2·5. G.=1·55—1·65; 1·636—1·642, Kenngott. Lustre resinous, inclining to vitreous. Color honey-yellow, often reddish or brownish; rarely white. Streak white. Transparent—translucent. Fracture conchoidal. Sectile.

Comp.—$\ddot{\text{A}}\text{l}\,\bar{\bar{\text{M}}}^3 + 18\,\dot{\text{H}}$=Mellitic acid 40·58, alumina 14·32, water 45·15. Analyses: 1, Klaproth (Beitr., iii. 114); 2, Wöhler (Pogg., vii. 325); 3, J. v. Iljenkof (Koksch., iii. 217):

Mellitic acid	46	41·4	42·36
Alumina	16	14·5	14·20
Water	38=100 K.	44·1=100 W.	44·16 I.

Pyr., etc.—Whitens in the flame of a candle, but does not take fire. Dissolves in nitric acid; decomposed by boiling water. In a matrass yields water.

Obs.—Occurs in brown coal at Arten in Thuringia; at Luschitz near Bilin in Bohemia; near Walchow in Moravia; in the Govt. of Tula, Russia in Europe; Nertschinsk, beyond Lake Baikal.

829. PIGOTITE *Johnston* (Phil. Mag., III. xvii 382). A salt of alumina and an organic acid called mudoscous acid by Johnston. Composition $4\,\ddot{\text{A}}\text{l} + \text{Ȼ}_6\text{H}_{10}\text{Ɵ}_4$ (the acid) + $27\,\dot{\text{H}}$. Formed on granite, in Cornwall, from the action of wet vegetation. Reported also from Wicklow (Ch. Gaz., 1852, 378).

829A. ORGANIC SALTS OF IRON. Native compounds of iron and organic acids have been indicated by Berzelius and other chemists as common in marshes. But none of them has yet been properly investigated, the kinds of acids, as well as the proportions of acid to bases, being undetermined.

APPENDIX TO HYDROCARBONS.

830. ASPHALTUM. 'Ασφαλτος *Aristot.*, *Strabo*, *Diosc.*, etc. Bitumen *Plin.*, xxxv. 51. Asphalt, Mineral Pitch. Asphalt, Bergpech, Erdpech, *Germ.* Asphalte, Bitume, *Fr.* [For syn. of Pittasphalt or Mineral Tar (Bergtheer *Germ.*), see p. 728.]

Asphaltum, or mineral pitch, is a mixture of different hydrocarbons, part of which are oxygenated. Its ordinary characters are as follows:

Amorphous. G.=1—1·8; sometimes higher from impurities. Lustre like that of black pitch. Color brownish-black and black. Odor bituminous. Melts ordinarily at 90° to 100° C., and burns with a bright flame. Soluble mostly or wholly in oil of turpentine, and partly or wholly in ether; commonly partly in alcohol.

The more solid kinds graduate into the pittasphalts or mineral tar (p. 728), and through these there is a gradation to petroleum. The fluid kinds change into the solid by the loss of a vaporizable portion on exposure, and also by a process of oxydation, which consists first in a loss of hydrogen, and finally in the oxygenation of a portion of the mass.

Comp.—The action of heat, alcohol, ether, naphtha, and oil of turpentine, as well as direct analyses, show that the so-called asphaltum from different localities is very various in composition. Yet the true composition is not known of any one of them. It has been shown only that the following are the classes of ingredients present:

A. *Oils* vaporizable at about 100° C., or below; sparingly present, if at all.

B. *Heavy oils*, probably of the Pittolium or Petrolene groups (pp. 728, 729); vaporizable between 100° and 250° C.; constituting sometimes 85 p. c. of the mass.

C. *Resins* soluble in alcohol

D. *Solid asphalt-like substance or substances soluble in ether and not in alcohol*; black, pitch-like, lustrous in fracture; 15 to 85 p. c.

E. *Black or brownish-black substance or substances not soluble either in alcohol or ether*; similar to D in color and appearance, Kersten; brown and ulmin-like, Völckel; 1 to 75 p. c.

F. Nitrogenous substances; often as much as corresponds to 1 or 2 p. c. of nitrogen.

Boussingault attempted an investigation of the composition in 1837 (Ann. Ch. Phys., lxxiv. 141), and arrived at the conclusion that there were two principles present; one *petrolène*, an oil, the other *asphaltène*, a solid, and concluded that all asphalts were mixtures of these two in different proportions. But his *petrolene*, as already observed, is beyond question a mixture of oils; and his *asphaltene* needs much more investigation. His special examinations on this point were made only on the asphalt of Bechelbronn. He found in it (1) no light oil (or A), as nothing was given off at 100° C.; (2) 85·4 p. c. of heavier oil, or his *petrolene*, vaporized between 100° and 230° C. (B); and (3) 14·6 p. c. of a black, lustrous, asphalt-like solid, his *asphaltene*, soluble in *ether*, oil of turpentine, and fatty oils, but not in alcohol (D). Asphaltene was the solid substance after subjecting the asphaltum to a temperature of 250° C. in a hot oil-bath.

(Boussingault has been quoted by Berzelius, Kersten, Rammelsberg, and others, as making the asphaltene *not* soluble in ether, but he expressly mentions its solubility. He also states earlier that the *mass* of the asphalt was *wholly* soluble in ether; and, also, that he used ether to separate it from the impurities present, after which kind of purification it burnt without residue.)

Boussingault's analysis of asphaltene afforded:

Carbon 75·0 Hydrogen 9·9 Oxygen 14·8=99·7;

giving the ratio for Θ, H, Θ=40 : 64 : 6. He closes the paper with his analysis of an asphalt (the mass) from Caxitambo, as follows:

C 75·0 H 9·5 O 15·5=100;

and remarks on the near approach of this alphalt in composition to *asphaltene*. But in 1840 (l. c., lxxiii. 444) he gives two new analyses of the Caxitambo asphalt, in which he obtained only 1·65 of oxygen and nitrogen (see anal. 7, below); and adds that "his earlier analysis was made by the method ordinarily followed at that time, by which method he was never able to obtain more than 76 p. c. of carbon." The remark virtually concedes the inaccuracy of the analysis also of asphaltene, or at least gives sufficient occasion for a very large doubt. No special mention is made in this second paper of the asphalt of Bechelbronn, but analyses are given of *petrolene* from the locality.

Nendtvich, in an investigation of an asphalt from Peklenicza, Austria, found it to consist almost solely of *asphaltene*, that is, it was soluble in ether and not in alcohol; and in 1843 (Jahrb. G. Reichs., vii. 743) obtained for it nearly the composition of asphaltene (or C 72·45, H 11·07, O 16·48); but in 1847 (Haid. Ber., iii. 271) he rejects his earlier results, and states that the mineral contained *no oxygen*, and was essentially identical in composition with petrolene, as stated on p. 730.

Other analysts have not afforded more satisfactory results. Part have been contented with analyses of the undivided mass; while others have ascertained the portions soluble in different menstrua, without ascertaining the constituents of the substances obtained.

The following table contains the proportions of the ingredients A, B, C, D, E, above, in a few asphalts. The letters E and A, in connection with the statement of the solubility, stand for *ether* and *alcohol*. 1, Boussingault (l. c.); 2, Kersten (J. pr. Ch., xxxv. 271); 3, 4, Völckel (Ann. Ch. Pharm., lxxxvii. 139); 5, Klaproth (Beitr., iii. 315); 6, Meyrac (J. d. Phys., xcix. 118); 7, Hermann (J. pr. Ch., lxxiii. 232); 8, Nendtvich (Haid. Ber., l. c.):

	A. Light oils.	B. Heavier oils.	C. Resin.	D. Sol. in E. Insol. in A.	E. Insol. in E & A.		
1. Bechelbronn	0	85·4	?	14·6	0	=100	Boussingault.
2. Brazza, Dalmatia	5·0		1·0	20·0	74·0	=100	Kersten.
3. Dax	*very little*			*about half*	*about half*		Völckel.
4. Travers, near Neufchatel	"			"	"		Völckel.
5. Albania	0	0	0	*all*	0		Klaproth.
6. Bastennes			*two thirds*		*a third*		Meyrac.
7. Tschetschna, Caucasus		11·2	0	88·8	0	=100	Hermann.
8. Peklenicza		*trace*		*all*	0		Nendtvich.

Klaproth found the asphalt of Avlona, Albania, to give nothing to alcohol, and to dissolve completely in ether, like that of Peklenicza.

It is probable that the material insoluble in both alcohol and ether (column E, above) is not always of the same kind. That from the Brazza asphalt (anal. 2) was black and lustrous, asphalt-like; while that of Dax (anal. 3) was brown, and ulmin-like.

Ultimate analyses of different asphalts have afforded the following results: 1–3, Ebelmen (Ann. d. M., xv. 523); 4, 5, Regnault (Ann. d. M., III. xii. 161); 6, Wetherill (Trans. Am. Phil. Soc. Philad., 1852, 358); 7, Boussingault (l. c., lxxxiii. 444):

	C	H	O	N	Ash		
1. Bastennes	78·50	8·80	[2·60]	1·65	8·45	=100	Ebelmen.
2. Pont du Chateau	76·13	9·41	[10·34]	2·32	1·80	=100	Ebelmen.
3. Auvergne	77·64	7·86	[8·35]	1·02	5·13	=100	Ebelmen.
4. Abruzzi, Italy	67·43	7·22	[23·98]	1·37	——	=100	Regnault.
5. Cuba	81·46	9·57	[8·97]		——	=100	Regnault.
6. "	82·34	9·10	[6·25]	1·91	0·40	=100	Wetherill.
7. Caxitambo	(?) 88·66	9·69	[1·65]		——	=100	Boussingault.

The most of these analyses need revision.

Obs.—Asphaltum belongs to rocks of no particular age. The most abundant deposits are superficial. But these are generally, if not always, connected with rock deposits containing some kind of bituminous material or vegetable remains (see p. 725).

Some of the noted localities of asphaltum are the region of the Dead Sea, or Lake Asphaltites, whence the most of the asphaltum of ancient writers; a lake on Trinidad, 1½ m. in circuit, which is hot at the centre, but is solid and cold toward the shores, and has its borders over a breadth of ½ m. covered with the hardened pitch with trees flourishing over it; and about Point La Braye, the masses of pitch look like black rocks among the foliage; at various places in S America, similar lakes, as at Caxitambo (not Coxitambo), Peru, which is used at Payta, on the coast (under the equator), for pitching boats, etc.; at Berengela, Peru, not far from Arica (S.) where it is put to the same use; in California, near the coast of St. Barbara, an area of some acres; in a large bed, near Avlona in Albania (G.=1·205). Also in smaller quantities, sometimes disseminated through shale and sandstone rocks, and occasionally limestones, or collected in cavities or seams in these rocks; near Matlock, Derbyshire, in stalactitic masses; Poldice mine in Cornwall; Haughmond Hill in Shropshire; at Bastennes and Dax, Dept. of Landes, constituting 6 p. c. of a sandy deposit; Val de Travers, Neuchatel, impregnating a bed in the Cretaceous formation, and serving as a cement to the rock. which is used for buildings; impregnating dolomite on the island of Brazza in Dalmatia; in the Caucasus; in gneiss and mica schist in Sweden.

The following substances are closely related to asphaltum, and, like it, are mixtures of undetermined carbohydrogens.

830A. GRAHAMITE *Wurtz* (Coal or Asphalt *Lesley*, Proc. Am. Phil. Soc. Philad., ix. 183, 1863; Grahamite *Wurtz*, Rep. Min. Format. in W. Virginia, 1865, Am. J. Sci., II. xlii. 420, 1866.) Resembles the preceding in its pitch-black, lustrous appearance; H.=2; G.=1·145. Soluble mostly in oil of turpentine; partly in ether, naphtha, or benzole; not at all in alcohol; wholly in chloroform and sulphid of carbon. No action with alkalies or hot nitric or muriatic acid. Melts only imperfectly, and with a decomposition of the surface; but in this state the interior may be drawn into long threads.

Occurs in W. Virginia, about 20 m. in an air line S. of Parkersburg, filling a fissure (shrinkage fissure) in a sandstone of the Carboniferous formation; and supposed to be, like the albertite, an inspissated and oxygenated petroleum. There is yet no reliable analysis of it, not even an ultimate analysis. The material is partly columnar from a fracturing as a result of contraction in the material, the structure being vertical to the sides of the vein.

830B ALBERTITE *Robb.* (Melan-Asphalt *Wetherill*, Trans. Am. Phil. Soc. Philad., 1852, 353.) Differs from ordinary asphaltum in being only partially soluble in oil of turpentine, and in its very imperfect fusion when heated. It has H.=1–2; G.=1·097; lustre brilliant, pitch-like; color jet-black. Softens a little in boiling water; in the flame of a candle shows incipient fusion. According to imperfect determinations, only a trace soluble in alcohol; 4 p. c. in ether; 30 in oil of turpentine.

Wetherill obtained in an ultimate analysis (l. c.) Carbon 86·04, hydrogen 8·96, oxygen 1·97, nitrogen 2·93, S *tr.*, ash 0·10=100. By destructive distillation, oils of the Naphtha, Betanaphtha, and Ethylene series have been obtained by Warren.

Occurs filling an irregular fissure in rocks of the Subcarboniferous age (or Lower Carboniferous) in Nova Scotia, and is regarded as an inspissated and oxygenated petroleum. For an article on its mode of occurrence, see Hitchcock, Am. J. Sci., II. xxxix. 267.

830C. PIAUZITE (Retinit von Piauze, Piauzit, *Haid.*, Pogg., lxii. 275, 1844). An asphalt-like substance, remarkable for its high melting-point, 315° C. It occurs slaty massive; color brownish- or greenish-black; thin splinters colophonite-brown by transmitted light; streak light brown, amber-brown; H.=1·5; G.=1·220; 1·186, Kenngott.

After melting, it burns with an aromatic odor and much smoke, leaving 5·96 per cent. of ash. Soluble in ether and caustic potash, also largely in absolute alcohol. Heated in a glass tube a yellowish oily fluid is distilled, having an acid reaction.

It comes from a bed of brown coal at Piauze, near Neustadt in Carniola; on Mt. Chum, near Tüffer in Styria, where thousands of pounds have been obtained. It much resembles a black lamellar coal (Kenngott, Jahrb. G. Reichs., 91, 1856).

830D. BERENGELITE *Johnston*, Phil. Mag., III. xiii. 329, 1838. Asphaltum-like. Color dark brown, with a tinge of green. Powder yellow. Lustre of surface of fracture resinous.

Analysis: Johnston (l. c.): C 72·47, H 9·20, O 18·33=100, corresponding to the ratio for Ꞓ, H, Ɵ, 40 : 62 : 8. Forms a solution with cold alcohol, which is bitter to the taste. On evaporation the resin obtained has a clear red color, and remains soft and viscid at the ordinary temperature. Nearly insoluble in caustic potash. Odor resinous, disagreeable; but after fusion for some time at 100° C., this odor is succeeded by an agreeable one; on cooling it regains the original odor. It is said to form a lake like that of Trinidad, in the province of St. Juan de Berengela, about 100 m. from Arica, Peru, and is used at Arica for paying boats and vessels.

831. MINERAL COAL. Ἀνθρακευτὰ δ'ὅσα τῶν τοιούτων γῆς πλέον ἔχει ἢ καπνοῦ [=Coal-like substances which have in them more of earth than of smoke or fire] *Aristot.*, Μετεωρολογ., iv. 9. Ἐν ᾧ (river Pontus in Thrace) τινας λίθους οἳ καίονται [=Certain stones which burn] *Aristot.*, Περὶ Θαυμ. Ἀκουσμ., c. 115. Οὓς δὲ καλοῦσιν εὐθὺς ἄνθρακας τῶν θρυπτομένων (? ὀρυττομένων) διὰ τὴν χρείας εἰσὶ γεώδεις, etc. [=Those (of minerals) dug for use, which are called simply coals, are earthy, but will kindle and burn like charcoal] (fr. Liguria), *Theophr.*, xvi. (in Schneider's edit.), 315 B.C. Ἔνιοι δὲ τῶν θραυστῶν ἀνθρακοῦνται τῇ καύσει καὶ διαμένουσι πλείω χρόνον [=Some brittle stones become by burning like glowing coals, and remain so a long time] (fr. Bena in Thracia, and the promontory of Erineas) *Theophr.*, xii. Θρακίας λίθος *Aristot.* Γαγγίτης λίθος *Strabo* Γαγάτης λίθος, Θρακιας λίθος, *Diosc.*, v. 145, 146. Thracius lapis, Gemma Sammothracia, *Plin.*, xxxiii 30, xxxvii. 67. Gagates *Plin.*, xxxvi. 34. Steinkohle *Germ.* Houille, Charbon fossile, *Fr.*

Mineral coal is made up of different kinds of hydrocarbons, with perhaps in some cases free carbon; but the species have not yet been investigated.

The distinguishing characters of mineral coal are as follows:

Compact massive, without crystalline structure or cleavage; sometimes breaking with a degree of regularity, but from a jointed rather than a cleavage structure. Sometimes laminated; often faintly and delicately banded, successive layers differing slightly in lustre.

H.=0·5—2·5. G.=1—1·80. Lustre dull to brilliant, and either earthy, resinous, or submetallic. Color black, grayish-black, brownish-black, and occasionally iridescent; also sometimes dark brown. Opaque. Fracture conchoidal—uneven. Brittle; rarely somewhat sectile. Without taste, except from impurities present. Insoluble in alcohol, ether, naphtha, and benzole, excepting at the most 2 or 3 p. c. (rarely 10?); usually less than 1 p. c. Insoluble in a solution of potash. Infusible to subfusible; but often becoming a soft, pliant, or paste-like mass when heated. On distillation most kinds afford more or less of oily and tarry substances, which are mixtures of hydrocarbons and paraffin.

Var.—The variations depend partly (1) on the amount of the volatile ingredients afforded on destructive distillation: or (2) on the nature of these volatile compounds, for ingredients of similar composition may differ widely in volatility, etc.; (3) on structure, lustre, and other physical characters.

1. ANTHRACITE (Anthracit *Karst.*, Tab., 58, 96, 1808. Glanzkohle *Germ.*). H.=2—2·5. G.=1·32—1·7, Pennsylvania; 1·81, Rhode Island; 1·26—1·36, South Wales. Lustre bright, often submetallic, iron-black, and frequently iridescent. Fracture conchoidal. Volatile matter after drying 3 to 6 p. c. Burns with a feeble flame of a pale color.

The anthracites of Pennsylvania contain ordinarily 85 to 93 per cent. of carbon; those of South Wales, 88 to 95; of France, 80 to 83; of Saxony, 81; of southern Russia, sometimes 94 per cent.

Anthracite graduates into bituminous coal, becoming less hard and containing more volatile matter; and an intermediate variety is called *free-burning* anthracite.

2. *Native Coke.* More compact than artificial coke, and some varieties afford considerable bitumen. From the Edgehill mines, near Richmond, Va., according to Genth, who attributes its origin to the action of a trap eruption on bituminous coal.

BITUMINOUS COALS (Schwarzkohle *Hausm.*, Handb, 73, 1813. Steinkohle pt. *Germ.*). Under the head of Bituminous Coals, a number of kinds are included which differ strikingly in the action of heat, and which therefore are of unlike constitution. They have the common characteristic of burning in the fire with a yellow, smoky flame, and giving out on distillation hydrocarbon oils or tar, and hence the name *bituminous.* The *ordinary* bituminous coals contain from 5 to 15 p. c. (rarely 16 or 17) of oxygen (ash excluded); while the so-called *brown coal* or *lignite* contains from 20 to 36 p. c., after the expulsion, at 100° C., of 15 to 36 p. c. of water. The amount of hydrogen in each is from 4 to 7 p. c. Both have usually a bright, pitchy, greasy lustre (whence often called *Pechkohle* in German), a firm compact texture, are rather fragile compared with anthracite, and have G.=1·14—1·40. The *brown* coals have often a brownish-black color, whence the name, and more oxygen, but in these respects and others they shade into ordinary bituminous coals.

The ordinary bituminous coal of Pennsylvania has G.=1·26—1·37; of Newcastle, England, 1·27; of Scotland, 1·27—1·32; of France, 1·2—1·33; of Belgium, 1·27—1 3. The most prominent kinds are the following:

3. CAKING COAL. A bituminous coal which softens and becomes pasty or semi-viscid in the fire. This softening takes place at the temperature of incipient decomposition, and is attended with the escape of bubbles of gas. On increasing the heat, the volatile products which result from the ultimate decomposition of the softened mass are driven off, and a coherent, grayish-black, cellular, or fritted mass (*coke*) is left. Amount of coke left (or part not volatile) varies from 50 to 85 p. c. A caking coal will lose its caking quality if kept heated for 2 or 3 hours at 300° C., and sometimes on mere exposure for a time to the air.

4. Non-Caking Coal. Like the preceding in all external characters, and often in ultimate composition; but burning freely without softening or any appearance of incipient fusion. Percentage of volatile matter same as for caking coal, but the *coke* is not a proper coke, being in powder, or of the form of the original coal.

There are all gradations between caking and non-caking bituminous coals. In external characters the two kinds are alike. They often break into layers: and there is besides a horizontal banding arising from a succession of very thin *non-separable* layers, slightly differing in lustre or shade of color. *Cherry coal* or *soft coal* (of England) is a non-caking coal igniting well and burning rapidly, while *splint* or *hard coal* ignites less readily, burns less rapidly, owing to the smaller amount of volatile matter. Coals which do not cake on burning are called *free-burning* coals while the caking are called *binding* coals.

5. Cannel Coal (Parrot Coal). A variety of bituminous coal, and often caking; but differing from the preceding in texture, and to some extent in composition, as shown by its products on distillation. It is compact, with little or no lustre, and without any appearance of a banded structure; and it breaks with a conchoidal fracture and smooth surfaces; color dull black or grayish-black. On distillation it affords, after drying, 40 to 66 of volatile matter, and the material volatilized includes a large proportion of burning and lubricating oils, much larger than the above kinds of bituminous coal; whence it is extensively used for the manufacture of such oils It graduates into oil-producing coaly shales, the more compact of which it much resembles. The original *Parrot coal* is a cannel from near Edinburgh, which burns with a crackling noise, whence the name (Percy); and *Horn coal*, a kind from South Wales, which emits when burning something of the odor of burning horn.

6. Torbanite. A variety of cannel coal of a dark brown color, yellowish streak, without lustre, having a subconchoidal fracture; H.=2·25; G.=1·17—1·2. Yields over 60 p. c. of volatile matter, and is used for the production of burning and lubricating oils, paraffin, illuminating gas. Named from the locality at Torbane Hill, near Bathgate in Linlithgowshire, Scotland. Also called *Boghead Cannel* (see p. 742).

7. Brown Coal (Braunkohle *Germ.*, Pechkohle pt. *Germ.*, Lignite). The prominent characteristics of brown coal have already been mentioned. They are non-caking, but afford a large proportion of volatile matter. They are sometimes pitch-black (whence Pechkohle pt. *Germ.*), but often rather dull and brownish-black. G.=1·15—1·3; sometimes higher from impurities. It is occasionally somewhat lamellar in structure.

Brown coal is often called *lignite*. But this term is sometimes restricted to masses of coal which still retain the form of the original wood. *Jet* is a black variety of brown coal, compact in texture, and taking a good polish, whence its use in jewelry.

8. Earthy Brown Coal (*Erdige Braunkohle*) is a brown friable material, sometimes forming layers in beds of brown coal. But it is in general not a true coal, a considerable part of it being soluble in ether and benzole, and often even in alcohol; besides affording largely of oils and paraffin on distillation. For a notice of "coal" of this kind see under Leucopetrite, p. 743 Such a coal is sometimes called *wax coal* and *paraffin coal* (Wachskohle, Paraffinkohle, *Germ.*). See also Bathvillite, p. 742.

9. Mineral Charcoal. Fibrous charcoal-like substance often found covering the surfaces between layers of coal, and observed in coal of all ages. It is soft, and soils the fingers like charcoal. One variety of it is a dry powder.

Comp.—Most mineral coal consists mainly, as the best chemists now hold, of *oxygenated hydrocarbons*. On page 742 it is shown that the kind of cannel coal called *torbanite* and the substance *bathvillite* are closely related in composition, as well as insolubility, to the species of the Succinite group; and it is probable that other cannel coals contain this or some related compound; and that oil-producing (not oil-bearing) shales include a similar kind of hydrocarbon. The ordinary bituminous coals often have 10 to 15 p. c. of oxygen, and may be of analogous composition, though differing much in the precise constitution of these hydrocarbons, some containing such as produce a pasty fusion or incipient decomposition when heated (caking), and others such as undergo no semi-fusion (non-caking). The brown coals, in which there are 20 to 35 p. c. of oxygen, must include other kinds of oxygenated hydrocarbons, of the insoluble kinds. But microscopic examinations appear to show that woody fibre is present in it in various stages of alteration.

Besides oxygenated hydrocarbons, there may also be present *simple hydrocarbons* (that is, containing no oxygen). This would seem to follow from the small percentage of oxygen (2—3 p. c.) in the Tyneside cannel, while the hydrogen is as large in amount as in any cannel or bituminous coals. And there are various bituminous coals, low in oxygen, that suggest the same conclusion. At present, however, chemistry knows of no simple hydrocarbons that are insoluble in naphtha and benzole.

The presence of *free carbon* is naturally inferred from the composition of coals like the anthracites, which afford very little volatile matter. But even these coals contain ordinarily 1·5 to 2·5 p. c. of each oxygen and hydrogen; and Berthelot holds that they are hydrocarbon compounds like other coals. It is remarkable that in one of the analyses of anthracite from Piesberg, Hanover (anal. 4), no oxygen whatever was found, while there were 2·23 p. c. of hydrogen.

The portion of coal soluble in naphtha or benzole, although small in amount, indicates the presence of other hydrocarbons—simple or oxygenated—oils or resins. Their nature remains to be ascertained. Fyfe obtained by means of naphtha, from the Torbane mineral, 1·2 and 1·4 p. c.; from cannel coal, 2—4 p. c.; and from Newcastle caking, in three experiments, 4·2, 5·8, 9·8 p. c. of soluble material. These results do not accord with the ordinary statements with regard to the insolubility of coal, and the subject needs far more extended study.

Under microscopic examination, when in thin slices, many bituminous coals (including most cannel coals, the gas coals of Nova Scotia, Pelton, etc.) are seen to consist of *three kinds* of material, as first observed by Hutton (Geol. Soc. London, 1832–33), and further more particularly by Dr. Aitken of Glasgow (Ronalds & Richardson, Chem. Techn., i. 778).

(1) An opaque black substance, which is insoluble in acids as well as other menstrua, and, as suggested, may be free carbon (?). It is stated to be the main constituent of anthracite.

(2) A yellow or reddish resin-like substance, which is translucent or transparent, volatile by heat, and insoluble in naphtha, muriatic and nitric acids.

(3) Earthy matter, which is more or less soluble in water, and is earthy impurity.

The resin like material, No. 2, may well be a species of the Succinite group (see above). In many pitchy bituminous coals it is impossible to make out the structure here described on account of their opacity. Some Nova Scotia coal contains yellow matter, which is soluble in ether, and slightly so in turpentine and nitric acid; and the same is true of that of the Pelton coal. Many *brown* coals, as the Bovey, show the structure above described.

Coals often contain *resins* disseminated in *visible* points through the mass, which may or may not be of soluble kinds.

Sulphur is present in nearly all coals. It is supposed to be usually combined with iron, and when the coal affords a *red ash* on burning, there is reason for believing this true. But Percy mentions a coal from New Zealand (anal. 18) which gave a peculiarly white ash, although containing 2 to 3 p. c. of sulphur, a fact showing that it is present not as a sulphid of iron, but as a constituent of an organic compound. The discovery by Church of a resin containing sulphur (see TASMANITE, p. 746), gives reason for inferring that it may exist in this coal in that state, although its presence as a constituent of other organic compounds is quite possible.

The presence of *nitrogen*, sometimes 2 p. c., proves the presence of nitrogenous hydrocarbons; but of what nature is unknown.

The above review of the composition of coal shows that as yet very little is known as to its actual constituents; and that no analyses to determine them can be satisfactory which are not carried forward by the aid of the microscope, and by the preparatory separation of the coal into parts, as far as possible, by different menstrua, and the separate analyses of these parts.

The impurities present, which constitute the *ash* of the coal, consist of silica or quartz, oxyd of iron, clay, and other aluminous silicates, or such ingredients as make up the mud and clay of fine soil or alluvium; also some silica, potash, and soda, derived from the original vegetation. The ash in the purest mineral coal amounts to but 0·25 to 1 p. c.; but in that which passes for the best there are ordinarily 5 to 8 p. c.; and in most that is used for fuel there are 8 to 15 p. c.

Analyses: *Anthracite.* 1, Regnault (Ann. d. M., III. xii.); 2–4, Hilkenkamp & Kempner (Steink. Deutschl., ii. 284, 1865); 5, Regnault (l. c.); 6, 7, J. Percy (Proc. G. Soc., i. 202, Metal'gy, 105, 1861).

Caking coal. 8–10, Stein (Steink. Sachs., 1857); 11, Regnault (l. c.); 12, 13, Dick (Percy's Met., 99); 14, C. Tookey (ib.); 15–17, Noad (ib.): 18, C. Tookey (ib.); 19–21, Regnault (l. c.); 22, 23, Marsilly (C. R., xlvi. 891).

Non-caking. 24, Regnault (l. c.); 25, Nendtvich (Ber. Ak. Wien, 1851); 26, 27, A. Dick (Percy's Met., 102); 28, 29, Rowney (Edinb. N. Phil. J., ii. 141, 1855); 30, Stein (l. c.); 31–34 Marsilly (l. c.); 35, E. Riley (Percy's Met., 102).

Whether caking or not, not stated. 36-39, Fleck (Steink. Deutschl., ii. 272, 1865).

Cannel coal. 40, Regnault (l. c.); 41, Vaux (J. Ch. Soc., i. 320); 42, Taylor (Edinb. N. Phil. J., l. 145, 1851).

Torbanite. 43, Anderson (Greg & Lettsom, Min., 17); 44, Hofmann (ib.); 45, Stenhouse (ib.); 46, Fife (ib.); *47, Metter (J. pr. Ch., lxxvii. 38).

Brown coal. 48–51, Regnault (l. c.); 52, F. Vaux (J. Ch. Soc., v. 1, 318, 1849); 53, Nendtvich (l. c.); 54, Gräger (Jahresb. 1848, 261); 55, Schrötter (Jahresb. 1849, 708); 56, Baer (Jahresb. 1852, 733); 57, F. Bischof (B. H. Ztg. 1850, 69); 58, Wagner (Polyt. Centralbl. 1847, 1496); 59 F. Bischof (l. c.); 60, Liebig (Kenngott, 1852, 257); 61, Woskressensky (ib.).

Mineral charcoal. 62–65, Dr. Rowney (l. c.).

Anthracite.

						P. c., ash excluded.			
	C	H	O	N	Ash	C	H	O	
1. S. Wales, *Anthr.*	92·56	3·33	2·53	—	1·58	94·05	3·38	2·57	Regnault.
2. Piesberg, Hanover	90·40	1·90	1·73		6·04	96·14	2·02	1·84^{n}	H. & K.

	C	H	O	N	S	Ash	C	H	O	N	Coke	
3. Piesberg, Hanover	87·96	1·97	0·61		—	9·31	97·15	2·17	0·65^{n}	—	—	H. & K.
4. " "	91·14	2·08	—		—	6·81	97·77	2·23	—	—	—	H. & K.
5. Pennsylvania	90·45	2·43	2·45	—	—	4·67	94·89	2·55	2·56	—	—	Rt.
6. "	92·59	2·63	1·61	0·92	—	2·25	94·72	2·69	2·38^{n}	—	—	P.
7. "	84·98	2·45	1·15	1·22	—	10·20	94·64	2·73	2·64	—	—	P.
Caking Coals.												
8. Zwickau	76·59	4·12	12·87	0·33	0·81	6·00	81·47	4·38	13·71	0·35	54·64	St.
9. "	72·27	4·16	10·73	0·34	0·88	12·50	82·59	4·76	12·26	0·39	77·29	St.
10. Planitz	81·23	4·43	9·86	0·21	0·55	4·25	84·84	4·63	10·74	0·23	63·89	St.
11. Epinac	81·12	5·10	11·25	—	—	2·53	83·22	5·23	11·55	—	63·6	Rt.
12. Northumberland	78·65	4·65	14·21	—	0·55	2·49	80·54	4·76	14·70^{n}	—	—	Dk.
13. "	82·42	4·82	11·97	—	0·86	0·79	83·73	4·90	11·37^{n}	—	—	Dk.
14. "	78·69	6·00	10·07	2·37	1·51	1·36	81·01	6·17	10·38	2·44	—	T.
15. Blaina, S. W.	82·56	5·36	8·22	1·65	0·75	1·46	84·42	5·48	8·40	1·70	—	Nd.
16. "	83·44	5·71	5·93	1·66	0·81	2·45	86·25	5·90	6·13	1·72	—	Nd.
17. "	83·00	6·18	4·58	1·49	0·75	4·00	87·14	6·49	4·81	1·56	—	Nd.
18. N. Zealand	79·00	5·35	7·71	0·89	2·50	8·50	84·90	5·75	8·29	0·96	64·32	T.
19. Rive-de-Gier	82·04	5·27	9·12	—	—	3·57	85·08	5·46	9·46^{n}	—	72·0	Rt.
20. "	87·45	5·14	3·93	1·70	—	1·78	89·04	5·23	5·73^{n}	—	68·0	Rt.
21. Alais	89·27	4·85	4·47	—	—	1·41	90·55	4·92	4·53^{n}	—	78·0	Rt.
22. Valenciennes	84·84	5·53	6·83	—	—	2·80	87·28	5·69	7·03^{n}	—	67·75	M.
23. Pas-de-Calais	86·78	4·98	5·84	—	—	2·40	88·91	5·10	5·99^{n}	—	77·05	M.
Non-Caking Coals.												
24. Bianzy, France	76·48	5·23	16·01	—	—	2·28	78·26	5·35	16·39^{n}	—	57·0	R.
25. Hungary	—	—	—	—	0·74	1·55	78·37	3·92	17·70^{n}	—	70·60	Nh.
26. S. Staffordshire	76·40	4·62	17·43^{n}	—	0·55	1·55	77·68	4·69	17·62^{n}	—	—	Dk.
27. "	72·18	4·32	17·11^{n}	—	0·54	6·44	77·32	4·67	17·99	—	—	Dk.
28. Scotland	76·08	5·31	13·33	2·09	1·23	1·96	78·59	5·49	13·77	2·15	—	Ry.
29. "	80·93	5·21	10·91	1·57	0·63	6·75	82·06	5·29	11·06	1·59	—	Ry.
30. Zwickau	80·25	4·01	10·98	0·49	2·99	1·57	83·82	4·19	11·47	0·51	69·59	St.
31. Mons, France	82·95	5·42	10·93	—	—	0·70	83·53	5·46	11·01	—	63·58	M.
32. " "	82·91	5·22	10·13	—	—	1·74	84·38	5·31	10·31	—	66·96	M.
33. Pas-de-Calais	82·68	4·18	4·54	—	—	8·60	90·46	4·57	4·97	—	87·62	M.
34. Valenciennes	90·54	3·66	2·70	—	—	3·10	93·44	3·78	2·78	—	93·17	M.
35. Dowlais, S. Wales	89·33	4·43	3·25	1·24	0·55	1·20	90·93	4·51	3·30	1·26	—	R.
36. Zwickau	80·47	5·54	12·55		—	1·44	81·65	5·62	12·73^{n}	—	—	Fk.
37. "	75·59	2·90	14·44		—	7·06	81·34	3·18	15·48	—	—	Fk.
38. Lugau	76·75	4·85	13·48		—	4·92	80·72	5·10	14·72	—	—	Fk.
39. Littitz, Bohemia	75·69	4·89	16·33		—	3·08	78·09	5·05	16·86	—	—	Fk.
Cannel Coal.												
40. Wigan	84·07	5·71	7·82	—	—	2·40	85·81	5·85	8·34	—	59·0	Rt.
41. "	80·07	5·53	8·10	2·12	1·50	2·70	82·29	5·68	8·31	—	—	Vx.
42. Tyneside	78·06	5·80	3·12	1·85	2·22	8·94	87·86	6·53	2·53	2·09	—	Tr.
Torbanite.												
43. Torbane Hill	64·02	8·90	5·66	0·55	0·50	20·32	80·39	11·17	7·12	1·32	—	And
44. " "	65·66	8·90	6·34		—	19·10	81·17	11·01	7·82		—	Hn.
45. " "	65·5	9·0	6·0		—	19·5	81·35	11·18	7·45		—	St.
46. " "	60·25	8·80	3·60	1·50	0·13	25·6	81·12	11·85	4·84	2·19	—	Fife.
47. " "							80·56	12·17	5·82	1·45	—	M.
Brown Coal.												
48. Dax, France	70·49	5·59	18·93		—	4·99	74·19	5·88	20·13^{n}	—	49·1	Rt
49. Bouches-du-Rhone	63·88	4·58	18·11		—	13·43	73·79	5·29	20·92^{n}	—	41·1	Rt.

	C	H	O	N	S	Ash	C	H	O	Coke	
50 Hesse Cassel	71·71	4·85	21·67		—	1·77	73·00	4·93	22·07^n	48·5	Regnault
51. Basses Alpes	70·02	5·20	21·77		—	3·01	72·19	5·36	22·45^n	49·5	Regnault
52. Bovey	66·31	5·63	22·86	0·57	2·36	2·27	67·85	5·75	23·39	30·79	Vaux.
53. Oedenburg, Hung.	—	—	—	—	0·91	2·39	70·84	4·71	24·44^n	—	Nendtv.
54. Meissen, Sax.	58·90	5·36	21·63	—	6·61	7·50	68·58	6·24	25·18^n	—	Gräger.
55. Gloggnitz, Austr.	57·71	4·49	22·14	—	3·12	12·54	68·42	5·33	26·25^n	—	Schrötter.
56. Wittenberg	64·07	5·03	27·55	—	—	3·35	66·29	5·20	28·51^n	—	Baer.
57. Tenditz, Prussia	54·02	5·28	27·90	—	—	12·80	61·95	6·06	31·99^n	—	Bischof.
58. “ “	49·91	5·20	32·42	—	—	12·47	57·02	5·94	37·04^n	—	Wagner
59. Löderburg, “	55·30	4·90	31·95	—	—	7·85	60·01	5·31	34·68	—	Bischof.
60. Laubach, H. Darmst.	57·28	6·03	36·10	—	—	0·59	57·62	6·07	36·31	—	Liebig.
61. Irkutsk	47·46	4·56	33·02	—	—	14·95	55·81	5·36	38·83	—	Woskr.

Mineral Charcoal.

	C	H	O	N	S	Ash	C	H	O	Coke	
62. Glasgow, *fibrous*	82·97	3·34	6·84	0·75	—	6·08	88·36	3·56	7·28, N 0·80		Rowney
63. Stonelaws, *granular*	72·74	2·34	5·83		—	19·08	89·89	2·89	7·21^n		Rowney.
64. Ayrshire, *fibrous*	73·42	2·94	8·25		—	15·39	86·78	3·47	9·75^n		Rowney.
65. Fifeshire, “	74·71	2·74	7·67		—	14·86	87·78	3·21	9·01^n		Rowney.

Specific gravity of No. 8, 1·298; No. 9, 1·275; No. 10, 1·280; No. 19, 1·288; No. 20, 1·298; No. 21, 1·322; No. 24, 1·362; No. 25, 1·366; No. 30, 1·300; No. 40, 1·317; No. 41, 1·276; No. 42, 1·316; No. 52, 1·129; No. 53, 1·280; No. 55, 1·364; No. 57, 1·263; No. 59, 1·219.

The brown coals contain a large percentage of water; No. 52 gave 34·66 p. c.; No. 53, 18·60; No. 55, 25·15; No. 56, 17·26; No. 57, 48·60; No. 59, 49·50.

Much the larger part of the above analyses are cited from Percy's excellent chapter on coal in his Metallurgy (1861). The index ^{n} signifies that the nitrogen is included with the oxygen.

Professor W. R. Johnson obtained the following results in his examinations of some American coals (Rep. on Coals to Congress, 1844):

	G.	Vol. Combust. Matter.	Fixed Carbon.	Ash and Clinkers.
1. Pennsylvania, *Anthracite*	1·590--1·610	3·84	87·45	7·37
2. Maryland *free-burning bitum. coal*	1·3 —1·414	15·80	73·01	9·74
3. Pennsylvania “ “	1·3 —1·407	17·01	68·82	13·35
4. Virginia “ “	1·29 —1·45	36·63	50·99	10·74
5. Pittsburg, *bitum.*	1·252	36·76	54·93	7·01
6. Cannelton, Ind., “	1·273	33·99	58·44	4·97
7. Pictou, Nova Scotia	1·318	27·83	56·98	13·39
8. “ “	1·325	25·97	60·74	12·51

Coal occurs in beds, interstratified with shales, sandstones, and conglomerates, and sometimes limestones, forming distinct layers, which vary from a fraction of an inch to 30 feet or more in thickness. In the United States, the anthracites occur east of the Allegbany range, in rocks that have undergone great contortions and fracturings, while the bituminous are found farther west, in rocks that have been less disturbed; and this fact and other observations have led some geologists to the view that the anthracites have lost their bitumen by the action of heat. For observations on the geological relations of coal beds, reference may be made to geological treatises.

The *origin* of coal is mainly vegetable, though animal life has contributed somewhat to the result. The beds were once beds of vegetation, analogous, in most respects, in mode of formation to the peat beds of modern times, yet in mode of burial often of a very different character. This vegetable origin is proved not only by the occurrence of the leaves, stems, and logs of plants in the coal, but also by the presence throughout its texture, in many cases, of the forms of the original fibres; also by the direct observation that peat is a transition state between unaltered vegetable debris and brown coal, being sometimes found passing completely into true brown coal. *Peat* differs from true coal in want of homogeneity, it visibly containing vegetable fibres only partially altered; and wherever changed to a fine-textured homogeneous material, even though hardly consolidated, it may be true brown coal.

The derivation of coal from woody fibre has been explained in a general way on page 754. From the statements there made it is obvious that the vegetable material, in changing to ordinary mineral coal, has not passed necessarily through the stage of brown coal. When the material was long steeped in water, and buried under fine mud so as to exclude almost entirely atmospheric air, the decomposition in progress may have carried off most of the oxygen by its combination with the carbon of the plants, to form carbonic acid. Thus it happened probably with the cannel coals, as explained by Newberry, and also, though in general less perfectly, with most of the best bituminous coals. But when the bed had as free access to the air as occurs in the case of peat beds, there would have been a loss of carbon and hydrogen as marsh-gas, and also, probably, through combination with external oxygen, forming carbonic acid and water, while a large part of the oxygen would remain. Between these extremes, of excluded air and very imperfectly excluded, and of pressure from heavy superincumbent earthy beds and little or no pressure, lie the conditions which attended the origin of the various kinds of coal, and determined, in connection with the nature of the vegetation itself, the transformations in progress.

Extensive beds of mineral coal occur in Great Britain, covering about $\frac{1}{10}$ the whole area, or 11,859 square miles; in France about $\frac{1}{120}$, or 1719 sq. m.; in Spain about $\frac{1}{60}$, or 3408 sq. m.; in Belgium $\frac{1}{22}$, or 518 sq. m.; in Netherlands, Prussia, Bavaria, Austria, northern Italy, Silesia, Spain, Russia on the south near the Azof, and also in the Altai. It is found in Asia, abundantly in China, in Persia in the Cabul territory, and in the Khorassan or northern Persia, in Hindostan, north of the Gulf of Cutch, in the province of Bengal (the Burdwan coal field) and Upper Assam, in Borneo, Labuan, Sumatra, several of the Philippines, Formosa, Japan, New South Wales and other parts of Australia, New Zealand, Kerguelen's Land; in America, besides the United States, in Chili, at the Straits of Magellan, northwest America on Vancouver's Island near the harbor of Camosack, at Bellingham Bay in Puget's Sound, at Melville Island in the Arctic seas, and in the British Provinces of Nova Scotia, New Brunswick, and Newfoundland.

In the United States there are four separate coal areas. One of these areas, the Appalachian coal field, commences on the north, in Pennsylvania and southeastern Ohio, and sweeping south over western Virginia and eastern Kentucky and Tennessee to the west of the Appalachians, or partly involved in their ridges, it continues to Alabama near Tuscaloosa, where a bed of coal has been opened. It has been estimated to cover 60,000 sq. m. It embraces several isolated patches in the eastern half of Pennsylvania. The whole surface in Pennsylvania has been estimated at 15,437 sq. m., or $\frac{1}{3}$ the whole area of the State. A second coal area (the Illinois) lies adjoining the Mississippi, and covers the larger part of Illinois, though much broken into patches, and a small northwest part of Kentucky; it is continued westward over a portion of Iowa, Missouri, Kansas, Arkansas, and northern Texas west of the Mississippi. The latter area is divided along the Mississippi by a narrow belt of Silurian rock; the whole area is about the same with that of the Appalachian coal field. A third covers the central portion of Michigan, not far from 5000 sq. m. in area. Besides these, there is a smaller coal region (a fourth) in Rhode Island, which crops out across the north end of the island of Rhode Island, and appears to the northward as far as Mansfield, Massachusetts. The total area of coal measures in the United States is about 125,000 sq. m.

Out of the borders of the United States, on the northeast, commences a fifth coal area, that of Nova Scotia and New Brunswick, which covers, in connection with that of Newfoundland, 18,000 sq. m., or $\frac{1}{5}$ the whole area of these provinces.

The mines of western Pennsylvania commencing with those of the Blossburg basin, Tioga Co., those of the States west, and those of Cumberland or Frostburg, Maryland, Richmond or Chesterfield, Va., and other mines south, are *bituminous*. Those of eastern Pennsylvania constituting several detached areas—one, the *Schuylkill* coal field, on the south, worked principally at Mauch Chunk on the Lehigh, and at Pottsville on the Schuylkill—another, the *Wyoming* coal field, worked at Carbondale, in the Lackawanna region, and near Wyoming, besides others intermediate—those of Rhode Island and Massachusetts, and some patches in Virginia, are *anthracites*. Cannel coal is found near Greensburg, Beaver Co., Pa., in Kenawha Co., Va., at Peytona, etc.; also in Kentucky, Ohio, Illinois, Missouri, and Indiana; but part of the so-called cannel is a coaly shale.

In England, the principal coal fields are the Manchester of Lancashire and Cheshire; the Great Central of South Yorkshire, Nottingham, and Derby; that of South Wales, Glamorganshire, etc.; the Newcastle field of northern England. In Scotland, a range of beds extends across from the Firth of Forth to the Firth of Clyde; whole area 1650 sq. m. In Ireland, the three are the Limerick fields about the mouth of the Shannon, the Kilkenny fields to the eastward, and that of Ulster on the north. Cannel coal occurs in Great Britain at Lesmahago in Lanarkshire, about 20 m. from Glasgow; also near Wigan in Lancashire, and West Wemyss in Fyfe.

Mineral coal occurs in France, in small basins, 88 in number, and covering in all, according to Taylor, $\frac{1}{117}$ of the whole surface. The most important are the basin of the Loire, between the Loire and the Rhone, and that of Valenciennes on the north, adjoining Belgium. In Belgium, it occupies a western and eastern division, the western in the provinces of Namur and Hainault, and the eastern extending over Liege.

Brown coal comes from coal beds more recent than those of the Carboniferous age. But much of this more recent coal is not distinguishable from other bituminous coals. The coal of Richmond, Virginia, is supposed to be of the Liassic or Triassic era; the coal of Brora, in Sutherland, and of Bovey, Yorkshire, is Oolitic in age. Tertiary coal occurs on the Cowlitz, in Oregon (anal. 14), and in many places over the eastern slopes of the Rocky Mountains, where a "Lignitic formation" is very widely distributed; but it is rarely in beds of economical importance.

The coal known to the Greeks and Romans was probably brown coal. The first sentence, in the synonymy, from Aristotle evidently alludes to mineral coal of some kind; and the first of the two cited from Theophrastus (a favorite pupil of Aristotle) refers to a similar substance, and perhaps the same specimens. The locality of the latter, Liguria (or northwestern Italy along the Mediterranean), where, he adds, there also is amber, may be taken with some freedom, as articles brought by vessels trading with Ligurian ports, even though coming from French ports beyond, might be referred to Liguria. Elis, on the way to Olympias, is given as another locality. The sentence ends with the statement that "these coals are used by the smiths," showing that the value of the substance as fuel was well understood at the time (4th century B.C.). Theophrastus says further, that it will continue to burn as long as any one blows it, but on stopping it deadens, but may be made to burn again; and that it burns with a strong disagreeable odor. The second citation from each, Aristotle and Theophrastus, relates to a similar coal. The locality, in Thrace, identifies it with the *Thracian stone* of Dioscorides and Pliny, the locality of which, according to the former (from Aristotle), was at Sintia, on the river Pontus (on the Macedonian border of Thracia, to the west of the present Constantinop'e). According to Dioscorides and Pliny (quoting further in part from Aristotle's "Wonderful Things heard of"), water would make the Thracian stone to burn, and oil extinguish it; which is either altogether a fable, or a partial truth based on somebody's observation that masses or piles of impure pyritiferous coal will become hot, and sometimes ignited, in consequence of being wet. Aristotle mentions its bituminous odor when burning.

The *Gagates* (whence our word *jet*) occurred, according to Dioscorides and Pliny, at Gagas or Gages, a place in Lycia (Asia Minor). The former describes it as black, smooth, and combustible, to which Pliny adds, that it was light, and looked much like wood, and that it emitted a disagreeable odor when rubbed, and burned with the smell of sulphur. It was, in part at least, true lignite. Lignite is common in Syria, in the rocks of Mt. Lebanon, as near Beirut; and beds of coal have been recently opened in Asia Minor.

Some of the works or memoirs on coal economically considered are the following: Report to Congress on Coals, by W. R. Johnson, 1844; Statistics of Coal, by R. C. Taylor, 8vo, 2d. ed., Philadelphia, 1855; Report to the British Government on Coals, by De la Beche & Playfair, 1851; Ronalds & Richardson's Chemical Technology, Vol. I. on Fuel and its Applications, London, 1855; Percy's Metallurgy, London, 1861; Chem. Unters. d. Steinkohlen Sachsen's, by W. Stein, Leipzig, 1857; Die Steinkohlen Deutschland's und anderer Länder Europa's, etc., by Geinitz, Fleck & Hartig, 3 vols., 4to, München, 1865.

SPECIES OF UNCERTAIN PLACE IN THE SYSTEM.

832. AZORITE. New mineral from the Azores *J. E. Teschemacher*, Am. J. Sci., II. iii. 32, 1847
Azorite *Dana*, this Min., 396, 681, 1850.

Tetragonal. In minute octahedrons, with the basal edges replaced; angle of pyramid (by reflective goniometer) 123° 15′, $M \wedge e = 133° 40′$. Cleavage none.

H.=4—4·5. Translucent to opaque. White, with a faint greenish-yellow tinge, or colorless. Vitreous in fracture.

Comp.—According to A. A. Hayes, columbate of lime. B.B. infusible; smaller crystals become opaque white; larger in outer flame reddish, and light yellow in inner. With borax, on platinum wire, dissolves with extreme slowness and difficulty to a transparent globule, sometimes faint greenish; with more borax opaque on flaming. With salt of phosphorus slowly dissolved, producing a faint green color.

Obs.—From the Azores, in an albitic rock, along with black tourmaline and pyrrhite. First distinguished and described by J. E. Teschemacher. The largest crystal seen was but 1½ lines in diameter. There is some resemblance in form to cryptolite (p. 529), but a re-examination of the species by Mr. Hayes corroborates his first announcement that the mineral contains neither cerium nor phosphoric acid.

The angle 123° 15′ is near that of zircon, and it is possible that it is that species. But Teschemacher says of its hardness, that "it just scratches fluor spar."

833. BREWSTERLINITE. A new fluid in the cavities of minerals *D. Brewster*, Ed. Phil. J., ix. 1823; Trans. R. Soc. Edinb., x. 1, 407, 1826; Am. J. Sci., vii. 186, 1824, xii. 214 (with a plate), 1827; Phil. Mag., IV. xxv. 174, 1863. Brewsterline *Dana*, Min., 559, 1850; Brewstoline, ib., 471, 1854.

In a vacuum (or as it occurs in the cavities of crystals) a colorless transparent fluid, adhering but slightly to the enclosing mineral, and hence very voluble; expanding about one-fourth with an increase of 16⅔° C. (30° F.), or between 10° and 27° C. (50° and 80° F.), 21 times more expansible than water; index of refraction 1·2106, for the fluid from an amethyst from Siberia; 1·1311 for a kind from a topaz; boiling point in a vacuum from 23° to 29° C. (74° to 84° F.), the fluid filling the cavities with the warmth of the hand or mouth.

On exposure to the air undergoes rapid movements, spreading over the surface and contracting again, and then dries to separate particles or grains, which are lustrous and appear to be opaque, but are transparent by transmitted light; by the approach of moisture, even the moisture of the hand, even after being dry for some days, becomes liquid again, and renews its rapid movements. Soluble without effervescence in sulphuric, nitric, and muriatic acids. Volatilized by heat.

Comp.—Unknown. The effect of moisture on the dry grains shows that the substance is not one of the hydrocarbon oils, or a resin.

Obs.—Occurs in cavities of topaz crystals from Brazil, Scotland and Australia, of chrysoberyl, of quartz crystals from Quebec, amethyst from Siberia, and first described by Sir David Brewster.

The cavities are mostly microscopic, but occasionally ½ in. across, or even larger. They are generally arranged in layers, and are sometimes counted by thousands in a single crystal. Brewster counted 30,000 in a chrysoberyl ¼ in. square. The strata run irregularly with reference to the symmetry of the crystal, often intersect one another, and are sometimes curved; it is rare that 3 or 4 strata are parallel. The very low refracting power, less than that of water, is a remarkable character of the fluid (the refraction index of water being 1·336; of alcohol 1·361; of ether 1·358). The fluid from a quartz crystal from Quebec, which exploded with much force when heated, had a disagreeable taste.

In his original memoir Brewster states that the fluid was 32 times more expansible than water, but in the later reference to it in 1863 (Phil. Mag., l. c.) makes it 21 times.

The lower index of refraction, 1·1311, obtained for the fluid of a topaz, is so much below the other, 1·2106, that it may indicate a distinct species.

834. CRYPTOLINITE. A new fluid, etc., *Brewster* (see for ref., BREWSTERLINITE). Cryptoline *Dana*, Min., 559, 1850.

A colorless transparent fluid, as observed in the cavities of crystals, like brewsterlinite, but more dense; adhering like water to the enclosing surfaces; expansibility about that of water; index of refraction 1·2946. Not soluble in, or a solvent of, brewsterlinite, the two, when occurring together, not being miscible.

On exposure to the air hardens speedily to a resin-like substance; brilliant in lustre; yellowish; transparent; absorbent of moisture, but much less so than brewsterlinite; insoluble in water and alcohol; rapidly dissolved with effervescence by sulphuric acid, and soluble also in nitric and muriatic acids; not volatilized by heat.

Comp.—Nothing is known.

Obs.—Occurs in the same crystals, and generally the same cavities, with brewsterlinite. The denser of the two fluids, according to Brewster, occupies the angles of the cavities, or the necks or narrow passages which unite two or more large cavities, while the other rarer fluid floats on it and fills the rest of the cavity, excepting a circular vacuity, occupied only by this fluid in the gaseous state, if at all.

835. HESSENBERGITE. Hessenbergit *Kenng.*, Ber. Ak. München, 1863, ii. 230. Siderox *Hessenb.*, Min. Not., No. 7, 1866.

Monoclinic. $C=89° 53'=O \wedge i\text{-}i$; $I \wedge I=59° 27'$, $O \wedge \frac{1}{2}\text{-}\grave{i}=152° 20\frac{1}{2}'$; $a : b : c=0·59843 : 1 : 0·570967$. Observed planes: O; vertical, I, $i\text{-}i$, $i\text{-}\grave{i}$, $i\text{-}3$, $i\text{-}9$; clinodome, $\frac{1}{2}\text{-}\grave{i}$; hemidomes, $1\text{-}i$, $\frac{5}{4}\text{-}i$, $3\text{-}i$, $-1\text{-}i$; hemioctahedral, $\frac{3}{5}\text{-}3$.

$O \wedge I=90° 3\frac{1}{2}'$	$i\text{-}3 \wedge i\text{-}3=119° 27'$	$i\text{-}i \wedge \frac{5}{4}\text{-}i$, calc., $=126° 43'$
$O \wedge i\text{-}3=90\ \ 6$	$i\text{-}i \wedge 3\text{-}i=150\ \ 51$	$i\text{-}i \wedge \frac{5}{4}\text{-}i$, obs., $=127\ \ 35$
$O \wedge 1\text{-}i=149$	$O \wedge -1\text{-}i=149\ \ 8$	$I \wedge i\text{-}\grave{i}=150\ \ 16\frac{1}{2}$

Simple crystals unknown. Twins: composition-face $-1\text{-}i$; $I \wedge I_{,}=150° 39\frac{1}{2}'$, $i\text{-}i \wedge i\text{-}i_{,}=118° 2'$, $O \wedge O_{,}=61° 44'$.

H.=7–7·5. Lustre adamantine. Colorless, bluish. Transparent.

Comp.—A silicate of undetermined constituents.

Pyr., etc.—In a closed tube yields no water, and is unchanged. In the platinum forceps whitens, but does not fuse. In borax melts without intumescence. Heated with cobalt solution becomes gray. No action from muriatic acid.

Obs.—Occurs implanted on crystals of hematite (*Eisenrose*) at Mt. Fibia, west of the Hospice of St. Gothard. The habit a little after that of euclase.

Named after F. Hessenberg, the crystallographer, of Frankfort on the Main.

836. PARATHORITE. Thorite *Shep.*, Proc. Am. Assoc., ii. 321, 1850. Parathorite *Shep.*, Min., 287, 1857; *Dana*, *Brush*, Am. J. Sci., xxiv. 124, 1857.

Orthorhombic. In minute rectangular and rhombic prisms, with the planes *I*, *i-ī*, *i-ĭ*; $I \wedge I = 128°$, $I \wedge i\text{-}\breve{i} = 116°$.

H.=5—5·5. Lustre subresinous. Color garnet-red to pitch-black; thin edges of black crystals with a ruby translucence, a little like rutile. Translucent to opaque.

Comp., Pyr., etc.—In the matrass decrepitates slightly, but does not appear to contain water. B.B. in the platinum forceps glows, fuses with difficulty on the edges, and becomes paler. In borax dissolves to a bead, which is yellow, from iron, while hot, and becomes colorless on cooling. With salt of phosphorus gives in the outer flame a bead, yellow while hot and colorless on cooling. In the inner flame the bead assumes a delicate violet color (due to titanic acid?), Brush.

Obs.—Occurs imbedded in danburite and orthoclase, and only in very minute crystals, at Danbury, Ct.

Shepard made the crystallization erroneously tetragonal. There are also other discrepancies in his description, which might lead to the supposition that the mineral here described is a different mineral from Shepard's; but the evidence to the contrary is complete.

837. PYRRHITE. *G. Rose*, Pogg., xlviii. 562. 1840.

Isometric; in octahedrons. Cleavage not observed.

H.=6. Lustre vitreous. Color orange-yellow. Subtranslucent.

Pyr., etc.—B.B. infusible, but blackens, and colors the flame deep yellow. In fragments difficultly soluble in salt of phosphorus, but in fine powder it is readily taken up by this salt, as well as by borax, forming a clear glass when cold if only a small portion is used, while if saturated it is yellowish-green, becoming somewhat more intense in R.F. Fused with soda on charcoal, it spreads out and is absorbed by the coal, giving a slight white coating, somewhat resembling oxyd of zinc; it yields no metallic spangles when the surface of the coal is removed and rubbed in the mortar. Insoluble in muriatic acid (G. Rose).

Obs.—Pyrrhite was found by von Perovski of St. Petersburg at Alabaschka, near Mursinsk in the Ural, where it occurs in drusy feldspar cavities, containing also lepidolite, albite, and topaz. The largest crystal was but three lines long.

Named from πυῤῥός, *yellowish-red* or *fire-like*.

With this species J. E. Teschemacher identifies small orange-red, monometric octahedrons, found with albite at the Azores (J. Nat. H. Bost., iv. 499, 1844; Proc. id., ii. 108, 1846). along with tetragonal octahedrons of *azorite* (p. 761). The crystals are a half to two lines long, and those of minute size are transparent.

According to chemical and blowpipe trials by A. A. Hayes (Am. J. Sci., II. ix. 423) on specimens furnished him by Mr. Teschemacher, these crystals consist of columbate of zirconia, colored apparently by oxyds of iron, uranium, and manganese.

B.B. in the forceps, on the first impulse of the heat, becomes darker, and the fine orange color returns on cooling, even if the heat has been high; at the melting point of cast iron, in the reduction flame, the flame becomes permanently darker and brown. With borax (6 parts to 1 of assay) it dissolves, and affords a clear colorless glass, which becomes instantly opaline or opaque on flaming; transferred to the oxydating flame becomes opaque. With salt of phosphorus (in the same proportion) in the inner flame gives a clear glass, and when reduced the glass is green; but in the outer becomes yellow. With a little more of assay the glass remains clear. With soda (12 parts to 1 of assay) dissolves; some clear portions are seen in the globule while hot, but on cooling opacity precedes the crystallization of the globule; finally a gray-brown slag remains, which, cooled from the outer flame, has a green color, indicating oxyd of manganese. Decomposed by much soda, and the resulting mass, heated with nitric acid, gives a heavy, white, insoluble powder, which with boiling water takes a white flocculent form; the powder exhibited all the characters of columbic acid (?). The acid solution, when mixed with carbonate of ammonia, remains clear; heated, some oxyd of iron falls, and the fluid is light yellow; with oxalic acid, a white earth separates, which, heated with sulphuric acid to destroy the oxalic acid, dissolves, and the fluid forms with potash, before complete neutralization, a white double salt, which has the characters of that from zirconia, but may also contain oxyd of cerium. The oxalate, when first formed, did not afford, when heated, the cinnamon-brown color characteristic of deutoxyd of cerium. The extremely small amount of the mineral under examination forbids the expression of certainty respecting the base. Although inclining to the opinion of the existence of cerium in the mineral, from the red color of the crystals, Mr. Hayes observes that he obtained no positive proof on this point.

834. ALURGITE. Alurgit *Breith.*, B. H. Ztg., xxiv. 336.

Massive, consisting of scales, rarely having an hexagonal outline. Cleavage: basal eminent, as in mica.

H.=2·25—3. G.=2·984—3. Lustre pearly to vitreous. Color purple to cochineal-red; in thinnest plates rose-red; streak rose-red. Transparent to translucent. Optically uniaxial.

Contains much manganese.

Occurs with manganese ores at St. Marcel in Piedmont.

Named from *ἁλουργός*, *purple*.

CATALOGUE OF AMERICAN LOCALITIES OF MINERALS.

The following catalogue may aid the mineralogical tourist in selecting his routes and arranging the plan of his journeys. Only important localities, affording cabinet specimens, are in general included; and the *names of those minerals which are obtainable in good specimens are distinguished by italics.* When a name is not italicized the mineral occurs only sparingly or of poor quality. When the specimens to be procured are remarkably good, an exclamation mark (!) is added, or two of these marks (! !) when the specimens are quite unique. The more exact position of localities may in most instances be ascertained by reference to the descriptions of the species in the preceding part of the Treatise.

For the facts included the country is especially indebted to the various Geological Reports of the several States, the American Journal of Science, and the Journals or Transactions of the different Scientific Societies or Academies. The author is under special obligations, in the preparation of the Catalogue for this edition of the Mineralogy, to W. W. JEFFERIS, Esq., of Westchester, Pa., Prof. C. U. SHEPARD, Prof. A. E. VERRILL, Dr. J. S. NEWBERRY, Prof. WM. P. BLAKE, Prof. WM. H. BREWER, Dr. F. A. GENTH, Prof. B. SILLIMAN, Prof. O. C. MARSH, Prof. A. WINCHELL, Dr. GEORGE SMITH, of Upper Darby, Pa., Dr. T. R. RAND, of Philadelphia.

MAINE.

ALBANY.—*Beryl! green and black tourmaline, feldspar, rose quartz,* rutile.

AROOSTOOK.—Red hematite.

BATH.—Idocrase, *garnet,* magnetite, graphite.

BETHEL.—*Cinnamon garnet,* calcite, sphene, beryl, pyroxene. hornblende, epidote, graphite, talc, pyrite, mispickel, magnetite, wad.

BINGHAM.—*Massive pyrite.* galenite, blende, andalusite.

BLUE HILL BAY.—*Arsenical iron, molybdenite! galenite, apatite! fluorite!* black tourmaline (Long Cove), black oxyd of manganese (Osgood's farm), rhodonite, bog manganese, wolframite.

BOWDOIN.—*Rose Quartz.*

BOWDOINHAM.—*Beryl,* molybdenite.

BRUNSWICK.—*Green mica, garnet! black tourmaline!* molybdenite, epidote, *calcite, muscovite, feldspar,* beryl.

BUCKFIELD.—*Garnet* (estates of Waterman and Lowe), iron ore, *muscovite!* magnetite.

CAMDAGE FARM.—(Near the tide mills), molybdenite, wolframite.

CAMDEN.—*Macle, galenite,* epidote, black tourmaline, pyrite, talc, magnetite.

CARMEL (Penobscot Co.).—Stibnite, pyrite, macle.

CORINNA.—*Pyrite, arsenical pyrites.*

DEER ISLE.—*Serpentine, verd-antique,* asbestus, diallage, magnetite.

DEXTER.—Galenite, pyrite, blende, chalcopyrite, green talc.

DIXFIELD.—Native copperas, graphite.

FARMINGTON.—(Norton's ledge), *pyrite,* graphite, bog ore, garnet, staurolite.

FREEPORT.—*Rose quartz, garnet,* feldspar, scapolite, graphite, *muscovite.*

FRYEBURG.—*Garnet,* beryl.

GEORGETOWN.—(Parker's island), *beryl!* black tourmaline.

GREENWOOD.—Graphite, black manganese, *beryl! mispickel,* cassiterite, *mica, rose quartz, garnet,* corundum, albite, zircon, molybdenite, magnetite, copperas.

HEBRON.—*Cassiterite,* mispickel, idocrase, *lepidolite, amblygonite, rubellite!* indicolite, *green tourmaline, mica, beryl, apatite, albite, childrenite, cookeite.*

JEWELL'S ISLAND.—Pyrite.

KATAHDIN IRON WORKS.—Bog iron ore, pyrite, magnetite, quartz.

LETTER E, Oxford Co.—Staurolite, macle, copperas.

LINNÆUS.—Hematite, limonite, *pyrite,* bog-iron ore.

LITCHFIELD.—*Sodalite, cancrinite, elæolite, zircon,* spodumene, muscovite, pyrrhotite.

Lubec Lead Mines.—*Galenite, chalcopyrite, blende.*

Machiasport.—*Jasper*, epidote, laumontite.

Madawaska Settlements.—*Vivianite.*

Minot.—*Beryl, smoky quartz.*

Monmouth.—Actinolite, apatite, *elæolite, zircon*, staurolite, plumose mica, beryl, rutile.

Mt. Abraham.—*Andalusite*, staurolite.

Norway.—*Chrysoberyl!* molybdenite, *beryl, rose quartz, orthoclase*, cinnamon garnet.

Orr's Island.—*Steatite*, garnet, andalusite.

Oxford.—*Garnet, beryl*, apatite, wad, zircon, *muscovite.*

Paris.—*Green! red! black*, and *blue tourmaline! mica! lepidolite!* feldspar, *albite, quartz crystals! rose quartz, cassiterite, amblygonite*, zircon, brookite, beryl, smoky quartz, spodumene, *cookeite*, leucopyrite.

Parsonsfield.—*Idocrase! yellow garnet, pargasite, adularia, scapolite*, galenite, blende, chalcopyrite.

Peru.—*Crystallized pyrite.*

Phipsburg.—*Yellow garnet! manganesian garnet, idocrase, pargasite, axinite, laumontite!* chabazite, an ore of cerium?

Poland.—Idocrase, smoky quartz, cinnamon garnet.

Portland.—*Prehnite*, actinolite, garnet, epidote, amethyst, calcite.

Pownal.—*Black tourmaline, feldspar*, scapolite, pyrite, actinolite, apatite, rose quartz.

Raymond.—*Magnetite, scapolite, pyroxene, lepidolite, tremolite*, hornblende, epidote, orthoclase, yellow garnet, pyrite, idocrase.

Rockland.—Hematite, tremolite, *quartz*, wad, *talc.*

Rumford.—*Yellow garnet, idocrase, pyroxene*, apatite, scapolite, graphite.

Rutland.—Allanite.

Sandy River.—Auriferous sand.

Sanford, York Co.—*Idocrase!* albite, calcite, molybdenite, epidote, black tourmaline.

Searsmont.—*Andalusite*, tourmaline.

South Berwick.—Macle.

Streaked Mountain.—*Beryl! black tourmaline, mica, garnet.*

Thomaston.—*Calcite, tremolite, hornblende*, sphene, arsenical iron (Owl's head), black manganese (Dodge's mountain), *thomsonite, talc*, blende, pyrite, galenite.

Topsham.—*Quartz*, galenite, blende, tungstite? beryl, apatite, molybdenite.

Union.—Magnetite, bog-iron ore.

Wales.—Axinite in boulder, alum, copperas.

Waterville.—*Crystallized pyrite.*

Windham (near the bridge).—*Staurolite, spodumene, garnet*, beryl, amethyst, *cyanite*, tourmaline.

Winthrop.—*Staurolite*, pyrite, hornblende, garnet, copperas.

Woodstock.—*Graphite, specular iron*, prehnite, epidote, calcite.

York.—*Beryl*, vivianite, oxyd of manganese.

NEW HAMPSHIRE.

Acworth.—*Beryl!! mica! tourmaline, feldspar, albite, rose quartz, columbite!*

Alstead.—*Mica!! albite, black tourmaline.*

Amherst.—*Idocrase! yellow garnet*, pargasite, calc spar.

Bartlett.—Magnetite, *specular iron*, brown iron ore in large veins near Jackson (on "Bald face mountain"), *quartz crystals, smoky quartz.*

Bath.—Galenite, chalcopyrite.

Bellows Falls.—Cyanite.

Benton.—*Quartz crystals.*

Campton.—*Beryl!*

Canaan.—Gold in pyrites.

Charlestown.—*Staurolite macle, andalusite macle*, bog-iron ore.

Cornish.—Stibnite, tetrahedrite, *rutile in quartz!* (rare).

Croyden.—*Iolite!*

Eaton (3 m. S. of).—*Galenite, blende!* chalcopyrite, limonite (Six Mile Pond).

Franceston.—*Soapstone*, arsenical pyrites.

Franconia.—*Hornblende, staurolite! epidote! zoisite, specular iron, magnetite, black and red manganesian garnets, mispickel! (danaite)*, chalcopyrite, molybdenite, prehnite.

Gilford (Gunstock Mt.).—Magnetic iron ore, native "lodestone."

Goshen.—*Graphite*, black tourmaline.

GRAFTON.—*Mica!* (extensively quarried at Glass Hill, 2 m. S. of Orange Summit), *albite!* blue, green, and yellow *beryls!* (1 m. S. of O. Summit), *tourmaline, garnets.*

GRANTHAM.—*Gray staurolite!*

HANOVER.—*Garnet*, a boulder of quartz containing *rutile! black tourmaline, quartz.*

HAVERHILL.—*Garnet! arsenical pyrites, native arsenic*, galenite, blende, iron and copper pyrites, magnetic and white iron pyrites.

HILLSBORO' (Campbell's mountain).—*Graphite.*

HILLSDALE.—*Rhodonite*, black oxyd of manganese.

JACKSON.—Drusy quartz, tin ore, *arsenopyrite*, native arsenic, fluorite, apatite, *magnetite, molybdenite*, wolfram, chalcopyrite, arsenate of iron.

JAFFREY (Monadnock Mt.).—*Cyanite.*

KEENE.—*Graphite, soapstone*, milky quartz.

LANDAFF.—*Molybdenite*, lead and iron ores.

LEBANON.—*Bog-iron ore.*

LISBON.—*Staurolite*, black and red *garnets, granular magnetite, hornblende, epidote, zoisite, specular iron.*

LYME.—Cyanite (N.W. part), *black tourmaline*, rutile, pyrite, chalcopyrite (E. of E. village), *stibnite.*

MERRIMACK.—*Rutile!* (in gneiss nodules in granite vein).

MOULTONBOROUGH (Red Hill).—*Hornblende*, bog ore, pyrite, tourmaline.

NEWPORT.—Molybdenite.

ORANGE.—*Blue beryls!* Orange Summit, chrysoberyl, *mica* (W. side of mountain).

ORFORD.—*Brown tourmaline* (now obtained with difficulty), *steatite, rutile*, cyanite, brown iron ore, native copper, malachite, galenite.

PELHAM.—*Steatite.*

PIERMONT.—*Micaceous iron*, barite, green, white, and brown mica, apatite.

PLYMOUTH.—Columbite, beryl.

RICHMOND.—*Iolite!* rutile, steatite, pyrite.

RYE.—Macle.

SADDLEBACK MT.—Black tourmaline, garnet, spinel.

SHELBURNE.—*Galenite, black blende, chalcopyrite, pyrite*, manganese.

SPRINGFIELD.—Beryls (very large, eight inches diameter), *manganesian garnets!* in mica slate, *albite, mica.*

SULLIVAN.—*Tourmalines* (black), in quartz, beryl?

SURREY.—Amethyst, calcite.

SWANZEY (near Keene).—*Magnetic iron* (in masses in granite).

TAMWORTH (near White Pond).—Galenite.

UNITY (estate of James Neal).—*Copper and iron pyrites, chlorophyllite, green mica, radiated actinolite*, garnet, *titaniferous iron ore, magnetite.*

WALPOLE (near Bellows Falls).—Macle.

WARREN.—*Chalcopyrite, blende, epidote*, quartz, *pyrite, tremolite, galenite, rutile, talc*, molybdenite, *cinnamon stone! pyroxene.*

WESTMORELAND (south part).—*Molybdenite! apatite! blue feldspar, bog manganese* (north village), quartz, *fluorite*, chalcopyrite, oxyd of molybdenum and uranium.

WHITE MTS. (notch behind "old Crawford's house").—Green octahedral fluor, quartz crystals, black tourmaline, chiastolite.

WILMOT.—*Beryl.*

WINCHESTER.—Pyrolusite, rhodochrosite, psilomelane, magnetite, granular quartz.

VERMONT.

ADDISON.—*Iron sand*, pyrite.

ALBURGH.—Quartz crystals on calcite, pyrite.

ATHENS.—*Steatite, rhomb spar*, actinolite, garnet.

BALTIMORE.—*Serpentine, pyrites!*

BARNET.—Graphite.

BELVIDERE.—Steatite, chlorite.

BENNINGTON.—*Pyrolusite*, brown iron ore, pipe clay, yellow ochre.

BERKSHIRE.—*Epidote*, hematite, magnetite.

BETHEL.—*Actinolite!* talc, chlorite, octahedral iron, *rutile, brown spar in steatite.*

BRANDON.—Braunite, pyrolusite, *psilomelane*, limonite, lignite, white clay, statuary marble; fossil fruits in the lignite, graphite, chalcopyrite.

Brattleborough.—Black tourmaline in quartz, mica, zoisite, rutile, actinolite, scapolite, spodumene, roofing slate.

Bridgewater.—*Talc*, *dolomite*, *magnetite*, steatite, chlorite, gold, native copper, blende, galenite blue spinel, chalcopyrite.

Bristol.—*Rutile*, brown hematite, manganese ores, magnetite.

Brookfield.—*Mispickel*, *pyrite*.

Cabot.—Garnet, staurolite, hornblende, *albite*.

Castleton.—*Roofing slate*, jasper, manganese ores, chlorite.

Cavendish.—Garnet, *serpentine*, *talc*, *steatite*, *tourmaline*, *asbestus*, *tremolite*.

Chester.—*Asbestus*, feldspar, chlorite, *quartz*.

Chittenden.—Psilomelane, pyrolusite, brown iron ore, *specular* and *magnetic iron*, galenite, iolite.

Colchester.—Brown iron ore, iron sand, jasper, alum.

Corinth.—*Copper pyrites* (has been mined), pyrrhotite, pyrite, rutile, quartz.

Coventry.—Rhodonite.

Craftsbury.—Mica in concentric balls, calcite, rutile.

Derby.—Mica (*adamsite*).

Dummerston.—Rutile, roofing slate.

Fairhaven.—*Roofing slate*, pyrite.

Fletcher.—Pyrite, octahedral iron, acicular tourmaline.

Grafton.—The *steatite* quarry referred to Grafton is properly in Athens; *quartz*, actinolite.

Guilford.—Scapolite, rutile, roofing slate.

Hartford.—Calcite, *pyrite!* *cyanite* in mica slate, quartz, tourmaline.

Irasburgh.—Rhodonite, *psilomelane*.

Jay.—*Chromic iron*, *serpentine*, amianthus, dolomite.

Lowell.—Picrosmine, amianthus, serpentine, cerolite, talc, chlorite.

Marlboro'.—*Rhomb spar*, *steatite*, *garnet*, *magnetite*, chlorite.

Mendon.—Octahedral iron ore.

Middlebury.—Zircon.

Middlesex.—Rutile! (exhausted).

Monkton.—*Pyrolusite*, brown iron ore, pipe clay, feldspar.

Moretown.—*Smoky quartz!* *steatite*, talc, wad, rutile, serpentine.

Morristown.—Galenite.

Mount Holly.—*Asbestus*, chlorite.

New Fane.—*Glassy* and *asbestiform actinolite*, *steatite*, *green quartz* (called chrysoprase at the locality), chalcedony, drusy quartz, *garnet*, *chromic and titanic iron*, *rhomb spar*, serpentine, rutile.

Norwich.—*Actinolite*, *feldspar*, *brown spar* in talc, cyanite, zoisite, chalcopyrite, pyrite.

Pittsford.—*Brown iron ore*, manganese ores.

Plymouth.—Spathic iron, magnetic and specular iron, both in octahedral crystals, *gold*, galenite.

Plympton.—Massive hornblende.

Putney.—Fluorite, *brown iron ore*, *rutile*, and *zoisite*, in boulders, staurolite.

Reading.—*Glassy actinolite* in talc.

Readsboro'.—*Glassy actinolite*, *steatite*, hematite.

Ripton.—*Brown iron ore*, augite in boulders, octahedral pyrite.

Rochester.—Rutile, specular iron cryst., *magnetite* in chlorite slate.

Rockingham (Bellows Falls).—Cyanite, indicolite, feldspar, tourmaline, fluorite, calcite, prehnite, staurolite.

Roxbury.—*Dolomite*, *talc*, serpentine, asbestus, quartz.

Rutland.—*Magnesite*, *white marble*, hematite, serpentine, pipe clay.

Salisbury.—Brown iron ore.

Sharon.—*Quartz crystals*, cyanite.

Shoreham.—*Pyrite*, black marble, calcite.

Shrewsbury.—Magnetite and chalcopyrite.

Starksboro'.—Brown iron ore.

Stirling.—Chalcopyrite, talc, serpentine.

Stockbridge.—Mispickel, magnetic iron ore.

Strafford.—Magnetite and *chalcopyrite* (has been worked), native copper, hornblende, copperas.

Thetford.—Blende, *galenite*, *cyanite*; chrysolite in basalt, pyrrhotite, *feldspar*, *roofing slate*, steatite, garnet.

Townshend.—*Actinolite*, black mica, *talc*, steatite, feldspar.

Troy.—*Magnetite*, talc, *serpentine*, picrosmine, amianthus, *steatite*, one mile southeast of village of South Troy, on the farm of Mr. Pierce, east side of Missisco, *chromic iron*, saratite.

Vershire.—*Pyrite*, chalcopyrite, tourmaline, mispickel, quartz.

Wardsboro'.—*Zoisite*, tourmaline, *tremolite*, hematite.
Warren.—Actinolite, magnetite, wad, serpentine.
Waterbury.—Mispickel, chalcopyrite, *rutile*, *quartz*, serpentine.
Waterville.—*Steatite*, actinolite, talc.
Weathersfield.—*Steatite*, *specular iron*, *pyrite*, tremolite.
Wells' River.—Graphite.
Westfield.—*Steatite*, chromic iron, serpentine.
Westminster.—Zoisite in boulders.
Windham.—*Glassy actinolite*, *steatite*, *garnet*, serpentine.
Woodbury.—Massive pyrite.
Woodstock.—*Quartz crystals*, garnet, zoisite.

MASSACHUSETTS.

Alford.—Galenite, pyrite.
Athol.—*Allanite*, fibrolite, (?) *epidote!* babingtonite?
Auburn.—*Masonite.*
Barre.—*Rutile! mica*, *pyrite*, *beryl*, *feldspar*, *garnet.*
Great Barrington.—*Tremolite.*
Bedford.—*Garnet.*
Belchertown.—Allanite.
Bernardston.—Magnetite.
Beverly.—Columbite, *green feldspar*, cassiterite.
Blanford.—*Serpentine*, *anthophyllite*, *actinolite! chromite*, cyanite, rose quartz in boulders.
Bolton.—*Scapolite! petalite*, *sphene*, *pyroxene*, *nuttalite*, *diopside*, *boltonite*, apatite, magnesite, rhomb spar, *allanite*, *yttrocerite?* cerium ochre? (on the scapolite), spinel.
Boxborough.—*Scapolite*, spinel, *garnet*, augite, actinolite, apatite.
Brighton.—Asbestus.
Brimfield (road leading to Warren).—*Iolite*, adularia, molybdenite, mica, garnet.
Carlisle.—*Tourmaline*, *garnet! scapolite*, actinolite.
Charlestown.—*Prehnite*, *laumontite*, stilbite, chabazite, quartz crystals, melanolite.
Chelmsford.—*Scapolite* (chelmsfordite), *chondrodite*, *blue spinel*, *amianthus!* rose quartz.
Chester.—*Hornblende*, *scapolite*, *zoisite*, *spodumene*, *indicolite*, apatite, magnetite, chromite, stilbite, heulandite, analcite and chabazite; at the Emery Mine, Chester Factories.—*Corundum*, *margarite*, *diaspore*, epidote, corundophilite, chloritoid, tourmaline, *menaccanite!* rutile, biotite, indianite? andesite? *cyanite.*
Chesterfield.—*Blue*, *green*, *and red tourmaline*, *cleavelandite* (albite), *lithia mica*, *smoky quartz*, *microlite*, *spodumene*, *cyanite*, apatite, *rose beryl*, *garnet*, *quartz crystals*, *staurolite*, cassiterite, *columbite*, zoisite, uranite, brookite (eumanite), scheelite, anthophyllite, bornite.
Conway.—Pyrolusite, fluorite, zoisite, *rutile!!* native alum, galenite.
Cummington.—*Rhodonite!* cummingtonite (hornblende), marcasite, *garnet.*
Dedham.—Asbestus, galenite.
Deerfield.—Chabazite, heulandite, stilbite, amethyst, carnelian, chalcedony, *agate.*
Fitchburg (Pearl Hill).—*Beryl*, *staurolite!* garnets, molybdenite.
Foxborough.—*Pyrite*, *anthracite.*
Franklin.—Amethyst.
Goshen.—*Mica*, *albite*, *spodumene! blue and green tourmaline*, *beryl*, *zoisite*, smoky quartz, columbite, tin ore, galenite, beryl (goshenite), pihlite (cymatolite).
Greenfield (in sandstone quarry, half mile east of village).—Allophane, white and greenish.
Hatfield.—Barite, yellow quartz crystals, galenite, blende, chalcopyrite.
Hawley.—*Micaceous iron*, massive pyrite, magnetite, zoisite.
Heath.—*Pyrite*, *zoisite.*
Hinsdale.—Brown iron ore, apatite, zoisite.
Hubbardston.—*Massive pyrite.*
Lancaster.—*Cyanite*, *chiastolite!* apatite, staurolite, pinite, andalusite.
Lee.—*Tremolite! sphene!* (east part).
Lenox.—Brown hematite, gibbsite (?).
Leverett.—Barite, galenite, blende, chalcopyrite.
Leyden.—*Zoisite*, *rutile.*
Littleton.—Spinel, scapolite, apatite.
Lynnfield.—Magnesite on serpentine.
Martha's Vineyard.—Brown iron ore, amber, selenite, radiated pyrite.
Mendon.—*Mica!* chlorite.

Middlefield.—*Glassy actinolite, rhomb spar, steatite, serpentine, feldspar*, drusy quartz, apatite, zoisite, nacrite, chalcedony, *talc!* deweylite.

Milbury.—*Vermiculite.*

Montague.—Specular iron.

Newbury.—*Serpentine*, chrysotile, *epidote, massive garnet*, siderite.

Newburyport.—*Serpentine, nemalite*, uranite.

New Braintree.—*Black tourmaline.*

Norwich.—*Apatite! black tourmaline, beryl, spodumene! triphyline* (altered), blende, quartz crystals, cassiterite.

Northfield.—*Columbite*, fibrolite, cyanite.

Palmer (Three Rivers).—*Feldspar*, prehnite, calc spar.

Pelham.—*Asbestus*, serpentine, *quartz crystals*, beryl, *molybdenite, green hornstone*, epidote, amethyst.

Plainfield.—*Cummingtonite, pyrolusite, rhodonite.*

Richmond.—*Brown iron ore, gibbsite! allophane.*

Rockport.—*Danalite, cryophyllite, annite, cyrtolite* (altered zircon), *green* and *white orthoclase.*

Rowe.—Epidote, talc.

South Royalston.—*Beryl!!* (now obtained with great difficulty), *mica!! feldspar!* allanite. Four miles beyond old loc., on farm of Solomon Heywood, *mica! beryl! feldspar!* menaccanite.

Russel.—Schiller spar (diallage?), *mica*, serpentine, beryl, galenite, chalcopyrite.

Salem.—In a boulder, cancrinite, sodalite, elæolite.

Saugus.—Porphyry, jasper.

Sheffield.—*Asbestus*, pyrite, native alum, pyrolusite.

Shelburne.—Rutile.

Shutesbury (east of Locke's Pond).—*Molybdenite.*

Southampton.—*Galenite*, cerussite, anglesite, *wulfenite*, fluorite, barite, copper and iron pyrites, blende, corneous lead, pyromorphite, stolzite, chrysocolla.

Sterling.—*Spodumene, chiastolite, spathic iron, mispickel, blende*, galenite, chalcopyrite, pyrite.

Stoneham.—*Nephrite.*

Sturbridge.—*Graphite*, garnet, apatite, bog ore.

Swampscot.—*Orthite*, feldspar.

Taunton (one mile south).—Paracolumbite (titanic iron).

Turner's Falls (Conn. River).—Chalcopyrite, prehnite, chlorite, *chlorophæite*, spathic iron, malachite, magnetic iron sand, anthracite.

Tyringham.—Pyroxene, scapolite.

Uxbridge.—Galenite.

Warwick.—*Massive garnet, radiated black tourmaline, magnetite*, beryl, epidote.

Washington.—*Graphite.*

Westfield.—*Schiller spar* (diallage), *serpentine, steatite*, cyanite, scapolite, actinolite.

Westford.—*Andalusite!*

West Hampton.—Galenite, *argentine, pseudomorphous quartz.*

West Springfield.—*Prehnite*, ankerite, satin spar, celestite, bituminous coal.

West Stockbridge.—*Hematite*, fibrous pyrolusite, spathic iron.

Whately.—*Native copper*, galenite.

Williamsburg.—*Zoisite*, pseudomorphous quartz, apatite, rose and smoky quartz, galenite, pyrolusite, chalcopyrite.

Williamstown.—*Cryst. quartz.*

Windsor.—*Zoisite*, actinolite, *rutile!*

Worcester.—*Mispickel*, idocrase, pyroxene, garnet, amianthus, bucholzite, spathic iron, galenite.

Worthington.—*Cyanite.*

Zoar.—Bitter spar. *talc.*

RHODE ISLAND.

Bristol.—*Amethyst.*

Cranston.—Actinolite in talc.

Cumberland.—*Manganese, epidote, actinolite*, garnet, titaniferous iron, magnetite, red hematite, chalcopyrite.

Foster.—*Cyanite.*

Gloucester.—*Magnetite* in chlorite slate.

Johnson.—Talc, brown spar.

Natic.—See Warwick.

Newport.—*Serpentine.*

Portsmouth.—*Anthracite*, graphite, asbestus, pyrite.

Smithfield.—*Dolomite*, *calcite*, *bitter spar*, *nacrite*, serpentine (bowenite), tremolite, asbestus, quartz, magnetic iron in chlorite slate, *talc!* anatase.

Warwick (Natic village).—*Masonite*, garnet, graphite.

Westerly.—*Ilmenite*.

CONNECTICUT.

Berlin.—Barite, datolite, blende, quartz crystals.

Bolton.—Staurolite, chalcopyrite.

Bradleyville (Litchfield).—Laumontite.

Bristol.—*Chalcocite!* *chalcopyrite*, barite, *bornite*, talc, *allophane*, pyromorphite, *calcite*, malachite, galenite, quartz.

Brookfield.—Galenite, calamine, *blende*, spodumene, pyrrhotite.

Canaan.—*Tremolite* and white *augite!* in dolomite, canaanite (massive pyroxene).

Chatham.—Mispickel, smaltite, chloanthite (chathamite), scorodite, niccolite, *beryl*, erythrite.

Cheshire.—*Barite*, *chalcocite*, *bornite cryst.*, *malachite*, kaolin, natrolite, prehnite, chabazite, datolite.

Chester.—*Sillimanite!* zircon, epidote.

Cornwall.—*Graphite*, *pyroxene*, *actinolite*, *sphene*, scapolite.

Danbury.—*Danburite*, *oligoclase*, *moonstone*, brown tourmaline, orthoclase, pyroxene, parathorite.

Farmington.—*Prehnite*, *chabazite*, agate, native copper.

Granby.—Green malachite.

Greenwich.—*Black tourmaline*.

Haddam.—*Chrysoberyl!* *beryl!* *epidote!* *tourmaline!* *feldspar*, *garnet!* *iolite!* *oligoclase*, *chlorophyllite!* *automolite*, *magnetite*, *adularia*, apatite, *columbite!* zircon (calyptolite), *mica*, pyrite, marcasite, *molybdenite*, allanite, bismuth, bismuth ochre, bismutite.

Hadlyme.—Chabazite and stilbite in gneiss, with epidote and garnet.

Hartford.—*Datolite* (Rocky Hill quarry).

Kent.—*Brown iron ore*, pyrolusite, ochrey iron ore.

Litchfield.—*Cyanite* with corundum, apatite, and andalusite, *menaccanite* (washingtonite), chalcopyrite, diaspore, niccoliferous pyrrhotite, margarodite.

Lyme.—Garnet, sunstone.

Meriden.—Datolite.

Middlefield Falls.—Datolite, chlorite, etc., in amygdaloid.

Middletown.—*Mica*, *lepidolite* with green and red tourmaline, *albite*, *feldspar*, *columbite!* *prehnite*, *garnet* (sometimes octahedral), beryl, topaz, uranite, apatite, pitchblende; at lead mine, *galenite*, *chalcopyrite*, blende, quartz, *calcite*, fluorite, pyrite, sometimes capillary.

Milford.—Sahlite, *pyroxene*, *asbestus*, zoisite, verd-antique marble, pyrite.

New Haven.—Serpentine, asbestus, chromic iron, sahlite, stilbite, prehnite.

Norwich.—*Sillimanite*, *monazite!* zircon, *iolite*, corundum, feldspar.

Oxford, near Humphreysville.—Cyanite, chalcopyrite.

Plymouth.—Galenite, *heulandite*, *fluorite*, *chlorophyllite!* garnet.

Roaring Brook (Cheshire).—*Datolite!* calcite, prehnite, saponite.

Reading (near the line of Danbury).—Pyroxene, *garnet*.

Roxbury.—*Spathic iron*, *blende*, *pyrite!* *! galenite*, quartz, chalcopyrite.

Salisbury.—*Brown iron ore*, ochrey iron, *pyrolusite*, triplite, *turgite*.

Saybrook.—*Molybdenite*, stilbite, plumbago.

Simsbury.—*Copper glance*, green malachite.

Southbury.—Rose quartz, laumontite, prehnite, calc spar, heavy spar.

Southington.—Heavy spar, datolite, asteriated quartz crystals.

Stafford.—Massive pyrites, alum, copperas.

Stonington.—Stilbite and *chabazite* on gneiss.

Thatchersville (near Bridgeport).—Stilbite on gneiss, babbingtonite?

Tolland.—Staurolite, massive pyrites.

Trumbull and **Monroe.**—*Chlorophane*, *topaz*, *beryl*, diaspore, pyrrhotite, pyrite, scheelite, *wolframite* (pseudomorph of scheelite), rutile, native bismuth, tungstic acid, spathic iron, mispickel, argentiferous galenite, blende, scapolite, *tourmaline*, *garnet*, albite, augite, graphic tellurium, (?) *margarodite*.

Washington.—*Triplite*, *menaccanite!* (washingtonite of Shepard), rhodochrosite, natrolite, *andalusite* (New Preston), cyanite.

Watertown, near the Naugatuck.—White sahlite, monazite.

West Farms.—Asbestus.

Willimantic.—*Topaz, monazite, ripidolite.*
Winchester and Wilton.—Asbestus, garnet.

NEW YORK.

ALBANY CO.—Bethlehem.—Calcite, stalactite, stalagmite, calcareous sinter, snowy gypsum.

Coeyman's Landing.—Gypsum, epsom salt, *quartz* crystals at Crystal Hill, three miles south of Albany.

Guilderland.—Petroleum, anthracite, and calcite, on the banks of the Norman's Kill, two miles south of Albany.

Watervliet.—*Quartz crystals*, yellow drusy quartz.

ALLEGHANY CO.—Cuba.—Calcareous tufa, petroleum, 3½ miles from the village.

CATTARAUGUS CO.—Freedom.—*Petroleum.*

CAYUGA CO.—Auburn.—Celestite, calcite, fluor spar, epsomite.
Cayuga Lake.—Sulphur.
Ludlowville.—Epsomite.
Union Springs.—*Selenite*, gypsum.
Springport.—At Thompson's plaster beds, *sulphur! selenite.*
Springville.—Nitrogen springs.

CLINTON CO.—Arnold Iron Mine.—*Magnetite*, epidote, molybdenite.
Finch Ore Bed.—*Calcite, green* and purple fluor.

CHATAUQUE CO.—Fredonia.—*Petroleum, carburetted hydrogen.*
Laona.—Petroleum.
Sheridan.—Alum.

COLUMBIA CO.—Austerlitz.—*Earthy manganese*, wulfenite, chalcocite; Livingston lead mine, vitreous silver?

Chatham.—Quartz, pyrite in cubic crystals in slate (Hillsdale).

Canaan.—Chalcocite, chalcopyrite.

Hudson.—Epidote, *selenite!*

New Lebanon.—Nitrogen springs, graphite, anthracite; at the Ancram lead mine, galenite, barite, *blende, wulfenite* (rare), chalcopyrite, calcareous tufa; near the city of Hudson, epsom salt, brown spar, *wad.*

DUTCHESS CO.—Amenia.—Dolomite, *limonite, turgite.*

Beekman.—*Dolomite.*

Dover.—Dolomite, tremolite, *garnet* (Foss ore bed), staurolite, *limonite.*

Fishkill.—Dolomite; near Peckville, talc, asbestus, *graphite, hornblende*, augite, *actinolite*, hydrous anthophyllite, *limonite.*

North East.—Chalcocite, chalcopyrite, galenite, blende.

Pawling.—Dolomite.

Rhinebeck.—Calcite, green feldspar, epidote, tourmaline.

Union Vale.—At the Clove mine, *gibbsite, limonite.*

ESSEX CO.—Alexandria.—Kirby's graphite mine, *graphite, pyroxene, scapolite*, sphene.

Crown Point.—*Apatite* (eupyrchroite of *Emmons*), *brown tourmaline!* in the apatite, chlorite, quartz crystals, pink and blue calcite, pyrite; a short distance south of J. C. Hammond's house, *garnet, scapolite*, chalcopyrite, *aventurine feldspar*, zircon, magnetic iron (Peru), epidote, mica.

Keene.—Scapolite.

Lewis.—*Tabular spar, colophonite*, garnet, *labradorite, hornblende*, actinolite; ten miles south of the village of Keeseville, mispickel.

Long Pond.—Apatite, *garnet, pyroxene*, idocrase, *coccolite!! scapolite*, magnetite, *blue calcite.*

McIntyre.—*Labradorite*, garnet, *magnetite.*

Moriah, at Sandford Ore Bed.—*Magnetite*, apatite, *allanite!* lanthanite, actinolite, and feldspar; at Fisher Ore Bed, *magnetic iron*, feldspar, quartz; at Hall Ore Bed, or "New Ore Bed," *magnetite, zircons;* on Mill brook, *calcite*, pyroxene, hornblende, albite; in the town of Moriah, magnetite, *black mica.*

Newcomb.—*Labradorite*, feldspar, magnetic iron, hypersthene.

Port Henry. *Brown tourmaline, mica, rose quartz, serpentine, green* and *black pyroxene*, hornblende, *cryst. pyrite*, graphite, tabular spar, pyrrhotine, *adularia; phlogopite!* at Cheever Ore Bed with magnetite and serpentine.

Roger's Rock.—*Graphite, tabular spar, garnet, colophonite, feldspar*, adularia, *pyroxene, sphene*, coccolite.

Schroon.—*Calcite*, pyroxene, *chondrodite*.

Ticonderoga.—*Graphite! pyroxene, sahlite, sphene*, black tourmaline, cacoxene ? (Mt. Defiance).

Westport.—Labradorite, prehnite, magnetite.

Willsboro'.—*Tabular spar, colophonite*, garnet, *green coccolite*, hornblende.

ERIE CO.—Ellicott's Mills.—*Calcareous tufas.*

FRANKLIN CO.—Chateaugay.—Nitrogen springs, calcareous tufas.

Malone.—*Massive pyrite*, magnetic iron ore.

GENESEE CO.—*Acid springs* containing sulphuric acid.

GREENE CO.—Catskill.—*Calcite.*

Diamond Hill.—Quartz crystals.

HERKIMER CO.—Fairfield.—*Quartz crystals*, fetid barite.

Little Falls.—*Quartz crystals!* barite, calcite, anthracite, pearl spar, *smoky quartz*; one mile outh of Little Falls, calcite, brown spar, feldspar.

Middleville.—*Quartz crystals! calcite*, brown and pearl spar, anthracite.

Newport.—*Quartz crystals.*

Salisbury.—*Quartz crystals!* blende, galenite, iron and copper pyrites.

Stark.—Fibrous celestite, *gypsum*.

HAMILTON CO.—Long Lake.—Blue calcite.

JEFFERSON CO.—Adams.—Fluor, calc tufa, barite.

Alexandria.—On the S.E. bank of Muscolonge Lake, fluorite, *phlogopite*, chalcopyrite; on High sland, in the St. Lawrence River, feldspar, *tourmaline*, hornblende, *orthoclase*, celestite.

Antwerp.—Stirling iron mine, *specular iron, chalcodite, spathic iron, millerite, red hematite*, crysallized quartz, *yellow aragonite*, niccoliferous iron pyrites, *quartz crystals*, pyrite; at Oxbow, *calcite!* orous coralloidal heavy spar; near Vrooman's lake, *calcite!* idocrase, *phlogopite! pyroxene, sphene*, luorite, pyrite, chalcopyrite; also *feldspar, bog-iron ore*, scapolite (farm of David Eggleson), *serpenine*, tourmaline (yellow, rare).

Brownsville.—Celestite in slender crystals, calcite (four miles from Watertown).

Natural Bridge.—Feldspar, *gieseckite! steatite, pseudomorphous* after pyroxene.

New Connecticut.—*Sphene, brown phlogopite.*

Omar.—*Beryl, feldspar, specular iron.*

Philadelphia.—*Garnets* on Indian river, in the village.

Pamelia.—*Agaric mineral*, calc tufa.

Pillar Point.—*Massive heavy spar* (exhausted).

Theresa.—*Fluor, calcite*, specular iron ore, hornblende, *quartz crystals*, serpentine (associated ith the specular iron), celestite, strontianite; the Muscolonge Lake locality of fluor is exhausted.

Watertown.—*Tremolite, agaric mineral*, calc tufa, celestite.

Wilna.—One mile north of Natural Bridge, *calcite*.

LEWIS CO.—Diana (localities mostly near junction of crystalline and sedimentary rocks, and ithin two miles of Natural Bridge).—*Scapolite! tabular spar, green coccolite, feldspar, tremolite, yroxene! sphene!!* mica, *quartz crystals*, drusy quartz, cryst. pyrite, pyrrhotite, *blue calcite*, serentine, *rensselaerite*, zircon, graphite, chlorite, specular iron, bog-iron ore, iron sand, *apatite*.

Greig.—*Magnetite*, pyrite.

Lowville.—*Calcite*, fluorite, pyrite, galenite, blende, calc tufa.

Martinsburgh.—Wad, galenite, etc., but mine not now opened, *calcite*.

Watson, Bremen.—Bog-iron ore.

MONROE CO.—Rochester.—*Pearl spar*, calc spar, snowy gypsum, fluor, celestite, galenite, lende, barite, hornstone.

MONTGOMERY CO.—Canajoharie.—Anthracite.

Palatine.—*Quartz crystals*, drusy quartz, anthracite, hornstone, agate, garnet.

Root.—Pearl spar, *drusy quartz*, *blende*, barite, stalactite, stalagmite, galenite, pyrite.

NEW YORK CO.—Corlear's Hook.—Apatite, brown and yellow feldspar, sphene.

Kingsbridge.—*Tremolite*, *pyroxene*, *mica*, *tourmaline*, pyrites, rutile, dolomite.

Harlem.—Epidote, apophyllite, stilbite, tourmaline, vivianite, lamellar feldspar, mica.

New York.—*Serpentine*, *amianthus*, actinolite, *pyroxene*, hydrous anthophyllite, garnet, staurolite, molybdenite, graphite, *chlorite*, jasper, *necronite*, feldspar.

NIAGARA CO.—Lewiston.—*Epsomite*.

Lockport.—*Celestite*, *calcite*, *selenite*, *anhydrite*, *fluorite*, dolomite, *blende*.

Niagara Falls.—*Calcite*, fluorite, blende, *dolomite*.

ONEIDA CO.—Boonville.—*Calcite*, *tabular spar*, *coccolite*.

Clinton.—*Blende*, *lenticular argillaceous iron ore;* in rocks of the Clinton Group, strontianite, celestite, the former covering the latter.

ONONDAGA CO.—Camillus.—*Selenite* and *fibrous gypsum*.

Cold Spring.—Axinite.

Manlius.—*Gypsum* and fluor.

Syracuse.—*Serpentine*, celestite, selenite, barite.

ORANGE CO.—Cornwall.—*Zircon*, *chondrodite*, *hornblende*, *spinel*, *massive feldspar*, *fibrous epidote*, hudsonite, menaccanite, *serpentine*, coccolite.

Deer Park.—*Cryst. pyrite*, galenite.

Monroe.—*Mica! sphene! garnet*, colophonite, *epidote*, *chondrodite*, *allanite*, bucholzite, brown spar, *spinel*, hornblende, talc, menaccanite, *pyrrhotite*, pyrite, chromic iron, *graphite*, rastolyte, moronolite.

At Wilks and O'Neil Mine in Monroe.—Aragonite, *magnetite*, dimagnetite (pseud. ?), jenkinsite, *asbestus*, serpentine, *mica*.

At Two Ponds in Monroe.—*Pyroxene! chondrodite*, *hornblende*, *scapolite! zircon*, *sphene*, apatite.

At Greenwood Furnace in Monroe.—*Chondrodite*, *pyroxene! mica*, *hornblende*, *spinel*, *scapolite*, *biotite!* menaccanite.

At Forest of Dean.—*Pyroxene*, *spinel*, zircon, scapolite, hornblende.

Town of Warwick, Warwick Village.—*Spinel! zircon*, *serpentine! brown spar*, *pyroxene! hornblende! pseudomorphous steatite*, *feldspar!* (Rock Hill), menaccanite, *clintonite*, tourmaline (R. H.), *rutile*, *sphene*, molybdenite, mispickel, marcasite, pyrite, yellow iron sinter, quartz, jasper, mica, coccolite.

Amity.—*Spinel! garnet*, *scapolite*, *hornblende*, *idocrase*, *epidote! clintonite! magnetite*, *tourmaline*, warwickite, *apatite*, *chondrodite*, *talc! pyroxene!* rutile, menaccanite, *zircon*, *corundum*, *feldspar*, sphene, calc spar, serpentine, schiller spar (?), silvery mica.

Edenville.—*Apatite*, *chondrodite! hair-brown hornblende!* tremolite, *spinel*, *tourmaline*, *warwickite*, *pyroxene*, *sphene*, *mica*, *feldspar*, *mispickel*, orpiment, *rutile*, menaccanite, scorodite, copper pyrites.

West Point.—*Feldspar*, *mica*, scapolite, *sphene*, *hornblende*, allanite.

PUTNAM CO.—Carmel (Brown's quarry).—Anthophyllite, schiller spar (?), orpiment, mispickel, epidote.

Cold Spring.—Chabazite, mica, sphene, epidote.

Patterson.—*White pyroxene! calc spar*, *asbestus*, *tremolite*, dolomite, massive pyrite.

Phillipstown.—*Tremolite*, *amianthus*, *serpentine*, *sphene*, *diopside*, *green coccolite*, hornblende, *scapolite*, stilbite, mica, laumontite, gurhofite, calc spar, magnetic iron, chromite.

Phillips Ore Bed.—Hyalite, *actinolite*, *massive pyrite*.

RENSSELAER CO.—Hoosic.—Nitrogen springs.

Lansingburgh.—Epsomite, *quartz crystals*, *pyrite*.

Troy.—*Quartz crystals*, *pyrite*, *selenite*.

RICHMOND CO.—Rossville.—Lignite, *cryst. pyrite*.

Quarantine.—*Asbestus*, *amianthus*, aragonite, *dolomite*, *gurhofite*, brucite, serpentine, *talc*, magnesite.

ROCKLAND CO.—Caldwell.—*Calcite*
Grassy Point.—Serpentine, actinolite.
Haverstraw.—*Hornblende*, barite.
Ladentown.—Zircon, malachite, cuprite.
Piermont.—Datolite, stilbite, apophyllite, stellite, prehnite, thomsonite, calcite, chabazite.
Stony Point.—Cerolite, lamellar hornblende, asbestus.

ST. LAWRENCE CO.—Canton.—*Massive pyrite, calcite*, brown tourmaline, *sphene, serpentine*, talc, *rensselaerite*, pyroxene, specular iron, chalcopyrite.

Dekalb.—*Hornblende*, barite, *fluorite, tremolite, tourmaline*, blende, graphite, pyroxene, quartz (spongy), serpentine.

Edwards.—*Brown and silvery mica!* scapolite, apatite, *quartz crystals*, actinolite, tremolite, specular iron, serpentine, magnetite.

Fine.—*Black mica*, hornblende.

Fowler.—*Barite, quartz crystals! specular iron, blende*, galenite, tremolite, chalcedony, bog ore, satin spar (assoc. with serpentine), iron and copper pyrites, actinolite, *rensselaerite* (near Somerville).

Gouverneur.—*Calcite! serpentine! hornblende! scapolite! orthoclase, tourmaline!* idocrase (one mile south of G.), pyroxene, apatite, *rensselaerite*, serpentine, *sphene*, fluorite, barite (farm of Judge Dodge), black *mica*, phlogopite, *tremolite!* asbestus, *specular iron*, graphite, idocrase; (near Somerville in serpentine) *spinel*, houghite, scapolite, *phlogopite*, dolomite; three-quarters of a mile west of Somerville, *chondrodite*, spinel; two miles north of Somerville, *apatite*, pyrite, *brown tourmaline!!*

Hammond.—*Apatite! zircon!* (farm of Mr. Hardy), *orthoclase* (loxolase), *pargasite*, barite, pyrite, purple fluorite, dolomite.

Hermon.—*Quartz crystals, specular iron, spathic iron*, pargasite, pyroxene, serpentine, tourmaline, bog-iron ore.

Macomb.—Blende, mica, *galenite* (on land of James Averil), sphene.

Mineral Point, Morristown.—Fluorite, blende, galenite, *phlogopite* (Pope's Mills), barite.

Ogdensburg.—Labradorite.

Pitcairn.—Satin spar, associated with serpentine.

Potsdam.—*Hornblende!*—eight miles from Potsdam on road to Pierrepont, *feldspar, tourmaline, black mica*, hornblende.

Rossie (Iron Mines).—*Barite. specular iron*, coralloidal aragonite in mines near Somerville, limonite, *quartz* (sometimes stalactitic at Parish iron mine), *pyrite, pearl spar.*

Rossie Lead Mine.—*Calcite! galenite! pyrite, celestite*, chalcopyrite, *spathic iron!* cerussite, anglesite, *octahedral fluor, black phlogopite.*

Elsewhere in Rossie.—*Calcite*, barite, quartz crystals, chondrodite (near Yellow Lake), *feldspar! pargasite! apatite, pyroxene*, hornblende, sphene, zircon, *mica*, fluorite, serpentine, automolite, pearl spar, graphite.

Russel.—*Pargasite, specular iron, quartz* (dodec.), calcite, serpentine, rensselaerite, magnetite.

SARATOGA CO.—Greenfield.—*Chrysoberyl! garnet! tourmaline! mica, feldspar* apatite, graphite, aragonite (in iron mines).

SCHOHARIE CO.—Ball's Cave, and others.—Calcite, stalactites.
Carlisle.—*Fibrous sulphate of baryta, cryst. and fib. carbonate of lime.*
Middlebury.—Anthracite, calcite.
Sharon.—Calcareous tufa.
Schoharie.—Fibrous celestite, *strontianite! cryst. pyrites!*

SENECA CO.—Canoga.—*Nitrogen springs.*

SULLIVAN CO.—Wurtzboro'.—*Galenite, blende, pyrite, chalcopyrite.*

TOMPKINS CO.—Ithaca.—Calcareous tufa.

ULSTER CO.—Ellenville.—*Galenite*, blende, *chalcopyrite! quartz, brookite.*
Marbletown.—Pyrite.

WARREN CO.—Caldwell.—*Massive feldspar.*

Chester.—*Pyrite*, tourmaline, rutile, chalcopyrite.
Diamond Isle (Lake George).—*Calcite*, *quartz crystals*.
Glenn's Falls.—Rhomb spar.
Johnsburg.—*Fluorite ! zircon ! ! graphite*, *serpentine*, *pyrite*.

WASHINGTON CO.—Fort Ann.—*Graphite*, serpentine.
Granville.—*Lamellar pyroxene*, massive feldspar, epidote.

WAYNE CO.—Wolcott.—Barite.

WESTCHESTER CO.—Anthony's Nose.—*Apatite*, pyrite, *calcite !* in very large tabular crystals, grouped, and sometimes incrusted with drusy quartz.
Davenport's Neck.—*Serpentine*, garnet, sphene.
Eastchester.—Blende, copper and iron pyrites, dolomite.
Hastings.—*Tremolite*, *white pyroxene*.
New Rochelle.—*Serpentine*, brucite, quartz, *mica*, tremolite, garnet, magnesite.
Peekskill.—Mica, feldspar, hornblende, stilbite, sphene.
Rye.—*Serpentine*, *chlorite*, *black tourmaline*, tremolite.
Singsing.—*Pyroxene*, *tremolite*, *pyrite*, beryl, azurite, green malachite, white lead ore, pyromorphite, anglesite, vauquelinite, galenite, native silver, chalcopyrite.
West Farms.—Apatite, tremolite, garnet, stilbite, heulandite, chabazite, epidote, sphene.
Yonkers.—*Tremolite*, apatite, calcite, analcite, *pyrite*, tourmaline.
Yorktown.—*Sillimanite*, *monazite*, magnetite.

NEW JERSEY.

Andover Iron Mine (Sussex Co.).—Willemite, brown garnet.
Allentown (Monmouth Co.).—*Vivianite*, *dufrenite*.
Belville.—Copper mines.
Bergen.—*Calcite ! datolite ! pectolite* (called stellite)! *analcite*, *apophyllite ! prehnite*, sphene, *stilbite*, *natrolite*, heulandite, laumontite, *chabazite*, pyrite, pseudomorphous steatite imitative of apophyllite.
Brunswick.—Copper mines; *native copper*, *malachite*, *mountain leather*.
Bryam.—Chondrodite, *spinel*, at Roseville, *epidote*.
Cantwell's Bridge (Newcastle Co.), three miles west.—Vivianite.
Danville (Jemmy Jump Ridge).—*Graphite*, chondrodite, augite, mica.
Flemington.—*Copper mines*.
Frankfort.—*Serpentine*.
Franklin and Sterling.—*Spinel ! garnet ! rhodonite ! willemite ! franklinite ! red zinc ore ! dysluite ! hornblende*, *tremolite*, *chondrodite*, *white scapolite*, *black tourmaline*, *epidote*, *pink calcite*, *mica*, actinolite, augite, sahlite, coccolite, asbestus, *jeffersonite* (augite), calamine, graphite, fluorite, beryl, galenite, serpentine, honey-colored sphene, quartz, chalcedony, amethyst, zircon, molybdenite, vivianite, *tephroite*, rhodochrosite, aragonite. Also *algerite* in gran. limestone.
Franklin and Warwick Mts.—*Pyrite*.
Greenbrook.—Copper mines.
Griggstown.—Copper mines.
Hamburgh.—One mile north, *spinel ! tourmaline*, *phlogopite*, *hornblende*, *limonite*, specular iron.
Hoboken.—Serpentine (marmolite), *brucite*, *nemalite* (or fibrous brucite), aragonite, dolomite.
Hurdstown.—*Apatite*, magnetic pyrites, magnetite.
Imleytown.—Vivianite
Lockwood.—*Graphite*, *chondrodite*, *talc*, *augite*, *quartz*, *green spinel*.
Montville (Morris Co.).—Serpentine, *chrysotile*.
Mullica Hill (Gloucester Co.).—*Vivianite* lining belemnites and other fossils.
Newton.—*Spinel*, blue, pink, and white corundum, *mica*, *idocrase*, *hornblende*, *tourmaline*, *scapolite*, rutile, pyrite, talc, calcite, barite, *pseudomorphous steatite*.
Paterson.—*Datolite*.

PENNSYLVANIA.

BERKS CO.—Morgantown.—At Jones's mines, one mile east of Morgantown, *green malachite*, *chrysocolla*, *magnetite*, pyrite, chalcopyrite, aragonite, talc; two miles N.E. from Jones's mine graphite, sphene; at Steele's mine, one mile N.W. from St. Mary's, Chester Co., *magnetite*, micaceous iron, coccolite, brown garnet.

READING.—*Smoky quartz* crystals, *zircon*, stilbite, iron ore; at Eckhardt's Furnace, *allanite* with *zircon*.

BUCKS CO.—BUCKINGHAM Township.—Crystallized quartz.

SOUTHAMPTON.—Near the village of Feasterville, in the quarry of Geo. Van Arsdale, *graphite*, pyroxene, sahlite, coccolite, *sphene*, green mica, calcite, *wollastonite*, glassy feldspar sometimes opalescent, phlogopite, *blue quartz*, garnet, molybdenite, zircon, pyrite, moroxite.

CARBON CO.—SUMMIT HILL, in coal mines.—*Kaolinite*.

CHESTER CO.—BIRMINGHAM TOWNSHIP.—Amethyst, *smoky quartz*, serpentine; in Ab'm Darlington's lime quarry, calcite.

EAST BRADFORD.—Near Buffington's bridge on the Brandywine, green, blue, and gray cyanite, the gray cyanite is found loose in the soil in crystals; on the farms of Dr. Elwyn, Mrs. Foulke, Wm. Gibbons, and Saml. Entrikin, *amethyst*. At Strode's mill, asbestus, *magnesite*, anthophyllite, oligoclase, drusy quartz, *collyrite?* on Osborne's Hill, *wad*, *manganesian garnet* (massive), *sphene*, schorl; at Caleb Cope's lime quarry, *fetid dolomite*, necronite, garnets, blue cyanite, *yellow actinolite in talc;* near the Black Horse Inn, *indurated talc*, rutile; on Amor Davis' farm, *orthite!* massive, from a grain to lumps of one pound weight; near the paper-mill on the Brandywine, *zircon*, associated with *titaniferous iron* in blue quartz

WEST BRADFORD.—Near the village of Marshalton, *green cyanite*, rutile, scapolite, pyrite, staurolite; at the Chester County Poor-house limestone quarry, *chesterlite!* in crystals implanted on dolomite, *rutile!* in brilliant acicular crystals, which are finely terminated, calcite in scalenohedrons, zoisite, *damourite?* in radiated groups of crystals on dolomite, *quartz crystals*.

CHARLESTOWN.—*Pyromorphite*, *cerussite*, *galenite*, quartz.

SOUTH COVENTRY.—In Chrisman's limestone quarry, near Coventry village, augite, sphene, graphite, *zircon* in iron ore (about half a mile from the village).

EAST FALLOWFIELD.—Soapstone.

EAST GOSHEN.—Serpentine, *asbestus*.

WEST GOSHEN.—On the Barrens, one mile north of West Chester, amianthus, serpentine, cellular quartz, jasper, chalcedony, drusy quartz, chlorite, marmolite, indurated talc, *magnesite* in radiated crystals on serpentine, hematite, *asbestus;* near R. Taylor's mill, chromite in octahedral crystals, *deweylite*, *radiated magnesite*, aragonite, *staurolite*, garnet, asbestus, epidote; *zoisite* on hornblende at West Chester water-works (not accessible at present).

NEW GARDEN.—At Nivin's limestone quarry, *brown tourmaline*, *necronite*, scapolite, apatite, brown and green mica, rutile, *aragonite*, *fibrolite*, *kaolinite*.

KENNETT.—Actinolite, brown tourmaline, brown mica, *epidote*, tremolite, scapolite, *aragonite;* on Wm. Cloud's farm, *sunstone!!* sphene. At Pearce's old mill, zoisite, *epidote*, *sunstone;* sunstone occurs in good specimens at various places in the range of hornblende rocks running through this township from N.E. to S.W.

LOWER OXFORD.—Garnets, *pyrite* in cubic crystals.

LONDON GROVE.—Rutile, jasper, chalcedony (botryoidal); in Wm. Jackson's limestone quarry, *yellow tourmaline*, *tremolite;* at Pusey's quarry, rutile, *tremolite*.

EAST MARLBOROUGH.—On the farm of Baily & Brothers, one mile south of Unionville, bright *yellow* and nearly white *tourmaline*, *chesterlite*, *albite;* near Marlborough meeting-house, epidote, serpentine, acicular black tourmaline in white quartz; *zircon* in small perfect crystals loose in the soil at Pusey's saw-mill, two miles S.W. of Unionville.

WEST MARLBOROUGH.—Near Logan's quarry, staurolite, cyanite, yellow tourmaline, rutile, garnets; near Doe Run village, *hematite*, scapolite, *tremolite;* in R. Baily's limestone quarry, two and a half miles S.W. of Unionville, *fibrous tremolite*, *cyanite*, scapolite.

NEWLIN.—On the serpentine barrens, one and a half miles N.E. of Unionville, *corundum!* massive and crystallized, also in crystals in *albite*, often in loose crystals covered with a thin coating of steatite, talc, picrolite, brucite, *green tourmaline*, with flat pyramidal terminations in albite, *unionite* (rare), *euphyllite*, mica in hexagonal crystals, *feldspar*, *beryl!* in hexagonal crystals, one of which weighs 51 lbs., chromic iron, drusy quartz, green quartz, actinolite, *emerylite*, chloritoid, diallage, *oligoclase;* on Johnson Patterson's farm, massive *corundum*, titaniferous iron, *clinochlore*, *emerylite*, sometimes colored green by chrome, albite, *orthoclase*, halloysite, margarite, garnets, *beryl;* on J. Lesley's farm, *corundum*, crystallized and in massive lumps, one of which weighed 5200 lbs., *diaspore!! emerylite! euphyllite crystallized! green tourmaline*, transparent crystals in the *euphyllite*, orthoclase; two miles N. of Unionville, *magnetite* in octahedral crystals; one mile E. of Unionville, *hematite;* in Edwards's old limestone quarry, purple fluor, rutile.

EAST NOTTINGHAM.—*Sand chrome*, *asbestus*, *chromic iron* in octahedral crystals.

WEST NOTTINGHAM.—At Scott's chrome mine, *chromic iron*, *foliated talc*, marmolite, serpentine, *chalcedony*, *rhodochrome*; at the magnesia quarry, *deweylite*, marmolite, magnesite, leelite, serpentine sand chrome.

EAST PIKELAND.—Iron ore.

WEST PIKELAND.—In the iron mines near Chester Springs, *gibbsite*, *zircon*, *hydro-hematite*, *hematite* (stalactitical and in geodes).

PENN.—Garnets, agalmatolite.

PENNSBURY.—On John Craig's farm, brown garnets, *mica*; on J. Dilworth's farm, near Fairville, *muscovite!* in hexagonal prisms from one quarter to seven inches in diameter; in the village of Fairville, *sunstone*; near Brinton's ford on the Brandywine, *chondrodite*, *sphene*, diopside, *augite*, coccolite: at Mendenhall's old limestone quarry, *fetid quartz*, sunstone.

POCOPSON.—On the farms of John Entrikin and Jos. B. Darlington, *amethyst*.

SADSBURY.—*Rutile!!* splendid geniculated crystals are found loose in the soil for seven miles along the valley, and particularly near the village of Parkesburg, where they sometimes occur weighing one pound, doubly geniculated and of a deep red color; near Sadsbury village, *amethyst*, tourmaline, epidote, *milk quartz*.

SCHUYLKILL.—In the railroad tunnel at PHŒNIXVILLE, *dolomite!* sometimes coated with pyrite, quartz crystals, yellow blende, brookite, *calcite* in hexagonal crystals enclosing *pyrite*; at the WHEATLEY, BROOKDALE, and CHESTER COUNTY LEAD MINES, one and a half miles S. of Phœnixville, *pyromorphite! cerussite! galenite*, *anglesite!!* quartz crystals, chalcopyrite, barite, *fluorite* (white), *stolzite*, *wulfenite! calamine*, *vanadinite*, *blende! mimetene!* native copper, malachite, *azurite*, limonite, *calcite*, *sulphur*, pyrite, indigo copper, black oxide of copper, phosphochalcite, gersdorffite.

THORNBURY.—On Jos. H. Brinton's farm, *muscovite* containing acicular crystals of tourmaline, *rutile*, titaniferous iron.

TREDYFFRIN.—*Pyrite* in cubic crystals loose in the soil.

UWCHLAN.—Massive *blue quartz*, *graphite*.

WARREN.—*Melanite*, feldspar.

WILLISTOWN.—*Magnetite*, *chromite*, actinolite, asbestus.

WEST-TOWN.—On the serpentine rocks 3 miles S. of West Chester, *clinochlore! jefferisite!* mica, asbestus, actinolite, magnesite, *talc*, titaniferous iron.

EAST WHITELAND.—*Pyrite*, in very perfect cubic crystals, is found on nearly every farm in this township, quartz crystals found loose in the soil.

WEST WHITELAND.—At Gen. Trimble's iron mine, *stalactitical hematite! wavellite!!* in radiated stalactites.

WARWICK.—At the Elizabeth mine, and Keim's old iron mine adjoining, one mile N. of Knauertown, *aplome garnet!* in brilliant dodecahedrons, *flosferri*, *pyroxene*, *micaceous iron*, *pyrite* in bright octahedral crystals in calcite, chalcopyrite massive and in single tetrahedral crystals, magnetite, *fascicular hornblende! bornite*, malachite, *brown garnet*, calcite, *byssolite!* serpentine; near the village of St. Mary's, magnetite in dodecahedral crystals, *melanite*, *garnet*, *actinolite* in small radiated nodules; at the Hopewell iron mine, one mile N.W. of St. Mary's, *magnetite* in octahedral crystals.

COLUMBIA CO.—At Webb's mine, yellow blende in calcite; near Bloomsburg, cryst. magnetite.

DAUPHIN CO.—NEAR HAMMELSTOWN.—Green garnets, cryst. *smoky quartz*, feldspar.

DELAWARE CO.—ASTON TOWNSHIP.—*Amethyst*, *corundum*, emerylite, staurolite, *fibrolite*, black tourmaline, pearl mica, *sunstone*, *asbestus*, anthophyllite, steatite; near Tyson's mill, garnet, staurolite; at Peter's mill-dam in the creek, *pyrope garnet*.

BIRMINGHAM.—*Fibrolite*, *kaolin* (abundant), crystals of rutile, *amethyst*; at Bullock's old quarry, zircon, *bucholzite*, nacrite, yellow crystallized quartz, *feldspar*.

BLUE HILL.—Green quartz crystals.

CHESTER.—*Amethyst*, *black tourmaline*, *beryl*, *crystals of feldspar*, *garnet*, cryst. pyrite, *molybdenite*, *molybdic ochre*, chalcopyrite, kaolin.

CHICHESTER.—Near Trainer's mill-dam, *beryl*, tourmaline, crystals of *feldspar*, kaolin; on Wm. Eyre's farm, *tourmaline*.

CONCORD.—*Crystals of mica*, *crystals of feldspar*, *kaolin* abundant, *drusy quartz* of a blue and green color, meerschaum, stellated *tremolite*, some of the rays 6½ in. diameter, *anthophyllite*, fibrolite acicular crystals of *rutile*, pyrope in quartz, amethyst, actinolite, *manganesian garnet*, *beryl*; in Green's creek, *pyrope garnet*.

DARBY.—*Blue* and *gray cyanite*, garnet, staurolite, zoisite, quartz, beryl, chlorite, mica, limonite.

EDGEMONT.—*Amethyst*, oxide of manganese, crystals of *feldspar*; one mile east of Edgemont Hall, *rutile* in quartz.

Green's Creek.—*Garnet* (so-called pyrope).

Marple.—*Tourmaline*, *andalusite*, amethyst, *actinolite*, *anthophyllite*, talc, *radiated actinolite* in talc, chromite, *drusy quartz*, beryl, cryst. pyrite, *titanic iron in quartz*, chlorite.

Middletown.—*Amethyst*, *beryl*, black mica, *mica* with reticulated magnetite between the plates, *manganesian garnets!* large trapezohedral crystals, some 8 in. in diameter, indurated talc, hexagonal crystals of *rutile*, *crystals of mica*, *green quartz!* *anthophyllite*, radiated tourmaline, staurolite, titanic iron, fibrolite, serpentine; at Lenni, *chlorite*, green and bronze *vermiculite!* *green feldspar*: at Mineral Hill, fine crystals of *corundum*, one of which weighs 1½ lbs., *actinolite* in great variety, bronzite, *green feldspar*, *moonstone*, *sunstone*, *graphic granite*, magnesite, *octahedral crystals of chromite* in great quantity, *beryl*, chalcedony, asbestus, *fibrous hornblende*, rutile, staurolite.

Newtown.—Serpentine, hematite.

Upper Providence.—*Anthophyllite*, *tremolite*, *radiated asbestus*, *radiated actinolite*, tourmaline, *beryl*, *green feldspar*, *amethyst* (one found on Morgan Hunter's farm weighing over 7 lbs.), *andalusite!* (one terminated crystal found on the farm of Jas. Worrall weighs 7½ lbs.); at Blue Hill, very fine crystals of *blue quartz* in chlorite, *amianthus* in serpentine.

Lower Providence.—*Amethyst*, *green mica*, garnet, large crystals of *feldspar!* (some over 100 lbs. in weight).

Radnor.—*Garnet*, marmolite, deweylite, chromite, asbestus, magnesite, talc, blue quartz, picrolite, limonite, magnetite.

Springfield.—*Andalusite*, *tourmaline*, beryl, titanic iron, garnet; on Fell's Laurel Hill, beryl, garnet; near Beattie's mill, staurolite, apatite; near Lewis's paper-mill, tourmaline, *mica*.

Thornbury.—*Amethyst*.

HUNTINGDON CO.—Near Frankstown.—In the bed of a stream and on the side of a hill, *fibrous celestite* (abundant), *quartz crystals*.

LANCASTER CO.—Drumore Township.—Quartz crystals.

Fulton.—At Wood's chrome mine, near the village of Texas, *brucite!!* zaratite (emerald nickel), *pennite!* *ripidolite!* *kammererite!* *baltimorite*, *chromic iron*, williamsite, *chrysolite!* marmolite, *picrolite*, hydromagnesite, *dolomite*, magnesite, *aragonite*, calcite, serpentine, hematite, menaccanite, genthite, chrome-garnet, bronzite; at Low's mine, *hydromagnesite*, *brucite* (lancasterite), *picrolite*, magnesite, *williamsite*, *chromic iron*, talc, zaratite, baltimorite, serpentine, hematite; on M. Boice's farm, one mile N.W. of the village, *pyrite*, in cubes and various modifications, *anthophyllite*; near Rock Springs, *chalcedony*, carnelian, *moss agate*, *green tourmaline* in talc, titanic iron, *octahedral magnetite in chlorite*; at Reynold's old mine, calcite, *talc*, picrolite, *chromite*.

Gap Mines.—Chalcopyrite, *pyrrhotite* (niccoliferous), *millerite* in botryoidal radiations, *vivianite!* (rare), actinolite, *pyroxene* crystals, *siderite*.

Pequea Valley.—Eight miles south of Lancaster, argentiferous galenite (said to contain 250 to 300 oz. of silver to the ton?), vauquelinite at Pequea mine; four miles N.W. of Lancaster, on the Lancaster and Harrisburg Railroad, *calamine*, galenite, blende; *pyrite* in cubic crystals is found in great abundance near the city of Lancaster; at the Lancaster zinc mines, *calamine*, blende, tennantite? *smithsonite* (pseud. of dolomite), *aurichalcite*.

LEBANON CO.—Cornwall.—*Magnetite*, *pyrite* (cobaltiferous), chalcopyrite, *native copper*, *azurite*, *malachite*, *chrysocolla*, *cuprite*, *allophane*, *brochantite*, serpentine, quartz pseudomorphs; *galenite* (with octahedral cleavage), fluorite.

LEHIGH CO.—Friedensville.—At the zinc mines, *calamine*, *smithsonite*, hydrozincite, massive blende, sulphid of cadmium, quartz, allophane, zinciferous clay; near Allentown, magnetite, pipe-iron ore; near Bethlehem, on S. Mountain, *allanite*, with zircon and altered sphene in syenite, magnetite, black spinel, tourmaline.

MONROE CO.—In Cherry Valley.—*Calcite*, chalcedony, quartz; in Poconac Valley, near Judge Mervine's, cryst. quartz.

MONTGOMERY CO.—Conshohocken.—Fibrous tourmaline, titanic iron, aventurine quartz, phyllite; in the quarry of Geo. Bullock, *calcite* in hexagonal prisms, aragonite.

Lower Providence.—At the Perkiomen lead and copper mines, near the village of Shannonville, azurite, *blende*, *galenite*, pyromorphite, cerussite, wulfenite, anglesite, barite, calamine, chalcopyrite, malachite, chrysocolla, *brown spar*.

White Marsh.—At D. O. Hitner's iron mine, five and a half miles from Spring Mills, limonite in geodes and stalactites, *göthite*, pyrolusite, wad, lepidocrocite; at Edge Hill Street, North Pennsylvania Railroad, titanic iron; one mile S.W. of Hitner's iron mine, *limonite*, velvety, stalactitic, and fibrous, fibres three inches long, *göthite*, pyrolusite, *velvet manganese*, wad; near Marble Hall, a Hitner's marble quarry, white marble, granular barite, resembling marble; at Spring Mills, limonite; at Flat Rock Tunnel, opposite Manayunk, *stilbite*, *heulandite*, *chabasite*, beryl, feldspar, mica.

NORTHUMBERLAND CO.—Opposite Selinsgrove.—Calamine.

NORTHAMPTON CO.—Near Easton.—*Zircon!* (exhausted), nephrite, coccolite, tremolite, pyroxene, sahlite, limonite, magnetite, purple calcite.

PHILADELPHIA CO.—Frankford.—On the Philadelphia, Trenton and Connecting Railroad, basinite; at the quarries on Frankford Creek, stilbite, molybdenite, hornblende; on the Connecting Railroad, wad, earthy cobalt.

Fairmount Water Works.—In the quarries opposite Fairmount, *lime uranite! copper uranite*, crystals of *feldspar*, beryl, pseudomorphs after beryl, tourmaline, albite, wad, menaccanite.

Gorgas' and Crease's Lane.—Tourmaline, cyanite, staurolite, hornstone.

Hestonville.—Alunogen, iron alum.

Heft's Mill.—Alunogen, tourmaline, cyanite, titanic iron.

Manayunk.—At the soapstone quarries above Manayunk, talc, *steatite*, chlorite, vermiculite, *anthophyllite*, staurolite, dolomite, apatite, asbestus, brown spar, epsomite.

Magarge's Paper-mill.—Staurolite, titanic iron, hyalite, *apatite*, green mica, iron garnets in great abundance.

McKinney's Quarry, on Rittenhouse Lane.—Feldspar, *apatite*, *stilbite*, natrolite, *heulandite*, epidote, hornblende, erubescite, malachite.

SCHUYLKILL CO.—Tamaqua, near Pottsville, in coal mines.—*Kaolinite.*

DELAWARE.

NEWCASTLE CO.—Brandywine Springs.—*Bucholzite*, *fibrolite* abundant, sahlite, pyroxene; Brandywine Hundred, muscovite, enclosing reticulated magnetite.

Dixon's Feldspar Quarries, six miles N.W. of Wilmington (these quarries have been worked for the manufacture of porcelain).—*Adularia*, *albite*, *oligoclase*, *beryl*, *apatite*, *cinnamon-stone!!* (both granular like that from Ceylon, and crystallized, rare), magnesite, serpentine, asbestus, black *tourmaline!* (rare), *indicolite!* (rare), sphene in pyroxene, cyanite.

Dupont's Powder Mills.—"Hypersthene."

Eastburn's Limestone Quarries, near the Pennsylvania line.—*Tremolite*, *bronzite*.

Quarryville.—Garnet, spodumene, fibrolite, sillimanite.

Near Newark, on the railroad.—Sphærosiderite on drusy quartz, jasper (ferruginous opal), cryst. spathic iron in the cavities of cellular quartz.

Way's Quarry, two miles south of Centreville.—*Feldspar* in fine cleavage masses, *apatite*, *mica*, *deweylite*, *granular quartz*.

Wilmington.—In Christiana quarries, *metalloidal diallage*.

Kennett Turnpike, near Centreville.—Cyanite and garnet.

HARFORD CO.—Cerolite.

KENT CO.—Near Middletown, in Wm. Polk's marl pits.—*Vivianite!*

On Chesapeake and Delaware Canal.—Retinasphalt, pyrite, amber.

SUSSEX CO.—Near Cape Henlopen.—Vivianite.

MARYLAND.

Baltimore (Jones's Falls, 1¼ miles from B.).—Chabazite (haydenite), heulandite (beaumontite of Levy), pyrite, lenticular carbonate of iron, *mica*, *stilbite*.

Sixteen miles from Baltimore, on the Gunpowder.—*Graphite.*

Twenty-three miles from B., on the Gunpowder.—*Talc.*

Twenty-five miles from B., on the Gunpowder.—*Magnetite*, *sphene*, pycnite,

Thirty miles from B., in Montgomery Co., on farm of S. Eliot.—Gold in quartz.

Eight to twenty miles north of B., in limestone.—*Tremolite*, *augite*, *pyrite*, brown and yellow tourmaline.

Fifteen miles north of B.—*Sky-blue chalcedony* in granular limestone.

Eighteen miles north of B., at Scott's mills.—*Magnetite*, cyanite.

BARE HILLS.—*Chromite*, *asbestus*, *tremolite*, *talc*, hornblende, serpentine, chalcedony, meerschaum baltimorite, *chalcopyrite*, magnetite.

CAPE SABLE, near Magothy R.—Amber, pyrite, alum slate.

CARROLL CO.—Near Sykesville, Liberty Mines, gold, magnetite, *pyrite* (*octahedrons*), *chalcopyrite*, linnæite (carrollite); at Patapsco Mines, near Finksburg, bornite, *malachite*, siegenite, *linnæite*, *remingtonite*, magnetite, *chalcopyrite;* at Mineral Hill mine, *bornite*, chalcopyrite, ore of *nickel* (see above), gold, magnetite.

CECIL CO., north part.—*Chromite* in serpentine.

COOPTOWN, Harford Co.—Olive-colored *tourmaline*, *diallage*, *talc* of green, blue, and rose colors, *ligniform asbestus*, *chromite*, *serpentine*.

DEER CREEK.—*Magnetite!* in chlorite slate.

FREDERICK CO.—Old Liberty mine, near Liberty Town, black copper, malachite, chalcocite, specular iron; at Dollyhyde mine, *bornite*, chalcopyrite, pyrite, argentiferous galenite in dolomite.

MONTGOMERY CO.—*Oxyd of manganese*.

SOMERSET and **WORCESTER COS.**, north part.—*Bog-iron ore*, *vivianite*.

ST. MARY'S RIVER.—*Gypsum!* in clay.

VIRGINIA AND DISTRICT OF COLUMBIA.

ALBEMARLE CO., a little west of the Green Mts.—*Steatite*, *graphite*, galena.

AMHERST CO., along the west base of Buffalo ridge.—*Copper ores*, etc.

AUGUSTA CO.—At Weyer's (or Weir's) cave, sixteen miles northeast of Staunton, and eighty-one miles northwest of Richmond, calcite, stalactites.

BUCKINGHAM CO.—*Gold* at Garnett and Moseley mines, also pyrite, pyrrhotite, calcite, garnet; at Eldridge mine (now London and Virginia mines) near by, and the Buckingham mines near Maysville, gold, auriferous pyrite, chalcopyrite, tennantite, *barite; cyanite*, *tourmaline*, *actinolite*.

CHESTERFIELD CO.—Near this and Richmond Co., bituminous coal, native coke.

CULPEPPER CO, on Rapidan river.—Gold, pyrite.

FRANKLIN CO.—Grayish steatite.

FAUQUIER CO., Barnet's mills.—Asbestus; gold mines, *barite*, *calcite*.

FLUVANNA CO.—Gold at Stockton's mine; also tetradymite at "Tellurium mine."

PHENIX Copper mines.—*Chalcopyrite*, etc.

GEORGETOWN, D. C.—Rutile.

GOOCHLAND CO.—Gold mines (Moss and Busby's).

HARPER'S FERRY, on both sides of the Potomac.—Thuringite (owenite) with quartz.

JEFFERSON CO., at Shepherdstown.—Fluor.

KENAWHA CO.—At Kenawha, *petroleum*, brine springs, cannel coal.

LOUDON CO.—*Tabular quartz*, *prase*, *pyrite*, *talc*, *chlorite*, *soapstone*, asbestus, *chromite*, *actinolite*, *quartz crystals; micaceous iron*, bornite, malachite, epidote, near Leesburg (Potomac mine).

LOUISA CO.—Walton gold mine, gold, pyrite, chalcopyrite, argentiferous galenite, siderite, blende, anglesite; boulangerite, blende (at Tinder's mine).

NELSON CO.—Galenite, chalcopyrite, malachite.

ORANGE CO.—Western part, Blue Ridge, specular iron; gold at the Orange Grove and Vaucluse gold mines, worked by the "Freehold" and "Liberty" Mining Companies.

ROCKBRIDGE CO., three miles southwest of Lexington.—Barite.

SHENANDOAH CO., near Woodstock.—Fluorite.

MT. ALTO, Blue Ridge.—Argillaceous iron ore.

SPOTSYLVANIA CO., two miles northeast of Chancellorville.—*Cyanite;* gold mines at the junction of the Rappahannock and Rapidan; on the Rappahannock (Marshall mine); Whitehall mine, affording also tetradymite.

STAFFORD CO., eight or ten miles from Falmouth.—Micaceous iron, gold, tetradymite, silver, galenite, vivianite.

WASHINGTON CO., eighteen miles from Abingdon.—*Rock salt* with *gypsum*.

WYTHE CO. (Austin's mines).—*Cerussite*, *minium*, *plumbic ochre*, blende, *calamine*, *galenite*.

On the Potomac, twenty-five miles north of Washington city.—*Native sulphur* in gray compact limestone.

NORTH CAROLINA.

ASHE CO.—Malachite, chalcopyrite.

Buncombe Co.—Corundum (from a boulder), *margarite*, corundophilite, *garnet*, chromite, barite, *fluorite*, rutile, iron ores, oxyd of manganese, *zircon*.

Burke Co.—Gold, monazite, zircon, beryl, *corundum*, *garnet*, sphene, *graphite*, iron ores.

Cabarrus Co.—Phenix Mine, gold, barite, *chalcopyrite*, auriferous pyrite, quartz pseudomorph after barite, tetradymite; Pioneer mines, *gold*, limonite, pyrolusite, *barnhardtite*, *wolfram*, *scheelite*, tungstate of copper, tungstite, diamond, chrysocolla, chalcocite, molybdenite, *chalcopyrite*, *pyrite*, White mine, needle ore, chalcopyrite, barite; Long and Muse's mine, argentiferous galenite, pyrite, chalcopyrite, limonite; Boger mine, tetradymite; Fink mine, valuable copper ores; Mt. Makins, tetrahedrite, magnetite, talc, blende, pyrites, proustite, galenite; Baugle mine, scheelite.

Caldwell Co.—Chromite.

Chatham Co.—Mineral coal, pyrite.

Cherokee Co.—Iron ores, gold, galenite, corundum, rutile.

Davidson Co.—King's, now Washington mine, native silver, cerussite, anglesite, scheelite, pyromorphite, galenite, blende, malachite, black copper, *wavellite*, garnet, stilbite; five miles from Washington mine, on Faust's farm, gold, *tetradymite*, oxyd of bismuth and tellurium, chalcopyrite, limonite, spathic iron, epidote; near Squire Ward's, gold in crystals, electrum.

Franklin Co.—At Partis mine, diamonds.

Gaston Co.—Iron ores, corundum, margarite; near Crowder's Mountain (in what was formerly Lincoln Co.), *lazulite*, *cyanite*, *garnet*, graphite; also twenty miles northeast, near south end of Clubb's Mtn., lazulite, cyanite, talc, rutile, topaz, *pyrophyllite*.

Guilford Co.—McCulloch copper and gold mine, twelve miles from Greensboro', *gold*, *pyrite*, *chalcopyrite* (worked for copper), *quartz*, spathic iron. The North Carolina Copper Co. are working the copper ore at the old Fentress mine; at Deep River, compact *pyrophyllite* (worked for slate-pencils).

Henderson Co.—*Zircon*, sphene (xanthitane).

Jackson Co.—Alunogen! at Smoky Mt.; at Webster, serpentine, chromite, genthite, *chrysolite*, talc.

Lincoln Co.—Diamond; at Randleman's, *amethyst!* rose quartz.

Macon Co.—Chromite.

McDowell Co.—Brookite, monazite, corundum in small crystals red and white, *zircons*, garnet, beryl, sphene, xenotime, rutile, elastic sandstone, iron ores, pyromelane.

Mecklenburg Co.—Near Charlotte (Rhea and Cathay mines) and elsewhere, *chalcopyrite*, *gold*; chalcotrichite at McGinn's mine; barnhardtite near Charlotte; pyrophyllite in Cotton Stone Mountain, diamond; Flowe mine, scheelite, wolframite; Todd's Branch, *monazite*.

Montgomery Co.—Steele's mine, ripidolite, albite.

Moore Co.—Carbonton, compact pyrophyllite.

Rowan Co.—Gold Hill mines, thirty-eight miles northeast of Charlotte, and fourteen from Salisbury, gold, auriferous pyrite; ten miles from Salisbury, *feldspar* in crystals, *bismuthine*.

Rutherford Co.—*Gold*, *graphite*, bismuthic gold, diamond, euclase, *pseudomorphous quartz*, chalcedony, corundum in small crystals, *epidote*, *pyrope*, brookite, zircon, monazite, rutherfordite, samarskite, *quartz crystals*, itacolumite; on the road to Cooper's Gap, cyanite.

Stokes and Surrey Cos.—Iron ores, graphite.

Union Co.—Lemmond gold mine, eighteen miles from Concord (at Stewart's and Moore's mine), gold, quartz, blende, argentiferous galenite (containing 29·4 oz. of gold and 86·5 oz. of silver to the ton, Genth), pyrite, some chalcopyrite.

Yancey Co.—*Iron ores*, amianthus, *chromite*.

SOUTH CAROLINA.

Abbeville Dist.—Oakland Grove, *gold* (Dorn mine), galenite, pyromorphite, amethyst, garnet.

Anderson Dist.—At Pendleton, *actinolite*, galenite, kaolin, *tourmaline*.

Charleston.—*Selenite*.

Cheowee Valley.—Galenite, tourmaline, gold.

Chesterfield Dist.—Gold (Brewer's mine), talc, chlorite, pyrophyllite, pyrite, native bismuth, carbonate of bismuth, red and yellow ochre, whetstone, enargite.

Darlington.—Kaolin.

Edgefield Dist.—Psilomelane.

Greenville Dist.—Galenite, phosphate of lead, kaolin, chalcedony in buhrstone, beryl, plumbago, epidote, *tourmaline*.

Kershaw Dist.—*Rutile*.

Lancaster Dist.—Gold (Hale's mine), talc, chlorite, cyanite, elastic sandstone, pyrite; gold also at Blackman's mine, Massey's mine, Ezell's mine.

Newberry Dist.—Leadhillite (?).

Pickens Dist.—Gold, manganese ores, kaolin.

Richland Dist.—Chiastolite, novaculite.

Spartanburg Dist.—*Magnetite*, chalcedony, *hematite;* at the Cowpens, limonite, *graphite*, limestone, copperas; Morgan mine, leadhillite, pyromorphite, cerussite.

Sumter Dist.—Agate.

Union Dist.—Fairforest gold mines, pyrite, chalcopyrite.

York Dist.—Limestones, whetstones, witherite, barite.

GEORGIA.

Burke and Scriven Cos.—Hyalite.

Cherokee Co.—At Canton Mine, chalcopyrite, galenite, clausthalite, plumbogummite, hitchcockite, *mispickel*, lanthanite, *harrisite*, *cantonite*, pyromorphite, automolite, zinc, staurolite, cyanite; at Ball-Ground, spodumene.

Clark Co., near Clarksville.—Gold, *xenotime*, zircon, rutile, cyanite, specular iron, garnet, quartz.

Dade Co.—Halloysite, near Rising Fawn.

Fannin Co.—*Staurolite*, chalcopyrite.

Habersham Co.—*Gold*, iron and copper pyrites, *galenite*, hornblende, garnet, quartz, kaolinite, soapstone, chlorite, *rutile*, iron ores, tourmaline, staurolite, zircon.

Hall Co.—*Gold*, quartz, kaolin, diamond.

Hancock Co.—Agate, chalcedony.

Heard Co.—*Molybdite*, quartz.

Lincoln Co.—*Lazulite! ! rutile! !* hematite, cyanite, menaccanite, *pyrophyllite*, gold, itacolumite rock.

Lumpkin Co.—At Field's gold mine near Dahlonega, *gold*, *tetradymite*, pyrrhotite, chlorite, menaccanite, allanite, apatite.

Rabun Co.—Gold, *chalcopyrite*.

Washington Co., near Saundersville.—*Wavellite*, *fire opal*.

ALABAMA.

Bibb Co., Centreville.—*Iron ores*, marble, *barite*, coal, cobalt.

Tuscaloosa Co.—*Coal*, galenite, pyrite, vivianite, limonite, calcite, dolomite, cyanite, steatite, quartz crystals, manganese ores.

Benton Co.—Antimonial lead ore (boulangerite?).

FLORIDA.

Near Tampa Bay.—Limestone, sulphur springs, chalcedony, carnelian, agate, silicified shells and corals.

KENTUCKY.

Anderson Co.—Galenite, barite.

Clinton Co.—Geodes of quartz.

Crittenden Co.—Galenite, fluorite, calcite.

Cumberland Co.—At Mammoth Cave, *gypsum rosettes!* calcite, stalactites, nitre, epsomite.

Fayette Co.—Six miles N.E. of Lexington, galenite, barite, witherite, blende.

Livingstone Co., near the line of Union Co.—Galenite, chalcopyrite.

Mercer Co.—At McAfee, *fluorite*, *pyrite*, calcite, barite, celestite.

Owen Co.—Galenite, barite.

TENNESSEE.

Brown's Creek.—Galenite, blende, barite, celestite.

Carter's Co., foot of Roan Mt.—*Sahlite*, magnetite.

Claiborne Co.—*Calamine*, galenite, smithsonite, chlorite, steatite, magnetite.

Cocke Co., near Brush Creek.—Cacoxene? kraurite, iron sinter, stilpnosiderite, brown hematite.

Davidson Co.—Selenite, with granular and snowy *gypsum*, or alabaster, crystallized and compact *anhydrite*, *fluorite* in crystals? *calcite* in crystals. Near Nashville, blue *celestite* (crystallized, fibrous, and radiated), with *barite* in limestone. Haysboro', galenite, blende, with barite as the gangue of the ore.

Dickson Co.—Manganite.

JEFFERSON Co.—*Calamine,* galenite, fetid barite.

KNOX Co.—Magnesian limestone, *native iron, variegated marbles!*

MAURY Co.—Wavellite in limestone.

MORGAN Co.—Epsom salt, nitrate of lime.

POLK Co., Ducktown mines, southeast corner of State.—*Black copper!* chalcopyrite, pyrite, native copper, bornite, rutile, *zoisite,* galenite, *harrisite,* alisonite, blende, *pyroxene, tremolite, sulphates of copper and iron* in stalactites, allophane, rahtite, chalcocite (ducktownite), chalcotrichite, azurite, malachite, *pyrrhotite,* limonite.

ROAN Co., eastern declivity of Cumberland Mts.—Wavellite in limestone.

SEVIER Co., in caverns.—Epsom salt, soda alum, saltpetre, nitrate of lime, *breccia marble.*

SMITH Co.—Fluorite.

SMOKY MT., on declivity.—Hornblende, garnet, staurolite.

WHITE Co.—*Nitre.*

OHIO.

BAINBRIDGE (Copperas Mt., a few miles east of B.).—Calcite, barite, pyrite, copperas, alum.

CANFIELD.—*Gypsum!*

DUCK CREEK, Monroe Co.—Petroleum.

LAKE ERIE.—Strontian Island, *celestite!* Put-in Bay Island, *celestite! sulphur!* calcite.

LIVERPOOL.—Petroleum.

MARIETTA.—Argillaceous iron ore; iron ore abundant also in Scioto and Lawrence Cos.

OTTAWA Co.—Gypsum.

POLAND.—*Gypsum!*

MICHIGAN.

BREST (Monroe Co.).—*Calcite,* amethystine quartz, apatite, celestite.

GRAND RAPIDS.—*Selenite,* fib. and granular gypsum, *calcite, dolomite, anhydrite.*

LAKE SUPERIOR MINING REGION.—The four principal regions are Keweenaw Point. Isle Royale, the Ontonagon, and Portage Lake. The mines of Keweenaw Point are along two ranges of elevation, one known as the Greenstone Range, and the other as the Southern or Bohemian Range (Whitney). The copper occurs in the trap or amygdaloid, and in the associated conglomerate. *Native copper! native silver!* chalcopyrite, horn silver, gray copper, manganese ores, epidote, *prehnite, laumontite, datolite,* heulandite, orthoclase, *analcite,* chabazite, compact datolite, chrysocolla, *mesotype* (Copper Falls mine), *leonhardite* (ib.), *analcite* (ib.), *apophyllite* (at Cliff mine), *wollastonite* (ib.), *calc spar! quartz* (in crystals at Minnesota mine), compact datolite, orthoclase (Superior mine), *saponite, black oxyd* of copper (near Copper Harbor, but exhausted), chrysocolla; on Chocolate River, galenite and sulphid of copper; chalcopyrite and native copper at Presq' Isle; at Albion mine, *domeykite;* at Prince Vein, *barite, calcite, amethyst;* at Michipicoten Ids., copper nickel, stilbite, analcite; at Albany and Boston mine, Portage Lake, *prehnite, analcite, orthoclase,* cuprite; at Sheldon location, *domeykite, whitneyite, algodonite;* Isle Royale mine, Portage Lake, compact datolite; Quincy mine, calcite, compact datolite.

MARQUETTE.—Manganite, galenite; twelve miles west at Jackson Mt., and other mines, *hematite, limonite, göthite!* magnetite, jasper.

MONROE.—Aragonite, apatite.

POINT AUX PEAUX (Monroe Co.).—*Amethystine quartz, apatite,* celestite, *calcite.*

SAGINAW BAY.—At Alabaster, *gypsum.*

STONY POINT (Monroe Co.).—Apatite, amethystine quartz, celestite, calcite.

ILLINOIS.

GALLATIN Co., on a branch of Grand Pierre Creek, sixteen to thirty miles from Shawneetown, down the Ohio, and from half to eight miles from this river.—*Violet fluorite!* in carboniferous limestone, barite, *galenite,* blende, brown iron ore.

HANCOCK Co.—At Warsaw, *quartz geodes!* containing *calcite! chalcedony, dolomite, blende!* brown spar, pyrite, aragonite, gypsum, bitumen.

HARDIN Co.—Near Rosiclare, *calcite,* galenite, blende; five miles back from Elizabethtown, bog iron; one mile north of the river, between Elizabethtown and Rosiclare, *nitre.*

JO DAVIES Co.—At Galena, *galenite,* calcite, *pyrite,* blende; at Marsden's diggings, *galenite! blende, cerussite, pyrite!* in stalactitic forms.

JOLIET.—*Marble.*

QUINCY.—*Calcite!* pyrite.

SCALES MOUND.—*Barite,* pyrite.

INDIANA.

LIMESTONE CAVERNS; Corydon Caves, etc.—*Epsom salt.*

In most of the southwest counties, *pyrite, sulphate of iron*, and *feather alum;* on Sugar Creek, pyrite and *sulphate of iron;* in sandstone of Lloyd Co., near the Ohio, *gypsum;* at the top of the blue limestone formation, *brown spar, calcite.*

MINNESOTA.

NORTH SHORE OF L. SUPERIOR (range of hills running nearly northeast and southwest, extending from Fond du Lac Superieure to the Kamanistiqueia River in Upper Canada).—*Scolecite, apophyllite, prehnite, stilbite, laumontite, heulandite, harmotome,* thomsonite, *fluorite, barite, tourmaline, epidote,* hornblende, calcite, quartz crystals, pyrite, magnetite, steatite, blende, black oxyd of copper, malachite, native copper, chalcopyrite, amethystine quartz, ferruginous quartz, *chalcedony, carnelian, agate,* drusy quartz, hyalite? fibrous quartz, jasper, prase (in the debris of the lake shore), dogtooth spar, augite, native silver, spodumene? arsenate of cobalt? chlorite; between Pigeon Point and Fond du Lac, near Baptism River, saponite (thalite) in amygdaloid.

KETTLE RIVER TRAP RANGE.—Epidote, nail-head calcite, amethystine quartz, calcite, undetermined zeolites, saponite.

STILLWATER.—Blende.

FALLS OF THE ST. CROIX.—Green carbonate of copper, native copper, epidote, nail-head spar.

RAINY LAKE.—Actinolite, tremolite, fibrous hornblende, garnet, pyrite, magnetite, steatite.

WISCONSIN.

BIG BULL FALLS (near).—Bog iron.

BLUE MOUNDS.—Cerussite.

LAC DU FLAMBEAU R.—Garnet, cyanite.

LEFT HAND R. (near small tributary).—Malachite, chalcocite, native copper, red copper ore arthy malachite, epidote, chlorite? quartz crystals.

LINDEN.—*Galenite, smithsonite, hydrozincite.*

MINERAL POINT and vicinity.—Copper and lead ores, chrysocolla, *azurite!* chalcopyrite, malachite, *alenite,* cerussite, anglesite, blende, *pyrite,* barite, *calcite, marcasite, smithsonite!* (so-called dry-bone).

MONTREAL RIVER PORTAGE.—Galenite in gneissoid granite.

SANK CO.—Specular iron! malachite, chalcopyrite.

SHULLSBURG.—*Galenite!* blende, pyrite; at Emett's diggings, *galenite* and pyrite.

IOWA.

DU BUQUE LEAD MINES, and elsewhere.—*Galenite! calcite, blende,* black oxyd of manganese; at wing's and Sherard's diggings, *smithsonite,* calamine; at Des Moines, quartz crystals, selenite; lakoqueta R., *brown iron ore;* near Durango, galenite.

CEDAR RIVER, a branch of the Des Moines.—*Selenite* in crystals, in the bituminous shale of the al measures; also elsewhere on the Des Moines, gypsum abundant; argillaceous iron ore, athic iron; copperas in crystals on the Des Moines, above the mouth of Saap and elsewhere, *yrite,* blende.

FORT DODGE.—*Celestite.*

MAKOQUETA.—Hematite.

NEW GALENA.—Octahedral galenite, anglesite.

MISSOURI.

BIRMINGHAM.—Limonite.

JEFFERSON CO., at Valle's diggings.—*Galenite, cerussite,* anglesite, calamine, chalcopyrite, malaite, azurite, witherite.

MINE A BURTON.—*Galenite, cerussite, anglesite. barite,* calcite.

DEEP DIGGINGS.—Carbonate of copper, *cerussite* in crystals, and manganese ore.

MADISON CO.—Wolframite.

MINE LA MOTTE.—*Galenite!* malachite, *earthy cobalt* and *nickel,* bog manganese, sulphuret of iron d nickel, *cerussite,* caledonite, plumbogummite, wolframite, *siegenite,* smaltite.

T. FRANCIS RIVER.—Wolframite.

PERRY'S DIGGINGS, and elsewhere.—Galenite, etc.

Forty miles west of the Mississippi and ninety south of St. Louis, the iron mountains, specula n, limonite; 10 m. east of Ironton, wolframite, tungstite.

ARKANSAS.

Batesville.—In bed of White R., some miles above Batesville, gold.

Green Co.—Near Gainesville, lignite.

Hot Springs Co.—At Hot Springs, thuringite; Magnet Cove, *brookite! schorlomite, elæolite*, magnetite, quartz, green coccolite, garnet, apatite, *perowskite*, rutile, ripidolite, thomsonite (ozarkite

Independence Co.—Lafferay Creek, psilomelane.

Lawrence Co.—Hoppe, Bath, and Koch mines, *smithsonite*, dolomite, galenite; nitre.

Marion Co.—Wood's mine, smithsonite, hydrozincite (marionite), galenite; Poke bayou *braunite?*

Ouachita Springs.—*Quartz!* whetstones.

Pulaski Co.—Kellogg mine, 10 m. north of Little Rock, *tetrahedrite, tennantite*, nacrite, galenite, blende, quartz.

CALIFORNIA.

The principal *gold mines* of California are in Tulare, Fresno, Mariposa, Tuolumne, Calaveras, El Dorado, Placer, Nevada, Yuba, Sierra, Butte, Plumas, Shasta, Siskiyou, and Del Norte counties, although gold is found in almost every county of the State. The gold occurs in quartz, associated with sulphids of iron, copper, zinc, and lead; in Calaveras and Tuolomne counties, at the Mellones, Stanislaus, Golden Rule, and Rawhide mines, associated with tellurids of gold and silver; it is also largely obtained from placer diggings, and further it is found in beach washings in Del Norte and Klamath counties.

The *copper mines* are principally at or near Copperopolis, in Calaveras county; near Genesee Valley, in Plumas county; near Low Divide, in Del Norte county; on the north fork of Smith's River; at Soledad, in Los Angeles county.

The *mercury mines* are at or near New Almaden and North Almaden, in Santa Clara county; at New Idria and San Carlos, Monterey county; in San Luis Obispo county; at Pioneer mine and other localities in Lake county; in Santa Barbara county.

Alpine Co.—Morning Star mine, *enargite*, stephanite, polybasite, barite, quartz, pyrite.

Amador Co.—At Volcano, chalcedony, *hyalite*.

Alameda Co.—Diabolo Range, magnesite.

Butte Co.—Cherokee Flat, *diamond*.

Calaveras Co.—Copperopolis, *chalcopyrite*, malachite, *azurite, serpentine, picrolite*, native copper, near Murphy's, jasper, opal; albite, with gold and pyrite; Mellones mine, *calaverite, petzite*.

Contra-Casta Co.—San Antonio, chalcedony.

Del Norte Co.—Crescent City, agate, carnelian; Low Divide, chalcopyrite, bornite, malachite; on the coast, iridosmine, platinum.

El Dorado Co.—Pilot Hill, chalcopyrite; near Georgetown, hessite, from placer diggings; Roger's Claim, Hope Valley, *grossular garnet*, in copper ore; Coloma, *chromite;* Spanish Dry Diggings, *gold*.

Fresno Co.—Chowchillas, *andalusite*.

Ingo Co.—Ingo district, *galenite, cerussite*, dolomite, *barite*, atacamite, calcite, *grossular garnet!*

Lake Co.—Borax Lake, *borax!* boric acid, *glauberite;* Pioneer mine, cinnabar, native mercury, selenid of mercury; near the Geysers, sulphur, hyalite.

Los Angeles Co.—Near Santa Anna River, *anhydrite;* William's Pass, chalcedony; Soledad mines, chalcopyrite, *garnet*, gypsum; Mountain Meadows, garnet, in copper ore.

Mariposa Co.—Chalcopyrite; Centreville, cinnabar; Pine Tree mine, tetrahedrite; Burns Creek, limonite; Geyer Gulch, pyrophyllite; La Victoria mine, *azurite!* near Coulterville, *cinnabar, gold*.

Mono Co.—Partzite.

Monterey Co.—Alisal Mine, arsenic; near Paneches, chalcedony; New Idria mine, cinnabar; near New Idria, chromite, zaratite, chrome garnet; near Pachecos Pass, stibnite.

Nevada Co.—Grass Valley, *gold!* in quartz veins, with pyrite, chalcopyrite, blende, mispickel, galenite, *quartz*, biotite; near Truckee Pass, gypsum; Excelsior Mine, molybdenite, with molybdite and gold; Sweet Land, pyrolusite.

Placer Co.—Miners' Ravine, *epidote!* with *quartz, gold*.

Plumas Co.—Genesee Valley, chalcopyrite; Hope mines, *bornite*, sulphur.

Santa Barbara Co.—San Amedio Cañon, stibnite, asphaltum, bitumen, maltha, petroleum, cinnabar, iodid of mercury; Santa Clara River, sulphur.

San Diego Co.—Carisso Creek, gypsum; San Isabel, tourmaline, orthoclase, garnet.

San Francisco Co.—Red Island, pyrolusite and manganese ores.

Santa Clara Co.—New Almaden, *cinnabar, calcite, aragonite*, serpentine, chrysolite, quartz; North Almaden, chromite; Mt. Diabolo Range, magnesite.

San Luis Obispo Co.—Asphaltum, cinnabar.

San Bernardino Co.—Colorado River, agate, trona; Temescal, cassiterite; Russ District, galenite, cerussite; Francis mine, cerargyrite.

Shasta Co.—Near Shasta City, hematite, in large masses.

Siskiyou Co.—Surprise Valley, selenite, in large slabs.

Sonoma Co.—Actinolite, garnets.

Tulare Co.—Near Visalia, magnesite, asphaltum.

Tuolumne Co.—Tourmaline, tremolite; Sonora, *graphite;* York Tent, chromite; Golden Rule mine, *petzite*, *calaverite*, altaite, hessite, magnesite, tetrahedrite, gold; Whiskey Hill, *gold!*

Trinity Co.—Cassiterite, a single specimen found.

LOWER CALIFORNIA.

La Paz.—Cuproscheelite. Loretto.—Natrolite, siderite, selenite.

NEVADA.

Carson Valley.—Chrysolite.

Churchill Co.—Near Ragtown, *gay-lussite*, trona, common salt.

Comstock Lode.—Gold, *native silver*, *argentite*, *stephanite*, *polybasite*, pyrargyrite, proustite, tetrahedrite, cerargyrite, pyrite, chalcopyrite, galenite, blende, pyromorphite, arsenical antimony, arsenolite, quartz, calcite, gypsum, cerussite, cuprite, wulfenite, amethyst, küstelite

Esmeralda Co.—Alum, 12 m. north of Silver Creek; at Aurora, fluorite, stibnite; near Mono Lake, native copper and cuprite, obsidian; Columbus district, borate of lime; Walker Lake, gypsum, hematite; Silver Peak, *salt*, saltpetre, sulphur, silver ores.

Humboldt District.—Sheba mine, *native silver*, *jamesonite*, stibnite, *tetrahedrite*, proustite, blende, cerussite, calcite, bournonite, pyrite, galenite, malachite, xanthocone (?).

Mammoth District.—*Orthoclase*, turquois, *hübnerite*, scheelite.

Reese River District.—Native silver, *proustite*, *pyrargyrite*, stephanite, blende, polybasite, rhodochrosite, embolite, *tetrahedrite!* cerargyrite, embolite.

San Antonia.—Belmont mine, stetefeldtite.

Six Mile Cañon.—*Selenite.*

Ormsby Co.—W. of Carson, *epidote.*

Storey Co.—Alum, natrolite, scolezite.

ARIZONA.

On and near the Colorado, gold, silver, and copper mines; at Bill Williams's Fork, chrysocolla, malachite, atacamite, brochantite; Dayton Lode, gold, fluorite, cerargyrite; Skinner Lode, octahedral fluorite; at various places in the southern part of the territory, silver and copper mines; Heintzelmann mine, *stromeyerite*, chalcocite, tetrahedrite, atacamite.

OREGON.

Gold is obtained from beach washings on the southern coast; quartz mines and placer mines in he Josephine district; also on the Powder, Burnt, and John Day's rivers, and other places in astern Oregon; platinum, iridosmine, on the Rogue River, at Port Orford, and Cape Blanco.

IDAHO.

In the Owyhee, Boise, and Flint districts, *gold*, also extensive silver mines; Poorman Lode, *cerar- yrite! proustite*, *pyrargyrite! native silver*, *gold*, pyromorphite, quartz, malachite; polybasite; on ordan Creek, stream tin; Rising Star mine, *stephanite*, *argentite*, pyrargyrite.

COLORADO.

The principal gold mines of Colorado are in Boulder, Gilpin, Clear Creek, and Jefferson Cos., on line of country a few miles W. of Denver, extending from Long's Peak to Pike's Peak. A large portion of the gold is associated with veins of pyrite and chalcopyrite; silver and lead mines are a and near Georgetown, Clear Creek Co., and to the westward in Summit Co., on Snake and Swa rivers; Willis Gulch, near Black Hawk, *enargite* with pyrite, fluorite, scorodite?

CANADA.

CANADA EAST.

Abercrombie.—Labradorite.

Bay St. Paul.—*Menaccanite!* apatite, allanite, rutile (or brookite?).

Aubert.—Gold, iridosmine, platinum.

Bolton.—*Chromite*, *magnesite*, serpentine, picrolite, steatite, bitter spar, wad.

Boucherville.—*Augite* in trap.

Brome.—*Magnetite*, chalcopyrite, *sphene*, menaccanite, phyllite, sodalite, cancrinite, galenite, chloritoid.

Chambly.—Analcime, chabazite and calcite in trachyte, *menaccanite*.

Chateau Richer.—*Labradorite*, *hypersthene*, andesite.

Daillebout.—Blue spinel with clintonite.

Grenville.—*Tabular spar*, *sphene*, idocrase, calcite, pyroxene, steatite (rensselaerite), *garn* (cinnamon-stone), *zircon*, *graphite*, *scapolite*.

Ham.—Chromite in serpentine, diallage, *antimony! senarmontite! kermesite*, *valentinite*, stibnite.

Inverness.—*Variegated copper.*

Lake St. Francis.—*Andalusite* in mica slate.

Landsdowne.—*Barite.*

Leeds.—Dolomite, chalcopyrite, gold, *chloritoid*.

Mille Isles.—*Labradorite!* menaccanite, hypersthene, andesite, *zircon*.

Montreal.—*Calcite*, *augite*, sphene in trap, chrysolite, natrolite.

Morin.—*Sphene*, *apatite*, *labradorite*.

Orford.—White garnet, *chrome garnet*, *millerite*, serpentine.

Ottawa.—*Pyroxene.*

Polton.—Chromite, *steatite*, serpentine, *amianthus*.

Rougemont Mts.—Augite in trap.

Sherbrooke.—At Suffield mine, *albite! native silver*, argentite, chalcopyrite, blende.

St. Armand.—Micaceous iron ore with quartz, epidote.

St. François Beauce.—Gold, platinum, iridosmine, ilmenite, magnetite, serpentine, chromite, soapstone, barite.

St. Jerome.—*Sphene*, *apatite*, *chondrodite*, *phlogopite*, *tourmaline*, *zircon*, molybdenite, *magnetic pyrites*.

St. Norbert.—Amethyst in greenstone.

Stukeley.—Serpentine, *verd-antique!* schiller spar.

Sutton.—*Magnetite* in fine crystals, *specular iron*, *rutile*, dolomite, *magnesite*, chromiferous *talc*, bitter spar, steatite.

Upton.—Chalcopyrite, malachite, calcite.

Vaudreuil.—Limonite, vivianite.

Yamaska.—Sphene in trap.

CANADA WEST.

Balsam Lake.—*Molybdenite*, scapolite, quartz, pyroxene, pyrite.

Brantford.—Sulphuric acid spring (4·2 parts of pure sulphuric acid in 1000).

Bathurst.—Barite, *black tourmaline*, *perthite* (orthoclase), *peristerite* (albite), *bytownite*, pyroxene, *wilsonite*.

Brome.—Magnetite.

Bruce Mines.—*Calcite*, dolomite, quartz, chalcopyrite.

Burgess.—*Pyroxene*, albite, *mica*, *sapphire*, sphene, chalcopyrite, *apatite*, *black spinel!* spodumene (in a boulder), serpentine.

Bytown.—*Calcite*, *bytownite*, chondrodite, spinel.

Cape Ipperwash, Lake Huron.—Oxalite in shales.

Clarendon.—*Idocrase.*

Dalhousie.—Hornblende, dolomite.

Drummond.—Labradorite.

Elmsley.—Pyroxene, sphene, feldspar, *tourmaline*, apatite.

Fitzroy.—Amber, brown *tourmaline*, in quartz.

Gœtineau River, Blasdell's Mills.—Calcite apatite, tourmaline, hornblende, pyroxene.

Grand Calumet Island.—*Apatite, phlogopite! pyroxene!* sphene, *idocrase!!* serpentine, tremolite, *scapolite*, brown and black *tourmaline!* pyrite, loganite.

High Falls of the Madawaska.—*Pyroxene!* hornblende.

Hull.—*Magnetite*, garnet, graphite.

Hunterstown.—*Scapolite, sphene*, idocrase, garnet, *brown tourmaline!*

Huntingdon.—*Calcite!*

Inniskillen.—Petroleum.

Kingston.—*Celestite.*

Lac des Chats, Island Portage.—*Brown tourmaline!* pyrite, calcite, quartz.

Lanark.—Raphilite (hornblende), serpentine, asbestus.

Landsdown.—*Barite!* vein 27 in. wide, and fine crystals.

Madoc.—Magnetite.

Marmora.—Magnetite, chalcolite, garnet, epsomite, specular iron.

Maimanse.—*Pitchblende* (coracite).

McNab.—Specular iron, barite.

Michipicoten Island, Lake Superior.—*Domeykite, niccolite, genthite.*

Newborough.—*Chondrodite*, graphite.

South Crosby.—Chondrodite in limestone, magnetite.

St. Adele.—Chondrodite in limestone.

St. Ignace Island.—*Calcite*, native copper.

Sydenham.—Celestite.

Terrace Cove, Lake Superior.—Molybdenite.

Wallace Mine, Lake Huron.—*Specular iron*, nickel ore, nickel vitriol.

NEW BRUNSWICK.*

Albert Co.—Hopewell, gypsum; Albert mines, coal (albertite); Shepody Mountain, alunite in clay, calcite, iron pyrites, *manganite*, psilomelane, *pyrolusite.*

Carleton Co.—Woodstock, chalcopyrite, hematite, limonite, wad.

Charlotte Co.—Campobello, at Welchpool, blende, chalcopyrite, bornite, galenite, pyrite; at head of Harbor de Lute, galenite; Deer Island, on west side, calcite, magnetite, quartz crystals; Digdiguash River, on west side of entrance, *calcite!* (in conglomerate), chalcedony; at Rolling Dam, graphite; Grandmanan, between Northern Head and Dark Harbor, agate, amethyst, *apophyllite, calcite*, hematite, heulandite, jasper, magnetite, natrolite, *stilbite;* at Whale Cove, *calcite!* heulandite, laumontite, stilbite, *semi-opal!* Wagaguadavic River, at entrance, azurite, chalcopyrite in veins, malachite.

Gloucester Co.—Tete-a-Gouche River, eight miles from Bathurst, chalcopyrite (mined), *oxyd of manganese!!* formerly mined.

Kings Co.—Sussex, near Cloat's mills, on road to Belleisle, argentiferous galenite; one mile north of Baxter's Inn, *specular iron* in crystals, limonite; on Capt. McCready's farm, *selenite!!*

Restigouche Co.—Bolledune Point, *calcite! serpentine, verd-antique;* Dalhousie, agate, carnelian.

Saint John Co.—Black River, on coast, calcite, chlorite, chalcopyrite, *hematite!* Brandy Brook, epidote, *hornblende*, quartz crystals; Carleton, near Falls, calcite; Chance Harbor, *calcite* in quartz veins, chlorite in argillaceous and talcose slate; Little Dipper Harbor, on west side, in greenstone, amethyst, barite, quartz crystals; Moosepath, feldspar, hornblende, muscovite, black tourmaline; Musquash, on east side harbor, copperas, graphite, pyrite; at Shannon's, chrysolite, serpentine; east side of Musquash, *quartz crystals!;* Portland, at the Falls, graphite; at Fort Howe Hill, *calcite*, graphite; Crow's Nest, asbestus, *chrysolite*, magnetite, *serpentine*, steatite; Lily Lake, white augite? chrysolite, graphite, serpentine, steatite, talc; How's Road, two miles out, epidote (in syenite), steatite in limestone, *tremolite;* Drury's Cove, graphite, pyrite, pyrallolite? indurated talc; Quaco, at Lighthouse Point, large bed oxyd of manganese; Sheldon's Point, actinolite, asbestus, calcite, *epidote*, malachite, specular iron; Cape Spencer, asbestus, calcite, chlorite, *specular iron* (in crystals); Westbeach, at east end, on Evans' farm, chlorite, talc, *quartz crystals;* half a mile west, chlorite, chalcopyrite, magnesite (vein), magnetite; Point Wolf and Salmon River, asbestus, chlorite, chrysocolla, chalcopyrite, bornite, pyrite.

Victoria Co.—Tabique River, *agate, carnelian*, jasper; at mouth, south side, galenite; at mouth of Wapskanegan, gypsum, salt spring; three miles above, stalactites (abundant); Quisabis River, blue phosphate of iron, in clay.

---

* For a more complete list of localities in New Brunswick, Nova Scotia, and Newfoundland, see catalogue by O. C. Marsh, Am. J. Sci., II. xxxv. 210, 1863.

Westmoreland Co.—Bellevue, pyrite; Dorcester, on Taylor's farm, cannel coal; clay iron stone; on Ayres's farm, asphaltum, petroleum spring; Grandlance, apatite, selenite (in large crystals); Memramcook, coal (albertite); Shediac, four miles up Scadoue River, coal.

York Co.—Near Fredericton, stibnite, jamesonite, berthierite; Pokiock River, stibnite, *tin pyrite?* in granite (rare).

NOVA SCOTIA.

Annapolis Co.—Chute's Cove, *apophyllite*, natrolite; Gates's Mountain, analcite, magnetite, *mesolite! natrolite*, stilbite; Martial's Cove, *analcite!* chabazite, *heulandite*; Moose River, beds of magnetite; Nictau River, at the Falls, bed of hematite; Paradise River, black tourmaline, *smoky quartz!!*; Port George, faröelite, laumontite, mesolite, stilbite; east of Port George, on coast, apophyllite containing gyrolite; Peter's Point, west side of Stonock's Brook, *apophyllite!* calcite, heulandite, *laumontite!* (abundant), native copper, stilbite; St. Croix Cove, chabazite, heulandite.

Colchester Co.—Five Islands, East River, *barite!* calcite, dolomite (ankerite), hematite, chalcopyrite; Indian Point, malachite, magnetite, red copper, tetrahedrite; Pinnacle Islands, *analcite*, calcite, *chabazite!* natrolite, siliceous sinter; Londonderry, on branch of Great Village River, *barite*, ankerite, hematite, limonite, magnetite; Cook's Brook, ankerite, hematite; Martin's Brook, hematite, limonite; at Folly River, below Falls, ankerite, pyrite; on high land, east of river, ankerite, hematite, limonite; on Archibald's land, ankerite, *barite*, hematite; Salmon River, south branch of chalcopyrite, hematite; Shubenacadie River, anhydrite, calcite, *barite*, hematite, oxyd of manganese; at the Canal, pyrite; Stewiacke River, barite (in limestone).

Cumberland Co.—Cape Chiegnecto, barite; Cape D'Or, *analcite, apophyllite!!* chabazite, faröelite, laumontite, *mesolite*, malachite, *natrolite, native copper*, obsidian, red copper (rare), vivianite (rare); Horse-shoe Cove, east side of Cape D'Or, analcite, calcite, stilbite; Isle Haute, south side, analcite, *apophyllite!!* calcite, *heulandite!!* natrolite, mesolite, *stilbite!* Joggins, coal, hematite, limonite; malachite and tetrahedrite at Seaman's Brook; Partridge Island, analcite, *apophyllite!* (rare), *amethyst!* agate, apatite (rare), *calcite!!* chabazite (acadiolite) chalcedony, cat's-eye (rare), gypsum, hematite, *heulandite!* magnetite, *stilbite!!*; Swan's Creek, west side, near the Point, calcite, gypsum, *heulandite*, pyrite; east side, at Wasson's Bluff and vicinity, *analcite!! apophyllite!* (rare), *calcite, chabazite!!* (acadiolite), gypsum, *heulandite!! natrolite!* siliceous sinter; Two Islands, moss agate, analcite, calcite, chabazite, *heulandite*; McKay's Head, analcite, calcite, heulandite, *siliceous sinter!*

Digby Co.—Brier Island, native copper, in trap; Digby Neck, Sandy Cove and vicinity, *agate, amethyst, calcite, chabazite, hematite! laumontite* (abundant), magnetite, *stilbite*, quartz crystals; Gulliver's Hole, *magnetite, stilbite!*; Mink Cove, amethyst, *chabazite!* quartz crystals; Nichol's Mountain, south side, *amethyst, magnetite!*; William's Brook, near source, *chabazite* (green), heulandite, stilbite, quartz crystals.

Guysboro' Co.—Cape Canseau, *andalusite*.

Halifax Co.—Gay's river, galenite in limestone; southwest of Halifax, garnet, staurolite, tourmaline; Tangier, *gold!* in quartz veins in clay slate, associated with auriferous pyrites, galenite, hematite, mispickel, and magnetite; gold has also been found in the same formation, at Country Harbor, Fort Clarence, Isaac's Harbor, Indian Harbor, Laidlow's farm, Lawrencetown, Sherbrooke, Salmon River, Wine Cove, and other places.

Hants Co.—Cheverie, oxyd of manganese (in limestone); Petite River, gypsum, oxyd of manganese; Windsor, calcite, cryptomorphite (boronatrocalcite), howlite, glauber salt. The last three minerals are found in beds of gypsum.

Kings Co.—Black Rock, centrallassite, cerinite, cyanolite; a few miles east of Black Rock, prehnite? *stilbite!*; Cape Blomidon, on the coast between the cape and Cape Split, the following minerals occur in many places (some of the best localities are nearly opposite Cape Sharp): *analcite!! agate, amethyst! apophyllite!* calcite, chalcedony, chabazite, gmelinite (ledererite), hematite, *heulandite!* laumontite, magnetite, malachite, *mesolite*, native copper (rare), *natrolite!* psilomelane, *stilbite!* thomsonite, faröelite, *quartz*; North Mountains, amethyst, bloodstone (rare), *ferruginous quartz, mesolite* (in soil); Long Point, five miles west of Black Rock, *heulandite, laumontite!! stilbite!!*; Morden, *apophyllite, mordenite*; Scot's Bay, *agate*, amethyst, *chalcedony*, mesolite, natrolite; Woodworth's Cove, a few miles west of Scot's Bay, *agate! chalcedony! jasper*.

Lunenburg Co.—Chester, Gold River, gold in quartz, pyrite, mispickel; Cape la Have, pyrite; The "Ovens," *gold*, pyrite, *mispickel!* Petite River, gold in slate.

Pictou Co.—Pictou, *jet*, oxyd of manganese, limonite; at Roder's Hill, six miles west of Pictou, barite; on Carribou River, gray copper and malachite in lignite; at Albion mines, coal, limonite; East River, limonite.

Queens Co.—Westfield, gold in quartz, pyrite, mispickel; Five Rivers, near Big Fall, gold in quartz, pyrite, mispickel, limonite.

RICHMOND CO.—West of Plaister Cove, barite and calcite in sandstone; nearer the Cove, calcite, *fluorite* (blue), siderite.

SHELBURNE CO.—Shelburne, near mouth of harbor, garnets (in gneiss); near the town, rose quartz; at Jordan and Sable River, *staurolite* (abundant), schiller spar.

SYDNEY CO.—Hills east of Lochaber Lake, pyrite, chalcopyrite, siderite, hematite; Morristown, epidote in trap, gypsum.

YARMOUTH CO.—Cream Pot, above Cranberry Hill, gold in quartz, pyrite; Cat Rock, Fouchu Point, asbestus, calcite.

NEWFOUNDLAND.

ANTONY'S ISLAND.—*Pyrite.*

CATALINA HARBOR.—On the shore, *pyrite!*

CHALKY HILL.—*Feldspar.*

COPPER ISLAND, one of the Wadham group.—*Chalcopyrite.*

CONCEPTION BAY.—On the shore south of Brigus, bornite and gray copper in trap.

BAY OF ISLANDS.—Southern shore, *pyrite* in slate.

LAWN.—*Galenite, cerargyrite, proustite, argentite.*

PLACENTIA BAY.—At La Manche, two miles eastward of Little Southern Harbor, *galenite!*; on the opposite side of the isthmus from Placentia Bay, barite, in a large vein, occasionally accompanied by chalcopyrite.

SHOAL BAY.—South of St. John's, chalcopyrite.

TRINITY BAY.—Western extremity, barite.

HARBOR GREAT ST. LAWRENCE.—West side, fluorite, galenite.

FOREIGN LOCALITIES.

With reference to foreign localities, consult for
EUROPE generally, Leonhard's Topogr. Min.
GREAT BRITAIN, Greg & Lettsom's Min.; Brooke & Miller's Min.
FRANCE, Dufrénoy's Min.; Descloizeaux's Min.
SWITZERLAND, Kenngott's Min. der Schweiz.
GERMANY, Hausmann's Min.; Quenstedt's Min.
AUSTRIA, Zepharovich's Min. Lex.
SWEDEN, Hisinger's Min. Schwed.
FINLAND, A. E. Nordenskiöld's Finl. Min.
RUSSIA, Kokscharof's Min. Russl.
For the full titles of the works here referred to, see pp. **xxxiv–xlv.**

SUPPLEMENT.

This supplement contains descriptions of some species imperfectly known, and notices of new or described species which came to hand too late to be inserted in the preceding part of this work. The numbers affixed to the species indicate their places in the system.

ÆSCHYNITE (480, p. 522). Mean of four closely agreeing analyses by Marignac (Bib. Univ Genève, Aug. 25, 1867, p. 286):

$\ddot{\mathrm{C}}\mathrm{b}$, $\ddot{\mathrm{T}}\mathrm{i}$	$\ddot{\mathrm{S}}\mathrm{n}$	$\ddot{\mathrm{T}}\mathrm{h}$	$\dot{\mathrm{C}}\mathrm{e}$	$\dot{\mathrm{L}}\mathrm{a}$, $\dot{\mathrm{D}}\mathrm{i}$	$\dot{\mathrm{Y}}$	$\dot{\mathrm{F}}\mathrm{e}$	$\dot{\mathrm{C}}\mathrm{a}$	ign.
51·45	0·18	15·75	18·49	5·60	1·12	3·17	2·75	1·07=99·58.

G.=5·23. The amount of metallic acids varied between 51·15 and 51·75. Analyses of the metallic acid gave the relation, $\ddot{\mathrm{C}}\mathrm{b}$ 29·31, $\ddot{\mathrm{T}}\mathrm{i}$ 22·14, differing materially from Hermann's results. Marignac, having previously examined the acids of euxenite (see p. 522), concludes that the relation between the metallic acids is the same as in æschynite, and that these two minerals differ mainly in the character of the bases they contain; and that both may be represented by the general formula $5\,\dot{\mathrm{R}}\,\ddot{\mathrm{T}}\mathrm{i}+2\,\dot{\mathrm{R}}^{3}\,\ddot{\mathrm{C}}\mathrm{b}$.

AGNESITE. Carbonate of Bismuth *W. Macgregor*, Sowerby's English Min., *Beud.*, Tr., ii. 375, 1832; Agnesite *B. & M.* Min., 591, 1852. An earthy steatite-like mineral from St. Agnes in Cornwall, having G.=4·31, made by Macgregor to consist of $\ddot{\mathrm{C}}$ 51·3, $\dddot{\bar{\mathrm{B}}}\mathrm{i}$ 28·8, $\dot{\mathrm{F}}\mathrm{e}$ 2·1, $\dddot{\bar{\mathrm{A}}}\mathrm{l}$ 7·5, $\ddot{\mathrm{S}}\mathrm{i}$ 6·7, $\dot{\mathrm{H}}$ 3 6=100; which result is pronounced by Beudant as probably "quelque grande erreur," and so proved by Thomson (Min., ii. 594), who states, after personal trials, that it did "*not* effervesce with acids, and contained only a trace of bismuth"; and also by Greg and Lettsom, who examined a specimen in the late Mr. Allan's collection, from Mr. Macgregor, with the same result as to effervescence, and say that it may be an impure bismuth ochre. Allan appears to have thought it unworthy of a place in his edition of Phillips' Mineralogy (1837), and does not even allude to it under bismuth ochre.

ALTAITE (48, p. 44). This rare species has been identified at the Stanislaus mine, Cal., and F. A. Genth has also observed it in minute quantities associated with petzite at the Golden Rule mine, Cal. (Am. J. Sci., II. xlv. 311). The mineral from the former locality is tin-white, with a yellowish tinge, tarnishing to bronze-yellow; streak gray; with H.=3, and has a distinctly cubic cleavage. Composition, after deducting in 1, 1·03 p. c., and in 2, 1·96 of quartz:

	Te	Pb	Ag	Au
1.	37·31	60·71	1·17	0·26=99·45.
2.	[37·00]	47·84	11·80	3·85=100·00.

No. 1 is the first complete analysis of this species, and confirms the assumption of Rose that it is a compound analogous to hessite. Dr. Genth calculates No. 1 to contain 99·25 p. c. of altaite and 2·20 of hessite; and No. 2, 77·42 altaite, and 23·11 p. c. hessite. An earlier result on another specimen obtained by Genth, after separating carbonates and excluding 8 p. c. free gold, and 3·45 quartz, gave Te (37·14), Ag 44·49, Pb 18·37=100·00. This may represent 70·85 hessite, and 29·26 altaite. The material appeared to be pure, but Genth states that further investigation is needed to ascertain whether there is a tellurid of silver, or tellurid of silver and lead, which has a white color and cubic cleavage.

AMPHIBOLE (247, p. 332). Compact asbestus from Bolton, Mass, afforded T. Petersen (Jahresb for 1866, 924, 1868):

$\ddot{\mathrm{S}}\mathrm{i}$ 58·80 $\dddot{\bar{\mathrm{A}}}\mathrm{l}$ *tr.* $\dot{\mathrm{F}}\mathrm{e}$ 3·05 $\dot{\mathrm{M}}\mathrm{g}$ 22·23 $\dot{\mathrm{C}}\mathrm{a}$ 16·47 $\dot{\mathrm{H}}$ *tr.*=100 55. G.=3 007.

The formulas on the new system for aluminous pyroxene and amphibole, pp. 207, 208, become, if the Greek-lettered symbol be used also for the silica, $(\gamma \ddot{\text{Si}}_2, \beta \dddot{\bar{\text{Al}}}_2)\,\Theta|\Theta_4|\,\text{R}$.

ANDALUSITE (322, p. 371). The chiastolite of Lancaster, Mass., afforded T. Petersen (Jahresb 1866, 921):

$\ddot{\text{Si}}$ 41·95 $\dddot{\bar{\text{Al}}}$ 48·60 $\dddot{\bar{\text{Fe}}}$ 9·30 $\dot{\text{Ca}}$ 0·41=100·26. G.=2·923.

ANORTHITE (310, p. 337). *Tankite* is referred to anorthite on p. 337, on the authority of Descloizeaux, who has found them to have the same forms of crystals and angles (Mem. Soc. Min. St Pet., II. ii. 1867). Descloizeaux also publishes (l. c.) the following analyses of tankite by Pisani: $\ddot{\text{Si}}$ 42·49, $\dddot{\bar{\text{Al}}}$ 34·70, $\dddot{\bar{\text{Fe}}}$ 0·74, $\dot{\text{Mg}}$ 0·30, $\dot{\text{Ca}}$ 15·82, $\dot{\text{Na}}$, $\dot{\text{Li}}$ 1·60, $\dot{\text{K}}$ 0·63, $\dot{\text{H}}$, F 4·80=101·08; whence the oxygen ratio, R, $\bar{\text{R}}$, $\ddot{\text{Si}}$, 1 : 3 : 4. The mineral is from the iron mines of Arendal, Norway, where it was originally obtained by Mr. Tank.

Anorthite crystals from the Juvenas meteorite have been measured by v. Lang (Pogg., cxxxiii. 188).

ARSENOPYRITE (94, p. 78). Von Zepharovich has measured crystals of this species, with the following results (Ber. Ak. Wien, lvi. i. 21, 1867):

From Œblarn, Styria	$I \wedge I$=111° 10′ 38″	1-ĭ ∧ 1-ĭ, top,=80° 16′ 25″
Freiberg, Sax.	" 111 27	
Breitenbrunn, Sax.	" 111 29	½-ĭ ∧ ½-ĭ, top,=151 36
Reichenstein, Silesia	" 111 30	
Eisenerz, Styria	" 111 40	
Joachimsthal	" 111 10	⅓-ĭ ∧ ⅓-ĭ, top,=136 30

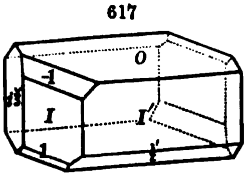
ATACAMITE (153, p. 121). The following are additional observations on this species:

Artif.—Field has shown (Phil. Mag., IV. xxiv. 123) that when an alkaline hypochlorite is added to a boiling solution of the sulphate, nitrate, or chlorid of copper, the latter being in excess, the precipitate produced has the formula 3 $\dot{\text{Cu}}\,\dot{\text{H}}$+Cu Cl $\dot{\text{H}}$. The same is formed when potash is added to an excess of chlorid of copper. If, in the first case given above, the time of ebullition is too short, the precipitate has the composition 3 $\dot{\text{Cu}}\,\dot{\text{H}}$ + Cu Cl $\dot{\text{H}}$ + 2 aq. Field's analysis gave $\dot{\text{Cu}}$ 49·85, Cu Cl 28·02, $\dot{\text{H}}$ 22·13, agreeing very closely, as he observed, with that of Berthier (anal. 1) from Cobija, Bolivia. The formula requires $\dot{\text{Cu}}$ 49·56, Cu Cl 28·01, $\dot{\text{H}}$ 22·43=100. This is also the composition of botallackite. Field states also that atacamite is formed in Chili at a seashore locality by the action of salt in the soil on chalcopyrite.

Debray finds that crystals may be obtained by heating to 200° C., $\dot{\text{Cu}}^3\,\dddot{\dot{\text{N}}}$ with a concentrated solution of common salt; or to 100° C., ammoniacal sulphate of copper with the same.

BABINGTONITE (242, p. 227). The small, black, brilliant crystals from Athol referred to babingtonite by Shepard (p. 228), do not afford very nearly the angles of that species. They are usually implanted on green epidote, and, although black, they appear, under a glass, to pass so gradually into the underlying mineral that the first impression is naturally that they are only a black variety of epidote. Yet they differ also from this species in angle. The author has attempted to make new measurements, but the crystals for the purpose were so minute ($\frac{1}{40}$ of an inch in length) that they require further study for satisfactory results. The author's figure and "approximate measurements" from the last edition of this work are consequently here added without modification, or even the change in the lettering that is required to bring the figure into parallelism with the figures of babingtonite. $O \wedge I$=90°−91°, $O \wedge I'$= 85°, $O \wedge \frac{1}{2}'$=153° 20′, $I \wedge I'$=110° 30′ and 69° 30′, $I \wedge i$-3=129°, $I' \wedge i$-3=120° 30′, $O \wedge$ −1= 135° 40′, $O \wedge$ 1=135° 30′, $O \wedge i$-3=95° 30′, $I \wedge \frac{1}{2}$=95° 30′.

617



BARNHARDITE (79, p. 67). A specimen of this mineral from Bill Williams Fork, Arizona, found with metallic copper, cuprite, chalcocite, pyrite, chrysocolla, malachite, and brochantite, gave N. S. Higgins, according to Genth (Am. J. Sci., II. xlv. 319), S 28·96, Cu 50·41, Fe 20·44=99·81; showing a slight admixture with chalcocite.

BERYL (254, p. 245). The green beryl of Royalston, Mass., yielded on analysis by T. Petersen (Jahresb. 1865, 925) $\ddot{\text{Si}}$ 67·52, $\dddot{\bar{\text{Al}}}$ 17·42, Be 14·35, $\dddot{\bar{\text{Fe}}}$, $\dot{\text{Ca}}$ *tr.*=99·29. G.=2·66.

Berzelianite (50, p. 46). According to A. E. Nordenskiöld (Œfv. Ak. Stockholm, 1866, 361, J. pr. Ch., cii. 456) berzelianite occurs at Skrikerum as a black to blackish-blue powder, disseminated through a coarse crystalline calcite, showing no traces of crystalline structure, but sometimes forming dendritic crusts. When in sufficient masses to be observed, it has a metallic lustre and silver-white fracture, the surface of which soon tarnishes. G.=6·71.

	Se	Cu	Ag	Fe	Tl
1.	39·85	53·14	4·73	0·54	0·38=98·64.
2.	38·74	52·15	8·50	0·54	*tr.*=99·74.

Nordenskiöld remarks that the varying percentage of the silver is possibly due to an admixture of eucairite, and that the amount of thallium in the analyses is probably too low.

Bismuthaurite or **Bismuthic Gold** *Shep.*, Min., 304, 1857. A furnace product (Am. J. Sci., II. xxiv. 112, 1867).

Bobierrite. Phosphate de Magnésie tribasique et hydraté *Bobierre*, Les Mondes, April 1868, 691; Bobierrite *Dana* (523A).—Monoclinic; in six-sided prismatic forms. Crystals minute, and forming crystalline agglomerations, imbedded in guano, looking like white spots in the guano. Crystals colorless. Composition, according to Bobierre (l. c.), $Mg^3\ddot{P}$ with water. It is insoluble in water, but easily soluble in acids without effervescence. Contains not a trace of lime.

From the guano of Mexillones, on the Peruvian Coast.

Boulangerite (124, p. 99). Found, according to v. Zepharovich, at Przibram in Bohemia, with jamesonite (Ber. Ak. Wien, lvi. 1867). He gives the following analyses:

			S	Sb	Pb	Fe
1.	Eusebi vein,	*fib.*	18·77	26·81	54·42	*tr.*=100 E. Boricky.
2.	" "	*comp.*	19·77	24·46	54·32	*tr.*=98·55 E. Boricky.
3.	Adelberti "	"	18·89	21·87	57·69	0·84, Ag 0·25, Zn 0·47=100·01 Helmhacker.
4	" "	"	18·64	24·31	55·06	1·46=99·47 Boricky.
5.	" "	*fib.*	18·47	24·17	55·96	Fe, Mn 0·08, Cu 0·22, Ag 0·84=99·74 Helmh.
6	" "	"	17·60	22·81	58·13	0·57=99·11 Boricky.
7.	" "	*capil.*	17·95	22·91	57·28	1·35, Ag 0·06, Zn 0·34=99·89 Helmhacker.
8.	" "	"	17·74	25·11	57·42	*tr.*=100·27 Boricky.
9.	" "	*needles*	20·49	27·72	48·38	3·47=100·06 Boricky.

1, fine fibrous, G.=5·75; 2, subfibrous, G.=5·91; 3, compact, with subconchoidal fracture, G.=5·877, associated with zinc-blende; 4, associated with a coarse granular to fibrous galenite, G.=5·809; 5, found in nests in galenite, G.=5·69; 6, G.=6·08; 7, in short, felt-like, capillary crystals, with quartz and calcite; 9, associated with quartz, G.=5·52.

F. A. Genth obtained for boulangerite from Echo District, Union Co., Nevada (Am. J. Sci., II. xlv. 320, 1868), S 17·91, Sb 26·85, Pb 54·82, Ag 0·42=100. Occurs in indistinct acicular striated crystals, in white quartz.

Brochantite (701, p. 664). F. A. Genth has found this mineral in minute crystals, showing the planes *I*, *i-ĭ*, and 1-*ĭ*, with the copper ores at Bill Williams Fork, Arizona. For analyses of specimen, mixed with atacamite, chrysocolla, etc., see Am. J. Sci., II. xlv. 321, 1868.

Calaverite *F. A. Genth*, Am. J. Sci., II. xlv. 314, 1868. (98A.) A new tellurid of gold, from the Stanislaus mine, Calaveras Co., Cal. It occurs massive, without crystalline structure; color bronze-yellow; streak yellowish-gray; brittle; fracture uneven, inclining to subconchoidal.

Composition.—$AuTe_4$=Te 55·53, Au 44·47. Analyses 1, 2, from 2 1·45 p. c. quartz deducted:

	Te	Au	Ag
1.	Te 55·89	Au 40·70	Ag 3·52=100·11.
2.	[56·00]	40·92	3·08=100.

B.B. on charcoal burns with a bluish-green flame, yielding globules of very yellow gold. Dissolves in nitro-muriatic acid, with separation of chlorid of silver.

Calaverite is frequently associated with petzite, to which a portion of the silver in the analyses is attributed. In a comparison of the results of analyses of sylvanite from Transylvania, Dr. Genth makes the suggestion that the so-called "*gelberz*" (see anal. 8, 9, p. 82) is nothing else than impure calaverite.

Calcite (715, p. 670). Vom Rath, in his elaborate papers on calcite (Pogg., cxxxii.), mentions besides the planes given from him on pp. 673, 674, 676, the scalenohedron $-\frac{3}{8}\frac{6}{8}^{2}$, which has for the angle over its longer edge, 155° 43′, shorter edge 101° 35′, middle edge, 114° 54′; and the rhombohedron $-\frac{3}{8}$, having $R \wedge R$=142° 56′, and $O \wedge R$=158° 28′.

CASSITERITE (192, p. 157). T. Petersen (Jahresb. 1866, 920, 1868) found in the tin-stone of Zinnwald, ($\frac{2}{3}$) $\ddot{\text{Sn}}$ 88·04, $\dddot{\bar{\text{Fe}}}$ 4·49, $\dddot{\bar{\text{Mn}}}$ 2·78, $\dot{\text{Ca}}\,\ddot{\text{C}}$ 4·30=99·61.

CATLINITE. C. T. Jackson (Am. J. Sci., xxxv. 388) thus named the red clay from the Coteau de Prairies, in the Upper Missouri region, where it forms a bed of considerable extent, referred by Hayden to the Cretaceous formation. Analyses:

$\ddot{\text{Si}}$	$\dddot{\bar{\text{Al}}}$	$\dddot{\bar{\text{Fe}}}$	$\dddot{\bar{\text{Mn}}}$	$\dot{\text{Mg}}$	$\dot{\text{Ca}}$	$\dot{\text{Na}}\,\dot{\text{K}}$	$\dot{\text{H}}$	
56·11	17·31	6·96	—	0·20	2·16	12·48	4·59	Thomson.
48·2	28·2	5·0	0·6	6·0	2·6	—	8·4	Jackson.

It is a rock and not a definite mineral species.

CENTRALLASSITE *How*, Ed. N. Phil. J., x. 84, 1859. (341A.) Radiated massive, the fibres or columns lamellar and separable; H.=3·5; G.=2·45—2·46; lustre pearly; color white or yellowish-white; thin laminæ transparent; graduating into an opaque white variety, subresinous in lustre; brittle. The mineral was found in a nodule from amygdaloid, near Black Rock, Bay of Fundy, and constituted the portion between a thin outer layer (named by How *cerinite*) and an inner bluish mass, called by him *cyanolite*. How obtained, as a mean of two analyses (l. c.):

$\ddot{\text{Si}}$ 58·86 $\dddot{\bar{\text{Al}}}$ 1·14 $\dot{\text{Mg}}$ 0·16 $\dot{\text{Ca}}$ 27·92 $\dot{\text{K}}$ 0·59 $\dot{\text{H}}$ 11·42.

B.B. fuses easily, with spirting, to an opaque glass; a clear bead with the fluxes.
It is near okenite in composition.

CHAMOISITE (469, p. 511). An oölitic mineral, near chamoisite, described by Pouillon Boblaye (Mem. Mus., xv.), has been called *Bavalite*. It has H. about 4; G.=3·99, Delesse; color greenish-black, bluish, or grayish; powder greenish-gray or black, to reddish-brown; and B.B. fusible with difficulty to a black magnetic scoria. Analyses: 1, Berthier; 2, Delesse:

	$\ddot{\text{Si}}$	$\dddot{\bar{\text{Al}}}$	$\dddot{\bar{\text{Cr}}}$	$\dddot{\bar{\text{Fe}}}$	$\dot{\text{Fe}}$	$\dot{\text{Ca}}$	$\dot{\text{H}}$	C	Clay
1. Quintin	11·0	13·3	0·3	48·8	23·4	—	—	—	3·2=100 Berthier.
2. "	6·50	7·50	0·50	65·45	13·25	0·45	4·85	1·30	0·20=100 Delesse.

Forms beds in old schistose rocks in different parts of Brittany, especially in the forest of Lorges, a locality that supplies furnaces at Pas near Quintin, in the vicinity of St. Brieuc, Dept. of Côtes-du-Nord; also at the Chapel St. Oudon, near Segré, Dept. of Maine-et-Loire; and elsewhere. Huot and others derive the name *bavalite* from Bavalon, a locality of it; but Descloizeaux says no such place exists in Brittany; but that a depression in the region where it is explored is called the *bas vallon*—an absurd origin for a name.

CHRYSOBERYL (191, p. 155). Frischman on twin crystals of chrysoberyl, Ber. Ak. München, 1867, i. 429.

CHRYSOLITE (259, p. 256). A partially decomposed olivine, from Neurode in Silesia, afforded Rammelsberg (ZS. G., xix. 285) $\ddot{\text{Si}}$ 34·97, $\dot{\text{Fe}}$ 18·55, $\dot{\text{Mg}}$ 36·00, $\dot{\text{Ca}}$ 0·44, $\dddot{\bar{\text{Al}}}$ 0·75, $\dot{\text{H}}$ 6, magnetite 3·21=99·92.

CLAUDETITE. Prismatic Arsenious Acid *F. Claudet*, Proc. Ch. Soc., 1868, Ch. News, xvii 128, 1868; Claudetite *Dana*. (221A.) Orthorhombic, and isomorphous with valentinite, while dimorphous with arsenolite. Observed in thin plates, resembling selenite. H.=2·5. G.=3·85. Lustre strongly pearly.

Composition As O^{3}, as for arsenolite, being essentially pure arsenous acid. Claudet obtained in an analysis about 47 p. c. of this acid with other metallic substances as impurities.

Occurs in seams in an ore of arsenical pyrites, at the San Domingo mines, Portugal.

It heads the Valentinite group, p. 184.

CLAUSTHALITE (45, p. 42). For analysis of this mineral from Cacheuta, see under **EUCAIRITE**, p. 798.

Columbite (474, p. 515). Hermann, in the J. pr. Ch., ciii. 127, sustains anew his views on ilmenic acid, and gives the following results of recent investigations:

	$\ddot{\bar{\text{C}}}\text{b}$	$\ddot{\bar{\text{T}}}\text{a}$	$\dddot{\text{Il}}$	$\ddot{\text{Sn}}$	$\dddot{\text{W}}$	$\dot{\text{Fe}}$	$\dot{\text{Mn}}$	$\dot{\text{Mg}}$
1. Haddam	41·17	10·77	25·74	0·40	0·26	14·08	5·63	0·49=98·52.
2. Bodenmais	35·49	28·12	16·38	0·36	——	14·11	4·13	1·27, $\dot{\text{Cu}}$ 0·13=99·99.
3. Greenland	38·27	0·56	39·73	*tr.*	——	16·54	5·00	0·06=100·16.

Hermann is here copied in making the metallic acids to contain 3 of oxygen. Analysis 1 is a revision of anal. 4, p. 517.

Hermann makes three varieties of columbite: (1) Tantalum-columbite, with density above 5·90. (2) Columbium-columbite, with G.=5·50–5·90. (3) Ilmenium-columbite, with G. below 5·50. He thus claims that the Greenland mineral is *ilmenium-columbite* (G.=5·40), while, according to the recent careful researches of Blomstrand (anal. 25, p. 518), it contains only columbic and tantalic acids.

Cosalite *F. A. Genth*, Am. J. Sci., II. xlv. 319. (112A.) Indistinctly crystalline, with longitudinal striations, apparently rhombic. Soft and brittle. Lustre metallic. Color lead-gray. Fracture uneven.

Composition $2\,\text{Pb}\,\text{S}+\text{Bi}\,\text{S}_3$=Sulphur 16·10, Bi 42·25, Pb 41·65=100. Analyses: 1 (after deducting 2·09 p. c. quartz); 2 (after deducting 26·83 p. c. quartz):

	S	As	Pb	Ag	Bi	Co
1.	15·59	3·07	37·72	2·48	39·06	2·41=100·33.
2.	15·64	5·37	33·99	2·81	37·48	4·22=99·51.

As cobaltite was associated with the mineral, Genth regards the Co and As as due to this species, and deducts them, making in anal. 1, 6·79 p. c cobaltite, and in 2, 11·88 p. c., giving for 1, S 15·27, Bi 41·76, Pb 40·32, Ag 2·65; and for 2, S 15·23, Bi 42·77, Pb 38·79, Ag 3·21; corresponding with the formula $2\,(\text{Pb},\,\text{Ag})\,\text{S}+\text{Bi}^2\text{S}^3$, making the mineral a jamesonite in which the antimony is replaced by bismuth. B.B. cosalite reacts for sulphur, lead, and bismuth, and with soda on charcoal yields a minute globule of silver. Found associated with quartz and cobaltite in a silver mine at Cosala, Province of Sinaloa, Mexico.

Cryolite (164, p. 127). Crystals of cryolite have been described and figured by Websky (Jahrb Min. 1867, 810). His measurements make the form triclinic. The general form of the crystals and the planes are as in f. 130. The following are his measured angles, using the lettering in that figure: *I* ∧ *I*=88° 3′ and 91° 57′, *O* ∧ 1-ī, left,=124° 35′, *O* ∧ 1-ī, front,=125° 54′—125° 57′, *O* ∧ 1-ī, back,=125° 28′—125° 33′, *O* ∧ *I*, right,=90° 24′, *O* ∧ *I*, left, 90° 1′—90° 10′, and 89° 58′, *I*, right, ∧ 1-ī, front,=124° 30′, *I*, left, ∧ 1-ī, front,=124° 14′; *I*, right, ∧ 1-ī, back,=126° 20′. Two kinds of twins are described: 1, composition-face ***i*-ī**; and 2, c.-face *O*.

Websky also describes the optical characters of the crystals.

Cyanolite *How*, Ed. N. Phil. J., x. 84, 1859. (341B.) Amorphous, of a bluish-gray color, little lustre, and nearly opaque: H.=4·5; G.=2·495: B.B. fuses only on the thin edges; gives clear beads with the fluxes. Two analyses by How afforded:

$\ddot{\text{Si}}$	$\dddot{\bar{\text{A}}}\text{l}$	$\dot{\text{Mg}}$	$\dot{\text{Ca}}$	$\dot{\text{K}}$	$\dot{\text{H}}$
74·15	0·84	*tr.*	17·52	0·53	7·39=100·43.
72·52	1·24	*tr.*	18·19	0·61	6·91=99·47.

Probably the same mineral with centrallassite (p. 796), impure with much more silica; or it is chalcedony, impure with centrallassite. The name alludes to the color.

Domeykite (37, p. 36). Occurs in the mountain of Paracatas, between Cuatzamala and Tlachapa.

Enargite (132, p. 107). Occurs, according to E. W. Root (Am. J. Sci., II. xlv.), at the Morning Star mine, Alpine Co., Cal., both massive and in small, brilliant, black crystals, associated with pyrite, quartz, and menaccanite. H.=4; G.=4·34. Mean of two analyses, S 31·66, As 13·70, Sb 6·03, Fe, with trace $\ddot{\text{Ti}}$, 0·72, Cu 45·95, $\ddot{\text{Si}}$ 1·08=99·14.

Erlanite. Erlan *Breith.* Handb., 606. Supposed to be a rock.

Eucairite (42, p 39). According to A. E. Nordenskiöld (Œfv. Ak. Stockholm, 1866, 361, in

J. pr. Ch., cii. 456), this species occurs in opaque silver-white to lead-gray grains in part disseminated in serpentine, sometimes with indications of cubic or octahedral planes. H.=2·5; G.=7·48—7·51. Analyses:

	Se	Cu	Ag	Fe	Tl
1.	——	24·86	42·57	0·35	*tr.*
2.	32·01	25·83	44·21	0·36	*tr.*

agreeing with the formula (Ȼu, Ag) Se or Ȼu Se + Ag Se.

Domeyko has examined the selenids from Cacheuta in the province of Mendoza, Chili (C. R., lxiii. 1064), and considers them to consist of mixtures or combinations of three selenids: (A) A compound analogous to eucairite; (B) a selenid of cobalt and iron; and (C) a selenid of lead. Analyses:

	Se	Ag	Cu	Fe	Co	Pb	$\dot{P}b\ddot{C}$	Gangue
1.	30·00	21·00	1·80	2·20	0·70	43·50	——	——=99·2.
2.	22·40	20 85	12·91	8·10	1·26	6·80	82·68	=100.
3.	30·80	9·80	10·20	1·20	2·80	37·10	6·5	=98·4.
4.	——	3·73	13·80	8·35	1·97	21·30	15·25	7·40=——.
5.	23·60	——	——	0·80	——	57·80	10·90	3·50=98·6.

No. 1 had a bright bluish-gray color and metallic lustre, was somewhat porous, and occurred with silicate of copper and carbonate of lead, which last was separated before analysis. G.=6 8. No. 2 was similar. In 3 and 4 the silver is partly replaced by copper. No 5 is almost pure selenid of lead. G.=7·6.

Ganomatite *Breith.*, Char., 106, 1832. (Gänseköthigerz *Germ.*, Goose-dung Ore, Chenocoprolite, *Dana*, Min.. 1st ed., 216, 1837.) The material thus named is in part an impure iron-sinter, containing some oxyd of cobalt, etc. That of Joachimsthal is a yellowish incrustation, occurring with smaltine. That of Andreasberg is a mixture of oxyds of antimony, arsenic, and iron, with a little arsenous acid (Ramm. Min. Ch., 993).

Gersdorffite (86, p. 72). Analyses of gersdorffite, having G.=5·49—5·65, from Craigmuir mine, Loch Fyne, Scotland, by D. Forbes (Phil. Mag., IV. xxxv. 181, 1868):

S	As	Ni	Co	Fe	Mn	Cu	Mg	Insol.
20·01	34·45	21·59	6·32	13·12	0·33	*tr.*	0·68	2·71=99·19.
19·75	35·84	23·16	6·64	11·02	0·33	*tr.*	0 66	2·60=100.

Geomyricite (797, p. 739). The author learns further from L. Lesquereux (March 4, 1868) that, as existing species of the families *Populus*, *Myrica*, and *Laurus* are wax-bearing, wax may have been afforded to the Gesterwitz beds by the species, now fossil in that basin, *Cinnamomum Rossmässleri* Heer, *Gautiera lignitum* Web., *Laurus primigenia* and *L. Lalages* Heer, and species of *Sassafras*; and, as *Ceratopetalum myricinum* of de la Harpe is probably a Myrica, this also may have been one of the wax-yielding species of the era. And although no Populus has yet been identified from the basin, species are common in the Tertiary of other parts of Europe and of America, and plants of the genus probably contributed largely towards these lignitic beds.

Gilbertite *Thom.*, Min., 1, 236. Perhaps an impure kaolinite. Whitish and silky; H.=2·75: G.=2 65. Lehunt obtained (l. c.) $\ddot{S}i$ 45·15, $\dddot{A}l$ 40·11, $\dot{F}e$ 2·43, $\dot{M}g$ 1·90, $\dot{C}a$ 4·17, $\dot{H}$ 4·25. From the lode of Stonagwyn, near St. Austle, Cornwall.

Gismondite (372, p. 418). Vom Rath mentions Frauenberg, near Fulda, as a new locality of this rare mineral. He speaks of the form as a tetragonal octahedron, and obtained for the angle between two planes over a basal angle 61° 3½′, 61° 4′, which gives for the terminal edge 118° 56½′, 118° 56′. The crystals are in druses in basalt with phillipsite.

Glaucodot (95, p. 80). Occurs, according to Tschermak (Ber. Ak. Wien, xv. 1867) and v. Kobell (J. pr. Ch. cii 409), at Hakansbö in Sweden. The crystals have the new plane 2-ī. Basal cleavage less perfect than in the Chilian variety. G.=5·973, Tsch.; 5·96, v. K. Analyses:

	As	S	Co	Ni	Fe	$\ddot{S}i$
1.	44·08	19·80	16·06		19·34	——=99·23 E. Ludwig.
2.	44·30	19·85	15·00	0·80	19·07	0·98=100 v. Kobell.

Gold (1, p. 3). Gold occurs in copper pyrites in the region of Black Bay, on the north shore of Lake Superior, between Neepigon and Thunder Bay, as observed by Chapman, and silver in the galenite of the same veins. The rocks, Chapman remarks, are not Laurentian or Azoic, although metamorphic, but altered Silurian, or "identical in general age with the gold-bearing rocks of eastern Canada and Nova Scotia."

D. Forbes has published analyses of Welsh gold (Phil. Mag., IV. xxxiv. 340):

	Au	Ag	Fe	Quartz.
1. Clogan	90·16	9·26	*tr.*	0·32, Cu *tr.*=99·74.
2. "	89·88	9·24	*tr.*	0·74=99·81.
3. Mawddach R.	84·89	13·99	0·34	0·43, Cu *tr.*=99·65.

Nos. 1 and 2 were from a quartz vein, associated with tetradymite, pyrite, chalcopyrite, galenite, chlorite, calcite, dolomite, ankerite? siderite, and barite. G. of 1=17·26. No. 3 was stream gold associated with menaccanite. G.=15·79.

Gold from the Stanislaus mine, Cal., gave Genth Au 88·63, Ag 11·37 (Am. J. Sci., II. xlv. 31).

Harmotome (390, p. 439). Descloizeaux has subjected crystals of the morvenite variety to a new examination (L'Institut, 1868, 35), and finds that they are optically *monoclinic* instead of orthorhombic; and observes, consequently, that they are not hemihedral as suggested by Gadolin, and as stated on p. 440.

Hematite (180, p. 140). New forms of crystals of hematite from Keswick, Cumberland, and from Elba, have been described by Hessenberg (Min. Not., No 8), adding the new planes $\frac{1}{9}$, $-\frac{5}{28}$, from the former, and $\frac{1}{10}$ and $-\frac{4}{7}$ from the latter.

Hessite (58, p. 50). Analyses of hessite from the Stanislaus mine by F. A. Genth (Am. J. Sci., II. xlv. 311, 1868):

	Te	Au	Ag	Pb	Ni
1.	44·45	8·28	46·34	1·65	4·71=100·43.
2.	[39·64]	3·22	55·60	——	1·54=100.

In No. 1, 7·21 p. c of impurity are excluded, of which 4·22 was free gold and the balance quartz; and in No. 2, 28·60 p. c., including 6 p. c. free gold. Genth concludes that the mineral is a mixture of hessite with altaite and his new species melonite ($\text{Ni}_2\,\text{Te}_3$); anal. 1 giving 78·11 hessite, 2·67 altaite, and 20·03 melonite, while 2 has 92·82 hessite and 6·55 melonite.

Hydrobucholzite of Thomson. Thomson obtained (Min., i. 237) $\ddot{\text{Si}}$ 41·35, $\overset{\cdots}{\overline{\text{Al}}}$ 49·55, $\dot{\text{H}}$ 4·85, gypsum 3·12=98·87. Probably from Sardinia.

Huyssenite. Eisenstassfurtit *Huyssen*, Berggeist, x. 67, 1865, Jahrb. Min. 1865, 329: Stassfurtit *Bischof*, ib.; Huyssenite *Dana.* (597 A.) This borate, briefly alluded to on page 596, appears to be a distinct species, and has the following characters:

Massive, and in nodular concretionary forms. G.=2·78; but after removal of mixed chlorids, 3·09. Lustre feeble. Color greenish-gray, becoming yellow on exposure, from the iron present.

Composition according to Bischof: $\dot{\text{Mg}}^3\ddot{\text{B}}^4$ 40·36, $\dot{\text{Fe}}^3\ddot{\text{B}}^4$ 50·05, Mg Cl 9·59=100, corresponding to the formula $(\frac{1}{2}\dot{\text{Mg}}+\frac{1}{2}\dot{\text{Fe}})^3\ddot{\text{B}}^4$.

Occurs at the salt mine of Stassfurt, with stassfurtite, which it much resembles; its nodules contain usually a nucleus of common salt, while those of stassfurtite have one of red carnallite.

Hyalophane (313, p. 346). An analysis of this mineral from Binnenthal gave T. Petersen (Jahresb. 1866, 928) $\ddot{\text{Si}}$ 51·84, $\overset{\cdots}{\overline{\text{Al}}}$ 22·08, $\dot{\text{Mg}}$ 0·10, $\dot{\text{Ca}}$ 0·65, $\dot{\text{Ba}}$ 14·82, $\dot{\text{K}}$, $\dot{\text{Na}}$ [10·03], $\dot{\text{H}}$ 0·48=100.

Hydrosilicite *v. Walt.*, Vulk. Gest., 305. (349 A.) An amorphous substance or crust from Palagonia and Aci Castello, Sicily, which afforded v. Waltershausen $\ddot{\text{Si}}$ 44·90, $\dot{\text{Mg}}$ 4·60, $\dot{\text{Ca}}$ 33·32, $\dot{\text{Na}}$ 2·11, $\dot{\text{K}}$ 1·86, $\dot{\text{H}}$ 13·21=100; and another variety, $\ddot{\text{Si}}$ 43·31, $\overset{\cdots}{\overline{\text{Al}}}$ 3·14, $\dot{\text{Mg}}$ 8·66, $\dot{\text{Ca}}$ 28·70, $\dot{\text{Na}}\dot{\text{K}}$ 1·70, $\dot{\text{H}}$ 14·48=100. Corresponds nearly to the formula $\dot{\text{R}}\ddot{\text{Si}}+\dot{\text{H}}$.

Hydrotalcite (214, p. 179). E. W. Root has obtained (priv. contrib.) for houghite from Somerville, N. Y.:

	$\overset{\cdots}{\overline{\text{Al}}}$	$\dot{\text{Mg}}$	$\dot{\text{H}}$	$\ddot{\text{C}}$	Insol.
1.	21·90	31·07	30·65	6·91	8·89=99·42.
2.	21·61	31·52	30·55	6·88	9·15=99·71.
Mean	21·75	31·24	30·60	6·89	9·02=99·50.

The insoluble in No. 2 consisted of 4·43 $\ddot{\mathrm{Si}}$ and 4·36 undecomposed mica, etc. The results accord closely with those of Johnson.

HYPOXANTHITE *Rowney*, Ed. N. Phil. J., II. ii. 308, 1855; Sienna Earth. A brownish-yellow ferruginous clay or ochre, probably only clayey yellow ochre. G.=3·46. Analysis obtained $\ddot{\mathrm{Si}}$ 11·14, $\ddot{\bar{\mathrm{A}}}\mathrm{l}$ 9·47, $\ddot{\bar{\mathrm{F}}}\mathrm{e}$ 65·35, $\dot{\mathrm{C}}\mathrm{a}$ 0·53, $\dot{\mathrm{M}}\mathrm{g}$ 0·03, $\dot{\mathrm{H}}$ 13·00=99·52.

JAMESONITE (112, p. 90). Jamesonite from Eusebi vein, Przibram, Bohemia (v. Zepharovich, Ber. Ak. Wien, lvi. June, 1867), afforded R. Helmhacker S 20·21, Sb 30·81, As *tr.*, Pb 47·15, Fe 1·35=99·54.

Occurs in fine fibrous plates and lenticular masses in granular galenite.

809. **JAULINGITE.** Pt. of Jaulingite *v. Zepharovich*, Ber. Ak. Wien, xvi. 366, 1855. Amorphous, resin-like. Brownish-yellow. Brittle. At 50°C. softens, 70°C. liquid. Easily soluble in alcohol and ether. Aromatic odor when heated. Ratio for C, H, O=39 : 60 : 4½=$\mathrm{C}_{26}\mathrm{H}_{40}\mathrm{O}_{3}$, Ragsky, who obtained (½) C 77·97, H 10·14, O 11·89=100. Not soluble in a carbonated alkali, and scarcely at all in a potash solution. The above was dissolved out of a resin (called Jaulingite by v. Z., because occurring at the Jauling, near St. Viet, in Lower Austria) by means of sulphid of carbon. The resin somewhat resembles amber, is hyacinth-red, translucent in thin splinters, may be rubbed to a yellow powder between the fingers, and has H.=2·5, G.=1·098—1·111.

813A. A *Beta-jaulingite* was obtained from the residue, after the treatment with sulphid of carbon, by the action of ether. Color brownish-yellow. Softens at 135° C., and becomes liquid at 160°. Dissolves easily in alcohol and ether, but not in carbonated alkali or sulphid of carbon. Ratio for C, H, O=40 : 53⅓ : 8⅞; or 18 : 24 : 4, Ragsky, who obtained (⅔) C 70·90, H 7·93, O 21·17 =100. It contains double the oxygen of the preceding, with less, proportionally, of hydrogen. The ratio is nearest to that of guyaquillite (No. 813).

KIRWANITE *Thom.*, Min., i. 378, 1836. A fibrous, green, chlorite-like mineral from the basalt of the N.E. coast of Ireland. R. D. Thomson found in it (l. c.) $\ddot{\mathrm{Si}}$ 40·5, $\ddot{\bar{\mathrm{A}}}\mathrm{l}$ 11·41, $\dot{\mathrm{F}}\mathrm{e}$ 23·91, $\dot{\mathrm{C}}\mathrm{a}$ 19·78, $\dot{\mathrm{H}}$ 4·35=99·95.

LEEDSITE *Thom.* A mixture of $\dot{\mathrm{C}}\mathrm{a}\,\dddot{\mathrm{S}}$ 71·9, $\dot{\mathrm{B}}\mathrm{a}\,\dddot{\mathrm{S}}$ 28·1, from near Leeds.

LESLEYITE *I. Lea*, Proc. Ac. Philad., 1867, 44. A soft fibrous mineral found near Unionville, Pa., on corundum, yet undescribed, and not proved to be a new species.

MAGNETITE (186, p. 140). A *niccoliferous* magnetite occurs, according to Petersen (Jahrb. Min. 1867, 836), north of Pregratten in the eastern Alps. He obtained for one specimen, on analysis, $\ddot{\bar{\mathrm{F}}}\mathrm{e}$ 68·92, $\dot{\mathrm{F}}\mathrm{e}$ 29·32, $\dot{\mathrm{N}}\mathrm{i}$ 1·76, $\ddot{\bar{\mathrm{M}}}\mathrm{n}$, $\ddot{\bar{\mathrm{C}}}\mathrm{r}$, $\ddot{\mathrm{T}}\mathrm{i}$ *tr.*=100.

MARCASITE (90, p. 75). C. Mène has observed that the pyrites of unaltered sedimentary beds is mostly marcasite, while that of metamorphic rocks is pyrite (C. R., lxiv. 867). The following analyses are by him:

	G.	S	Fe	$\ddot{\mathrm{Si}}$	$\ddot{\bar{\mathrm{A}}}\mathrm{l}$	$\dot{\mathrm{H}}$	Organ.
1. Champagne	4·1759	(⅔) 46·4	40·9	8·4	1·7	2·1	—=99·5.
2. Ain	4·1822	(⅔) 48·2	42·0	5·8	1·4	1·4	0·3, $\dot{\mathrm{C}}\mathrm{a}$ 0·7=99·8.
3. Bauregard, etc.	4·2066	(⅝) 50·7	44·0	3·2	0·6	0·9	0·1, $\dot{\mathrm{C}}\mathrm{a}$ 0·2=99·7.
4. Creusot	4·1809	(½) 49·1	32·5	5·9	0·9	0·9	0·3=99·6.
5. St. Etienne	4·1803	(⅓) 48·5	42·3	6·6	1·0	0·7	0·3=99·4.
6. Oise and Aisne	4·1770	(⅓) 44·9	38·9	11·3	2·4	1·7	0·3=99·5.

Anal. 1 of nodules; 2, from the oolite ore beds of Villebois and Serrières; 3, from ammonites, from Bauregard, Mazenay, and Laverpillière; 4, 5, from the coal-beds; 6, bituminous pyrites.

MELANTERITE (664, p. 646). An impure sulphate of iron, apparently a mixture of melanterite and a sulphate of the sesquioxyd (as remarked by Kenngott, Ueb. 1865), from Bourboule, in the Dept. of Puy de Dome, France, has been named *Bourboulite* by Lefort (C. R., 1862, lv. 949, Jahrb. Min. 1863, 588). Derived apparently from the alteration of marcasite. Lefort's analyses obtained:

$\dddot{\mathrm{S}}$	$\ddot{\bar{\mathrm{F}}}\mathrm{e}$	$\dot{\mathrm{F}}\mathrm{e}$	$\dot{\mathrm{H}}$
38·04	5·08	16·08	40·80=100.
37·55	8·71	13·83	39·91=100.
35·22	8·25	12·99	43·54=100.

It is a friable greenish substance, partly soluble in water and partly in acids.

MELONITE *F. A. Genth*, Am. J. Sci., II. xlv. 313, 1868. (100A, Appendix to Sulphids, etc.) A new tellurium mineral from among the ores of the Stanislaus mine. Form hexagonal, with eminent basal cleavage. Generally in indistinct granular and foliated particles. Lustre metallic; color reddish-white, rarely tarnished brown; streak dark gray.

Composition $\mathrm{Ni_2\ Te_3}$=Te 76·49, Ni 23·51=100. An analysis afforded Te 73·43, Ag 4·08, Pb 0·72, Ni 20·98=99·21; the nickel contained a minute trace of cobalt. B.B. in the open tube gives a sublimate fusing to colorless drops, leaving a gray mass; on charcoal burns with a bluish flame, giving a white volatile coating, and a greenish-gray residue; in R.F. with soda a gray powder of magnetic metallic nickel. Soluble in nitric acid, giving a green color, and on evaporation yielding a white crystalline powder of tellurous acid.

Genth considers the analysis to correspond to 6·60 p. c. hessite, 1·17 altaite, 2·29 native tellurium, and 89·25 melonite, which he assumes to have the composition $\mathrm{Ni_2\ Te_3}$, although he observes that the hexagonal form would better agree with the formula Ni Te. But the latter view would require that over one-third of the mixture should be native tellurium, which he thinks scarcely probable, as the material for analysis, when examined by a strong magnifier, showed a small quantity of dark colored hessite, but every other particle had a reddish hue, without the slightest admixture apparently of any grayish-white mineral.

MENACCANITE (181, p. 143). A variety of this species, from the basalt of Turner's Hill quarry, Staffordshire, gave D. Forbes (Phil. Mag., IV. xxxiv. 347), after excluding silicates and insoluble, $\ddot{\mathrm{Ti}}$ 34·28, $\overline{\mathrm{Fe}}$ 65·72; G.=4·69.

MICA GROUP. A micaceous mineral has been named *Helvetan* by R. T. Simmler (his Petrãa, 9, Keung. Ueb. 1865, 135, 1868), but without a determination of its composition or exact relations to other species. It forms part of a schist and quartzite in the gneiss formation (Alpinyte) of the Alps. H.=3–3·5; G.=2·77–3·03; lustre pearly or waxy; color gray to whitish, reddish, greenish, violet, and copper-red; streak grayish-white to reddish. In the closed tube yields little or no water. B.B. fuses with difficulty on the edges; the borax pearl is colorless when cold. Not attacked by hot acids. Stated to consist probably of silica, alumina, lime, magnesia, and protoxyd of iron.

A micaceous mineral from Chester Co., Pa., has been named *Pattersonite* by I. Lea (Proc. Ac. Philad., 1867, 45), but without the mention of its distinctive characters.

MONTANITE (711, p. 668). Dr. Genth has detected this tellurate with the tetradymite of Davidson Co., N. C. (Am. J. Sci., II. xlv. 319), two analyses affording:

	Te	$\overline{\mathrm{Bi}}$	$\dot{\mathrm{H}}$	$\dot{\mathrm{Cu}}$	$\overline{\mathrm{Fe}}$
1.	25·45	68·78	[3·47]	1·04	1·26=100.
2.	23·90	71·90	[2·80]	1·08	0·32=100.

Genth remarks that it is still doubtful whether the mineral contains 1 or 2 atoms of water.

MUSCOVITE (294, p. 309). New analyses of this species, with an extended discussion of the chemical composition of the different kinds of mica, have been published by Rammelsberg in ZS. G., xix. 400:

	$\ddot{\mathrm{Si}}$	$\overline{\mathrm{Al}}$	$\overline{\mathrm{Fe}}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Mn}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Na}}$	$\dot{\mathrm{K}}$	F	$\dot{\mathrm{H}}$
1. Uton, Sweden	45·75	35·48	1·86	—	0·52	0·42	1·58	10·36	1·32	2·50=99·79.
2. Easton, Pa.	46·74	35·10	4·00	1·53	—	0·80	—	9·63	1·05	3·36=102·21.
3. Goshen, Mass.	47·02	36·83	0·51	—	1·05	0·26	0·30[a]	9·80	0·52	3·90=100·19.
4. Aschaffenburg	47·69	33·07	3·07	2·02	—	1·73[b]	—	9·70	0·19	3·66=101·13.
5. Bengal	47·39	35·56	2·79	—	0·53[c]	0·96	0·83	9·53	0·46	4·11=102·16.

[a] With lithia. [b] With manganese. [c] With lime.

No. 1, G.=2·836, optic-axial angle 72°–73°, Senarmont; 2, G.=2·904, optic-axial angle 64·8° Quincke; 3, G.=2·859, optic-axial angle 75°–76°, Descl.; 4, G.=2·911, optic-axial angle 67·9°, Quincke; Bengal, G.=2·827, optic-axial angle 66·1°.

The mineral from Easton is evidently not the silvery mica referred on p. 307 to biotite, the optical angle of which, according to both Grailich and Blake, is less than 2°.

Mica from Royalston, Mass., afforded T. Petersen (Jahresb. 1866, 928, 1868) $\ddot{\mathrm{Si}}$ 46·03, $\overline{\mathrm{Al}}$ 32·10, $\overline{\mathrm{Fe}}$ 6·85, $\overline{\mathrm{Mn}}$ 2·48, $\dot{\mathrm{Mg}}$ 0·23, $\dot{\mathrm{Ca}}$ 0·90, $\dot{\mathrm{K}}$ 11·20=99·79; G.=2·947.

NEPHRITE. Kastner has analyzed an aluminous jade or nephrite from China (Gehlen's J., ii

459), differing from those of pp. 237, 290, 292; and Melchior and Meyer (Ber. Ak. Wien, xlix 475) a kind from New Zealand. Both are infusible, or nearly so. They obtained:

	S̈i	Äl	F̈e	Ṁg	Ċa	K̇	Ḣ
1. China	50·50	10·00	5·50	31·00	——	——	2·75, C̈r 0·05 Kastner.
2. N. Zealand	53·01	10·33	7·18	14·50	12·40	0·97	1·11=100·00 M. & M.
3. "	55·01	13·66	3·52	21·62	——	1·42	5·04=100·27 M. & M.

For 2. O. ratio for Ṙ, R̈, S̈i, 9·5 : 7·2 : 27 5; for 3, 8·9 : 7·4 : 28·6. Nos. 2 and 3, as described by Hochstetter (l. c.), are somewhat slaty, and are hardest on the transverse surfaces of fracture. In No. 2, H.=5—5·5; in another, 3·5—5. G.=2·61. It is called *tangiwai* by the New Zealanders. B.B. thinnest splinters infusible, but becomes white and opaque. In No. 3, H.=5·5—6·5; on a polished cross face, 7. G.=3·02. B.B. fuses with great difficulty, becomes discolored and opaque. This variety contains much water.

These minerals are probably mere mixtures, as may well be true of such massive substances. For non-aluminous jade or nephrite, see p. 237.

Orthoclase (316, p. 352). The twin crystals of orthoclase from Carlsbad, Bohemia, afforded Rammelsberg and Bulk (ZS. G., xviii. 393):

		S̈i	Äl	F̈e	Ṁg	Ċa	Ḃa	Ṅa	K̇
1. *White*	G.=2·573	63·02	18·28	——	0·14	——	0·48	2·41	15·67=100 Ramm.
2. *Reddish*	G.=2·55	65·23	18·26	0·27	——	*tr.*	——	1·45	14·66=99·87 C. Bulk.

White feldspar from Royalston, Mass., gave T. Petersen (Jahresb. 1866, 927, 1868) S̈i 65·79, Äl 17·46, F̈e *tr.*, Ṁg *tr.*, Ċa 0·59, Ṅa 5·21, K̇ 14·26, Ḣ 0·37=100·98. G.=2·631.

Palagonite (425, p. 483). Von Wartha found in the palagonite of the basaltic tufa of Battina in Baranyer Comitat (Hungary) (Verh. G. Reichs. 1867, 210), S̈i 26·99, Äl 11·09, F̈e 8·45, Ċa 12·69, Ṁg 2·29, Ṡr 1·03, Ṅa 0·63, K̇ 1·07, Ḣ 11·09, C̈ 7·70, phosphate of lime 0·97, insoluble residue 16·81=99·89. Excluding the residue, phosphate of lime and carbonic acid, with its equivalent of lime, the results become S̈i 41·78, Äl 17·17, F̈e 13·05, Ċa 4·47 Ṁg 3·55, Ṡr 0·19, K̇ 1·66, Ṅa 0·97, Ḣ 17·16=100·00, corresponding very well with the composition of palagonite from other localities.

Plagioclase. Breithaupt's name for the group of triclinic feldspars, the two prominent cleavage directions in which are oblique to one another, *πλάγιος* signifying *oblique*.

Plombierite *Daubrée*, C. R., xlvi. 1088, 1858, Ann. d. M., V. xiii. 244. (340A.) A gelatinous substance which hardens in the open air, formed from the thermal waters of Plombières. It becomes, on hardening, opaque snow-white. It afforded, after drying at 100°C., S̈i 40·6, Äl 1·3, Ċa 34·1, Ḣ 23·2=99·2, corresponding to Ċa S̈i+2 Ḣ, a hydrated silicate of lime.

Chabazite and apophyllite in fine crystals are other results of the action of the waters of Plombières on the brick and mortar of an old Roman aqueduct, besides hyalite, aragonite, and perhaps scolecite and harmotome.

Pyrite (75, p. 62). The pyrite associated with the niccoliferous pyrrhotite of Inverary, Scotland, gave D. Forbes (Phil. Mag., IV. xxxv. 178) S 49·32, Fe 45·73, Ni 1·99, Co 1·24, Cu 1·18, insoluble 0·06=99·52; G.=4·93. Forbes says that, in the examination of several hundred specimens of pyrite and pyrrhotite from different localities, nickel is rarely found in pyrite, while often present in pyrrhotite; on the contrary, cobalt is rather common in pyrite, and, compared with nickel, in quite small quantity in pyrrhotite.

Analyses of pyrite from different French localities by C. Mène (C. R., lxiv. 870):

	G.	S	Fe	S̈i	Äl	Ḣ
1. Chessy and St. Bel	4·6205	($\frac{1}{4}$) 46·5	39·3	10·0	3·8	0·2=99·8.
2. Lavoulte	4·7712	($\frac{1}{4}$) 48·7	42·9	7·0	0·8	0·1, Ċa 0·3=99·8.
3. Allevard	4·7500	48·5	42·1	6·5	2·0	0·4=99·5.
4. Aude	4·7428	49·1	43·5	6·0	1·0	0·2=99·8.
5. Elba	4·8008	52·2	43·5	4·0	0·1	——=99·8.
6. Conflens	4·8102	52·4	43·1	3·5	0·7	0·2=99·9.
7. Allier	4·8033	52·7	44·2	2·5	——	0·2=99·6.
8. Gard	4·7318	($\frac{3}{2}$) 48·5	40·5	8·7	1·7	0·3=99·7.

Mène observes that the pyrites of unaltered sedimentary rocks is mostly *marcasite*.

PYROMELANE *C. U. Shepard*, Am. J. Sci., II. xxii. 96, 1856, Min., 253, 1857. In angular grains from the gold-washings of McDowell Co., N. C. H.=6·5; G.=3·87; lustre resinous; color reddish to yellowish-brown and black; subtranslucent. B.B. infusible, but becomes black and opaque (whence the name); soluble in the fluxes, giving reactions of titanic acid and iron. Stated to be "essentially a titanate of alumina and iron with traces of lime and glucina," and "may contain zirconia also": but the evidence of such a composition is not given. Perhaps a variety of titanite.

PYROXENE (238, p. 212). An analysis of malacolite from Gefrees (Fichtelgebirge) afforded K. Haushofer (J. pr. Ch., cii. 35) $\ddot{\mathrm{Si}}$ 54·00, $\overset{\dots}{\bar{\mathrm{Al}}}$ 0·62, $\dot{\mathrm{Fe}}$ 3·78, $\dot{\mathrm{Mn}}$ 0·27, Mg 15·31, $\dot{\mathrm{Ca}}$ 25·46=99·65. G.=3·285.

For an article on the constitution of aluminous pyroxene and amphibole, by Rammelsberg, see ZS. G. Ges., xix. 496; and a word on the formula, by the author, p. 794.

Canaanite is a whitish *pyroxene rock*, as stated on page 322. It was called scapolite rock by Hitchcock (G. Rep. Mass., 315, 1835, 369, 1841), and later named *Canaanite* in Alger's Min., 1844, after an analysis (see below) by S. L. Dana. It is a whitish and grayish-white rock, subcrystalline in fracture, with H.=6·5 and G.=3·07, and constitutes ridges in the vicinity of Canaan, Ct. It is overlaid by a dolomite, abounding in some layers in crystals of whitish pyroxene, and at the junction is much mixed with the dolomite. Dr. Dana obtained in his analysis (Hitchcock's Rep., 569, 1841):

$\ddot{\mathrm{Si}}$ 53·37 $\overset{\dots}{\bar{\mathrm{Al}}}$ 10·38 $\dot{\mathrm{Fe}}$ 4·50 $\dot{\mathrm{Mg}}$ 1·62 Ca 25·80 $\ddot{\mathrm{C}}$ 4·00=99·67.

A specimen has been recently analyzed by B. S. Burton (priv. contrib.), with the following results, showing that the alumina of the preceding was an error:

$\ddot{\mathrm{Si}}$ 51·30 $\dot{\mathrm{Fe}}$ 1·60 $\dot{\mathrm{Mg}}$ 16·47 $\dot{\mathrm{Ca}}$ 25·21 $\ddot{\mathrm{C}}$ 5·91 $\dot{\mathrm{H}}$ 0·39=100·88.

The 5·91 carbonic acid corresponds to 13·41 of carbonate of lime present as impurity. Whether the carbonate is a result of alteration or not is yet unascertained.

PYRRHOTITE (68, p. 58). Analyses of niccoliferous pyrrhotite from Inverary and from the Craigmuir mine, Scotland, by D. Forbes (Phil. Mag., IV. xxxv. 174):

	S	Fe	Ni	Co	Cu	Insol.
1. Inverary	37·50	49 97	11·17	*tr.*	*tr.*	0·24, Mg 0·96=99·84.
2. Craigmuir	37·99	50·87	10·01	1·02	*tr.*	0·38, As 0·04=100·31.

G. of 1=4·50; 2=4·602. Forbes suggests that there may be two definite compounds under niccoliferous pyrrhotite; one with the formula $5\,(\mathrm{Fe}^7\,\mathrm{S}^8)+\mathrm{Ni}\,\mathrm{S}$, with 10·93 of nickel, and one $15\,(\mathrm{Fe}^7\,\mathrm{S}^8)+\mathrm{Ni}\,\mathrm{S}$ with 4·10 nickel, corresponding, according to him, with many analyses of pyrrhotite from a wide range of localities.

QUARTZ (231, p. 189). See **TRIDYMITE** and **VESTAN** beyond.

REFDANSKITE *Hermann*, J. pr. Ch., cii. 405. (412A.) An earthy mineral occurring in masses which fall to powder under slight pressure. Adheres to the tongue. Color dirty grayish-green. G.=2·77. Analysis:

$\ddot{\mathrm{Si}}$ 32·10 $\overset{\dots}{\bar{\mathrm{Al}}}$ 3·25 Fe 12·15 $\dot{\mathrm{Ni}}$ 18·33 $\dot{\mathrm{Mg}}$ 11·50 $\dot{\mathrm{H}}$ 9·50 $\dot{\mathrm{Mn}}$, $\overset{\dots}{\bar{\mathrm{Bi}}}$ *tr.* Sand 13·00=99·83.

Or, excluding the sand, $\ddot{\mathrm{Si}}$ 36·92, $\overset{\dots}{\bar{\mathrm{Al}}}$ 3·73, $\dot{\mathrm{Fe}}$ 13·97, $\dot{\mathrm{Ni}}$ 21·07, $\dot{\mathrm{Mg}}$ 13·22, $\dot{\mathrm{H}}$ 10·92=99·83. O. ratio for $\dot{\mathrm{R}}$, $\ddot{\mathrm{Si}}$, $\dot{\mathrm{H}}$, 3 : 4 : 2, the same as in serpentine, of which this species may be considered a niccoliferous variety (see p. 464).

RICHMONDITE. **HYPOTHETICAL PHOSPHATE.** The substance labelled gibbsite from Richmond, Mass., in which Hermann states he found 37 p. c. of phosphoric acid (see his analysis under Gibbsite, p. 178) has been named *Richmondite* by Kenngott (Vierteljahrschr. nat. Ges. Zurich, xi. 225).

SCHEELITE (614, p. 605). Rammelsberg has measured crystals from the Riesengebirge (ZS. G., xix. 493), and deduced the same dimensions as those of Dauber given on p. 605 (Pogg., cvii. 272). The crystals are unusually fine, some of them being an inch in length. They are found at Kies-berg between Gross-Aupa and the Riesenbaude, as described by Roemer (ZS. G., xv. 607), who also gives some measurements of the crystals, besides a particular account of the geological character of the region.

Selbite. Luftsaures Silber (from anal. by Selb) *Widenmann*, Min., 689, 1794, *Lenz*, Min., 95, 1794; Grausilber; Carbonate of Silver; *Selb*, Tasch. Min., xi. 394, 1817; Selbit *Haid.*, Handb., 506, 184. A grayish ore, made a carbonate by Selb, its discoverer, in 1788, at the mine Wenzel near Wolfach, with the composition (Widenmann, l. c., here cited from Lenz, l. c.), Carbonic acid 12, oxyd of silver 72·5, antimony 15·2, with carbonic acid and oxyd of copper. According to Walchner (Mag. f. Pharm., xxv. 1) it is only a mixture; and, according to Sandberger (Jahrb. Min. 1864, 221), one of Selb's original specimens, under the lens, proved to contain within earthy argentite, besides dolomite and silver, and all parts afforded a sulphur reaction.

Del Rio described a carbonate of silver from Real Catorce, Mexico, where it is called *Plata Azul* (Gilb. Ann., lxxi. 11), which also is regarded as a mixture.

Serpentine (411, p 464). An analysis of the dark green noble serpentine of Newburyport, Mass., gave T. Petersen (Jahresb. 1866, 931, 1868) $\ddot{S}i$ 41·76, $\overline{\ddot{A}}l$ *tr.*, $\dot{F}e$ 4·06, $\dot{M}g$ 41·40, $\dot{H}$ 13·40 = 100·62. G.=2·804.

Silicate of Yttria *Damour*, L'Institut, 1853, 78. H.=5–6; scratches glass. G.=4·391. Color brown. Probably a silicate of yttria. B.B. whitens, but infusible. Not soluble in salt of phosphorus. Sulphuric acid heated to 300°C. decomposes it, leaving a siliceous residue.

From the diamond sands of Bahia, Brazil.

Tenorite (Melaconite, 178, p. 136). The *tenorite*, or oxyd of copper (Cu O) in small delicate folia, occurring at Vesuvius, possesses, according to Maskelyne (Rep. Brit. Assoc., 1865, 331), double refraction, and moreover is optically biaxial. This author also states that there are two equal cleavages inclined to one another 72°. As the names tenorite and melaconite were given the same year, and tenorite was made non-isometric (hexagonal) by its describer, it appears to be right that tenorite should be sustained for the above mineral, and melaconite be left for the isometric kind, if any such proves to be a native species. That there is an isometric form of this Cu O has been announced by Becquerel, as stated on p. 137. Tenorite may have the form and dimensions found by Jenzsch in crystals of Cu O from the hearth of a furnace (l. c.), or those approximately of brookite; and this would place it near *brookite* in the system, under the chemical formula Ꞓu O$_2$ (analogous to that of brookite). Having this place in the arrangement it would be numbered 198B.

Melaconite crystals from Cornwall, collected by Mr. Talling, have been described by Maskelyne (l. c.) as *monoclinic*, with the planes *O*, *i-i*, *I*, 1, –1, 6-*i*, 6-6, and *O* ∧ *i-i*=80° 28'. No measured angles are given, but only the deduced dimensions. They have basal cleavage easy. The crystals are often twins, and the composition-face in some of them is *i-i*. H. a little above 4; G.=5·82527. Church has ascertained that the crystals are essentially pure Cu O.

It would appear, according to these observations, that this oxyd of copper is trimorphous; and there exists a doubt whether tenorite may not have this oblique form.

Tetradymite (31, p. 30). F. A. Genth has analyzed tetradymite from Highland, Montana Territory, and from the Phœnix mine, Cabarras Co., N. C., as follows (Am. J. Sci., II. xlv. 317):

	Te	Bi	S	$\dot{F}e$	Cu	Quartz.
1. Montana	47·60	50·43	——	0·90	——	0·78=100·01.
2. Phœnix mine	36·28	57·70	5·01	Fe 0·54	0·41	——=99·94.

No. 1 gives the ratio of Bi and Te 2 : 3, like the tetradymite from Fluvanna Co., Va., and Field's mine, Ga. No. 2 contains a small amount of pyrite, leaving 4·40 p. c. sulphur combined with the bismuth, and giving the ratio of S, Te, Bi=1 : 2·03 : 2=$Bi^2S^3+2Bi^2Te^3$.

Tetrahedrite (125, p. 100). The following are new analyses:

1. Mineral from the Goodwin mine near Prescott, Arizona, by F. A. Genth (Am. J. Sci., II. xlv 320).

2. An argentiferous variety (freibergite) from the Foxdale mine, Isle of Man, by D. Forbes (Phil. Mag., IV. xxxiv. 350), who calls it *polytelite*, though not the true polytelite of Glocker (p. 104), by whom this name was introduced; G.=4·97. Forbes mentions a similar variety from the Tyddynglwadis mine in N. Wales.

3. Freibergite from the De Soto mine, Star City, Nevada, by B. S. Burton (Am. J. Sci., II. xlv 320); G.=5.

	S	Sb	As	Cu	Fe	Zn	Ag	Pb
1. **Arizona**	26·97	24·67	*tr.*	38·16	1·05	6·23	3·21	—— = 100·29 Genth.
2. Isle of Man	27·48	24·85	—	22·62	4·80	4·65	13·57	1·43, quartz 0·34 = 99·74 Forbes.
3. Nevada	24·35	27·35	—	27·40	4·27	2·31	14·59	——, insol. 0·35 = 100·62 Burton.

From No. 1, 4·22 p. c. of quartz have been deducted.

Tiemannite (65, p. 56). Analysis of this species from Charlotte mine, at Clausthal in the Harz, gave T. Petersen (Jahresb. 1866, 919), after excluding oxyd of iron and gangue, Se 24·88, S 0·20, Hg 75·15, Pb 0·12 = 100·35. G. = 7·15.

Titanite (329, p. 383). Hessenberg, in No. 8 of his Min. Not. (1868), describes and figures crystals of sphene from Zillerthal, Greiseralp, St. Marcel (greenovite), Santorin.

In the lettering on the figures, pp. 383, 384, and in the accompanying text, the *minus* symbols should properly (according to the principle on p. xxvii) be *plus*, and the reverse.

Trichite, Belonite. The name *Trichite* (from θρίξ, *hair*) is applied by Zirkel (ZS. G., xix. 744, 1867) to microscopic *capillary* forms, often curved, bent, or zigzag, sometimes stellately aggregated, opaque and black or reddish-brown, of undetermined nature, which he detected in some kinds of glassy or semi-glassy volcanic rocks; and *Belonite* (ib., 738) to microscopic *acicular* crystals (whence the name, from βελόνη, *a needle*), colorless and transparent. The trichite, he states, is not pyroxene or hornblende; the belonite may be a feldspar.

Tridymite *Vom Rath*, Vorgetr. Ch. Ges. Bonn, March 7, 1866, pub. in 1868 (copy rec'd from v. R., May 8, 1868). (231 A.) Besides the two well-known forms of silica, quartz and opal, and the two problematical forms described by Jenzsch (pp. 201, and below), another is announced by v. Rath under the above name.

Tridymite occurs in small hexagonal tables, colorless and transparent, which are usually compound, and mostly of three individuals. It has G. = 2·2—2·3, or the low specific gravity of opal instead of that of ordinary quartz. Vom Rath alludes to the possibility of its being a pseudomorph of some unknown mineral, but observes that it has the double refraction of a substance optically uniaxial. It occurs in druses in a volcanic porphyry, from Cerro St Cristoval, near Pachucha, Mexico, along with crystals of hematite and needles of a gold-lustred hornblende. Named in allusion to its compound forms of three individuals, or *trins*, from τρίδυμος.

Uranophane *Websky*, ZS. G., v. 427, 1853, xi. 384. (376B?) Orthorhombic, $I \wedge I = 146°$ from $I \wedge i\text{-}i = 107°$; a macrodome of about 90°. Crystals microscopic acicular six-sided prisms in druses, containing also sometimes crystals of torbernite. Color of isolated crystals honey-yellow, of masses leek-green, sometimes blackish-green from mixture with uraninite. Optically orthorhombic. H. below 3. G. = 2·6—2·8; 2·78 of a specimen not wholly pure. Lustre of face $i\text{-}i$ pearly, elsewhere vitreous.

Analyses by Grundmann (ZS. G., xi. 390):

	$\ddot{\text{Si}}$	$\dddot{\bar{\text{Al}}}$	$\bar{\text{U}}$	$\dot{\text{Mg}}$	$\dot{\text{Ca}}$	$\dot{\text{K}}$	$\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\text{P}}}$	$\dot{\text{H}}$	Bi	Sb	Te	Fe	Pb	Cu	Ag	S
1.	15·81	5·65	49·84	1·35	4·69	1·71	0·12	14·11	1·78	1·46	0·43	0·57	0·29	0·21	0·11	1·66 = 99·74.
2.	11·19	2·80	54·23	1·19	3·58	0·80	0·05	12·19	1·77	1·86	0·22	0·89	0·38	5·24	?	3·96 = 100·34.

Separating the sulphids as impurities from No. 1, Websky deduces the O. ratio for $\dot{\text{R}}$, $\dddot{\bar{\text{R}}}$, $\ddot{\text{Si}}$, $\dot{\text{H}} = 1 : 5 : 4 : 6$, making it hence, if the water be taken as accessory, a ⅔-subsilicate; whence the formula $(\frac{1}{6}\dot{\text{R}}^3 + \frac{5}{6}\dddot{\bar{\text{R}}})\ddot{\text{Si}} + 3\dot{\text{H}}$. The specimen for the second analysis contained some uraninite. Found in granite, at Kupferberg in Silesia.

Valaite. Válait *W. Helmhacker*, Jahrb. G. Reichs, xvii. 210, 1867. Crystallized. Partly in small hexagonal tables, but forms not distinct. Also massive. H. below 1·5. Lustre shining. Color pitch-black. Streak black. Odor aromatic when rubbed between the fingers. Fracture uneven.

Belongs among the resins, but composition undetermined. B.B. swells to more than 10 times its former bulk, and becomes a light, porous mass, which in a higher heat is reduced to a grayish ash.

Occurs in thin crusts on dolomite and calcite, or in druses of small crystals, in the Rossitz-Oslawaner Coal formation, Moravia. It is associated with hatchettite, and the same bed affords some mineral oil.

VESTAN *Jenzsch*, Pogg., cv. 320, 1858. Quartz under a triclinic form, according to Jenzsch's observations. The angles are stated to be only approximative. Two of them. 95½° and 133°, are very near $R \wedge R$ and $R \wedge -R$ in ordinary quartz; G.=2·65—2·66, as in quartz. The observations need confirmation. The crystals here referred occur mostly in melaphyre, and the localities mentioned are mainly in Saxony and the Thuringer Wald.

VOLGERITE (229, p. 188). The name *Volgerite* was given by the author (Min., 142, 1854) to Volger's mineral, for which Volger wrote the formula adopted as that of the species on p. 188. The African mineral analyzed by Cumenge, which is referred on the same page to Volgerite, although of somewhat doubtful composition, is the *Cumengite* of Kenngott (Min., 29, 1853).

WASITE *J. F. Bahr*, Pogg., cxix. 572, 1863. A mineral resembling allanite, of a brownish-black color, but yellowish-brown in thin splinters and powder, with traces of cleavage in one direction. According to a qualitative examination by Bahr, it contains silica, alumina, yttria, sesquioxyd of iron, cerium, didymium, calcium, manganese, lime, alkali, a trace of uranium, without glucina, together with the oxyd of a new metal he named *wasium* (after the royal family of Wasa, Sweden). In a later paper (Ann. Ch. Pharm., cxxxii. 127), Bahr makes this oxyd thoria. Nicklès had suggested previously that it might be impure cerium.

From Rönsholm, an island near Stockholm. The relations of the mineral remain doubtful.

WERNERITE (299, p. 320). The pink scapolite of Bolton, Mass., yielded T. Petersen (Jahresb. 1866, 928, 1868) $\ddot{\mathrm{S}}\mathrm{i}$ 48·34, $\overset{...}{\bar{\mathrm{A}}}\mathrm{l}$ 29·09, $\dot{\mathrm{C}}\mathrm{a}$ 15·40, $\dot{\mathrm{N}}\mathrm{a}$, with a little $\dot{\mathrm{K}}$ [6·55], $\dot{\mathrm{H}}$ 0·62=100. G.=2·719. The analysis agrees very closely with that by Wolff (p. 320).

WÖHLERITE (265, p. 261). According to new optical investigations by Descloizeaux (L'Institut, 1868, 35), wöhlerite crystals are monoclinic instead of orthorhombic.

ZOISITE (280, p. 290). Damour (C.R., lxiii. 1038) found on analysis of an ancient stone implement from Neuchatel a composition corresponding to that of *saussurite*, $\ddot{\mathrm{S}}\mathrm{i}$ 50·69, $\overset{...}{\bar{\mathrm{A}}}\mathrm{l}$ 25·65, $\overset{...}{\bar{\mathrm{F}}}\mathrm{e}$ 2·50, $\dot{\mathrm{M}}\mathrm{g}$ 5·76, $\dot{\mathrm{C}}\mathrm{a}$ 10·61, $\dot{\mathrm{N}}\mathrm{a}$ 4·64, ign. 0·30=100·15. G.=3·20—3·43.

A zoisite from Pinzgau has part of the alumina replaced by oxyd of chrome, according to F. Sandberger (Jahrb. Min. 1867 834). A chrome zoisite has also been mentioned by Breithaupt as occurring in Salzburg.

GENERAL INDEX.

Abichite, 570.
Abrazite, 418.
Acadialite, 434.
Acanthite, 51.
Acerdese, 171.
Achates, 194.
Achirite, 401.
Achmatite, 281.
Achmit, 224.
Achroite, 365.
Achtaragdite, 478.
Acicular Bismuth, 100.
Aciculite, 100.
Acmite, 224.
Actinolite, Actinote, 232.
Adamantine spar, 138.
Adamas, 21, 138.
Adamine, Adamite, 565.
Adamsite, 309.
Adelpholite, 525; 275.
Adinole, 349.
Adularia, 352.
Ædelforsite, 212, 400.
Ædelite, 410.
Ægirine, Ægyrite, 223.
Ænigmatite, 285.
Ærosite, 94.
Aes cyprium, 14.
Æschynite, 522, 793.
Aftonite, 104.
Agalmatolite, 480; 452, 454, 483.
Agaphite, 580.
Agaric mineral, 680.
Agate, 194.
Agnesite, 793.
Agustite, 530.
Aigue-marine, 245.
Aikinite, 100.
Ainalite, 159.
Akanthit, 51.
Akanticone, 281.
Akmit, 224.
Akontit, 78.
Alabandin, Alabandite, 46.
Alabaster, 637.
Alalite, 214.
Alaun, 651.
Alaunstein, 658, 659.
Albertite, 753.
Albin, 415.
Albite, 348; 324.
Alexandrite, 155.
Algerite, 323.
Algodonite, 37.
Alipite, 404.
Alisonite, 84.
Alizite, *v.* Alipite, 404.
Allagite, 227.
Allanite, 285.
Allemontite, 18.
Allochroite, 268.
Alloclasite, 81.
Allogonite, 546.
Allomorphite, 616.
Allopalladium, 12.
Allophane, 419.
Alluaudite, 542.
Almandin, Almandite, 267.
Alstonite, 698.
Altaite, 44, 793.
Alum, Native, 651, 652.
    Ammonia, 651.
    Feather, 654.
    Iron, 654.
    Magnesia, Manganese, Soda, 653.
Alumian, 631.
Alumina, 137.
    Fluate, 126.
    Fluosilicate, 376.
    Hydrate, 168.
    Hydro-Sulphate, 658.
    Mellate, 750.
    Phosphates, 575, 587.
    Sulphate, 631, 649, 658, 662.
Alumina and Lime Phosphate, 587.
    Carbonate, 709.
Alumine fluatée alcaline, 126.
    phosphatée, 575, 587.
    sulfatée, 631, 649, 658, 662.
Aluminilite, 658.
Aluminite, 658.
Aluminum, Fluorid, 126.
Alumocalcite, 199.
Alumstone, 658.
Alun, 651.
Alunite, 658.
Alunogen, 649.
Alurgite, 764.
Alvite, 511.
Amalgam, Native, 18.
    Gold, 14.
Amausite, 351.
Amazonstone, 355.
Amber, 740.
Amblygonite, 545.
Ambrite, 741.
Amethyst, 193.
    Oriental, 138.
Amiant, 234, 465.
Amianthoide, 234.
Amianthoide magnesite, 175.
Amianthus, 234, 465.
Ammiolite, 547.
Ammonalun, 651.
Ammonia alum, 651.
Ammonia, Bicarbonate, 705.
    Muriate, 114.
    Phosphate, 551.
    Sulphate, 635.
Ammonia and Soda, Phosphate 551.
Amoibite, 72.
Amphibole, 232, 793.
Amphibolite, 235, 348.
Amphigène, 334.
Amphigenyte, 335.
Amphilogite, 311.
Amphithalite, 587.
Amphodelite, 337.
Anagenite, *v.* Chrome ochre.
Analcite, Analcime, 432.
Analcime carnea, 317.
Analzim, 432.
Anatase, 161.
Anauxite, 458.
Andalusite, 371, 794.
Andesine, Andesite, 344.
Andesyte, 345.
Andradite, 268.
Andreasbergolite, 439.
Andreolite, 439.
Anglarite, 556.
Anglesite, 622.
Anglesite, Cupreous, 663.
Anhydrite, 621.
Ankerite, 685.
Annabergite, 560.
Annite, 308.
Annivite, 103.

Anorthite, 337, 794.
Antholite, 234; 230, 231.
Anthophyllite, 231; 208.
    Hydrous, 242.
Anthosiderite, 407.
Anthracite, 754.
Anthraconite, 677.
Anthracoxen, 745, 746.
Anthracoxenite, 746.
Anthrax, 138, 147.
Antiedrite, 417.
Antigorite, 465.
Antimoine natif, 18.
    oxidé, 184.
    oxidé sulfuré, 186.
    sulfuré, 29.
    sulfuré nickelifère, 73.
    sulfuré plombo-cuprifère, 96.
Antimon, Gediegen, 18.
Antimon-arsen, 18.
Antimonate of Lead, 591.
Antimonbleispath, 591.
Antimonblende, 186.
Antimonblüthe, 184.
Antimonfahlerz, 100.
Antimonglanz, 90.
Antimonite of quicksilver, 547.
Antimonial arsenic, 18.
    copper, 85.
    copper glance, 96.
    nickel, 61.
    ochre, 187, 188.
    silver, 35.
Antimonite, 29.
Antimonkupferglanz, 96.
Antimonnickel, 61.
Antimonnickelglanz, 73.
Antimonocher, 187.
Antimonophyllite, 185.
Antimonoxyd, 184.
Antimonsaures bleioxyd, 591.
Antimonsilber, 35.
Antimonsilberblende, 94.
Antimony, Native, 18.
    Arsenical, 18.
    Gray, 29; 90.
    Oxyd, 184.
    Plumose ore of, 91.
    Red, 186.
    Sulphid, Sulphuret, 29.
    White, 184.
Antimony blende, 184.
    bloom, 184.
    glance, 29.
    ochre, 187, 188.
Antozonite, 124.
Antrimolite, 430.
Apatelite, 657.
Apatite, 530.
Aphanèse, Aphanesite, 570.
Aphanyte, 240.
Aphérèse, 563.
Aphrite, Aphrizite, 365, 678.
Aphrodite, 457.
Aphroselenon, 640.
Aphrosiderite, 502.
Aphthalose, Aphthitalite, 615.
Aphthonite, 104.
Apjohnite, 653.
Aplome, 268.
Apophyllite, 415.
Apyrite, 365.
Aquamarine, 245; 530.
Aræoxene, 609.
Aragonite, 694.
Aragonspath, 694.
Arcanite, 615.
Arcticite, 319.
Arendalite, 281.
Arfvedsonite, 243.
Argent antimonial, 35.
    antimonié sulfuré, 94; 93.
    bromuré, 115.
    corné, 115.
    fragile, 106.
    gris antimonial, 93.
    ioduré, 117.
    molybdique, 32.
    muriaté, 115.
    natif, 9.
    noir, 106.
    séléniuré, 39.
    sulfuré, 38.
    sulfuré flexible, 55.
    sulfuré fragile, 106.
    sulfuré antimonifère et cuprifère, 93.
Argentine, 678.
Argentite, 38.
Argentopyrite, 39.
Argillyte, 359.
Argyrit, 38.
Argyroceratite, 115.
Argyrose, 38.
Argyrythrose, 94.
Aricite, 418.
Arkansite, 164.
Arksutite, 128.
Armenian whetstone, 138.
Arquerite, 14.
Arragonite, 694.
Arsenate of lime, 554.
Arseneisen, 76, 77.
Arseneisensinter, 589.
Arsenglanz, 18.
Arsenic, Antimonial, 18.
    Native, 17.
    jaune, 27.
    oxydé, 183.
    rouge, 26.
    sulfuré, 27.
    Sulphid, 26, 27.
    White, 183.
Arsenical antimony, 18.
    bismuth, 18.
Arsenicite, 554.
Arsenigesäure, 183.
Arsenikalkies, 76.
Arsenikantimon, 18.
Arsenikbleispath, v. Mimetite
Arsenikblüthe, 183, 554.
Arsenikeisen, 76.
Arsenikalfahlerz, 104.
Arsenikglanz, 18.
Arsenikkalk, 183.
Arsenikkies, 76, 78.
Arsenikkobaltkies, 71.
Arsenikkupfer, 36.
Arsenikmangan, 61.
Arseniknickel, 60, 70.
Arsennickelglanz, 72.
Arseniksaures Kupfererz, 564.
Arseniksilber, 35.
Arseniksilberblende, 96.
Arsenik-sinter, 574.
Arsenikspiessglanz, 18.
Arsenikwismuth, 18, 391.
Arseniosiderite, 584.
Arsenite, 183.
Arsenocrocite, 584.
Arsenomelan, 87, 92.
Arsenolite, 183.
Arsenopyrite, 78, 794.
Arsenosiderite, 76.
Arsenous acid, 183.
Asbeferrite, 234.
Asbestus, 234; 216.
    Blue, 243.
Asbolan, Asbolite, 181.
Asparagus-stone, 530.
Aspasiolite, 485; 301.
Asperolite, 402.
Asphaltène, 729, 751.
Asphaltum, 751.
Aspidelite, 383.
Asteria, 138.
Astrakanite, 643.
Astrophyllite, 308.
Atacamite, 121, 794.
Atelesite, 392.
Atlaserz, 713.
Atlasite, 716.
Atheriastite, 323.
Atramenstein, 645.
Atramentum, 645.
Attacolite, 580.
Auerbachite, 275.
Augelite, 580.
Augite, 216.
Auina, 332.
Auralit, 485.
Aurichalcite, 712.
Auriferous pyrites, 6.
Auripigmentum, 27.
Aurotellurite, 81.
Aurum graphicum, 81.
    paradoxum, 19.
Automolite, 149.
Autunite, 586.
Aventurine, quartz, 193.
    feldspar, 335, 346, 355.
Axinite, 297.
Azorite, 761.
Azure spar, or stone, 572.

Azurite, 715; 572.

Babingtonite, 227, 794.
Bagrationite, 285.
Baierine, 515.
Baikalite, 215.
Baikerinite, 747.
Baikerite, 733.
Balas ruby, 147.
Ballesterosite, 68.
Baltimorite, 503; 465.
Bamlite, 373.
Bardiglione, 621.
Barilla de cobre, 15.
Barnhardtite, 67, 794.
Baralite, v. Bavalite.
Barite, 616.
Barolite, 697.
Baroselenite, 616.
Barrandite, 574; 584.
Barsowite, 340.
Barytocölestin, 616.
Barystrontianite, 699.
Baryta, Carbonate, 697.
  Carb. of lime and, 698.
  Sulphate, 616.
  Sulphato-carb., 698.
Baryt, Barytes, 616.
Barytite, Barytine, 616,
Baryt-Harmotome, 439.
Barytocalcite, 701; 698.
Barytocelestite, 620; 617.
Barytophyllit, 504.
Basalt, 343.
Basaltine, 216.
Basanite, 195.
Basanomelan, 143.
Basicerine, 126.
Bastite, 469; 209.
Bastonite, 308.
Bathvillite, 742.
Batrachite, 255.
Baudisserite, 686.
Baulite, 359.
Bauxite, 174.
Bavalite, 796.
Bayldonite, 565.
Beaumontite, 444.
Beauxite, 174.
Bechilite, 597.
Beckite, 196.
Beilstein, 233.
Beinbrech, v. Tufa.
Bell-metal ore, 68.
Belonit, 100, 805.
Benzole, 737.
Beraunite, 558.
Berengelite, 753.
Berg-butter, 655.
Berg-crystal, v. Quartz.
Bergholz, 406.
Bergmannite, 426.
Bergmehl, 680.
Bergmilch, 680.
Bergöl, 723.
Bergpech, 741, 751.
Berggrün, 713.
Bergsalz, 112.
Bergseife, 476.
Bergtheer, 751.
Berlinite, 571.
Bernstein, 740, 741.
Beryl, 245, 794.
Berthierine, 511.
Berthierite, 86.
Berzelianite, 46, 795.
Berzeliite, 544.
Berzeline, 46; 362.
Berzelite, 120.
Beudantite, 589.
Beurre de Montagne, 655.
Beustite, 281.
Bieberite, 647.
Biharite, 483.
Bildstein, 480.
Bimsstein, v. Pumice, 359.
Bindheimite, 591.
Binnite, 90; 87.
Biotine, 337.
Biotite, 304.
Bismite, 185.
Bismuth, 19.
  Acicular, 100.
  Carbonate, 716.
  Cupreous, 86, 98, 100.
  Native, 19.
  Oxyd, 185.
  Silicate, 391.
  sulfuré plombo-argentifère, 36.
  sulfuré plombo-cuprifère, 100.
  Sulphuret, 30.
  Telluric, 30, 31.
Bismuth-glance, 30.
  blende, 391.
  nickel, 47.
  ochre, 185.
  silver, 36.
Bismuthaurite, 795.
Bismuthine, 30.
Bismuthinite, 30.
Bismutholamprite, 30.
Bismutite, 716.
Bitterkalk, 682.
Bittersalz, 644.
Bitter spar, 682.
Bitterspath, 682.
Bitterstein, 290.
Bitume liquide, 723.
  glutineux, 728.
Bitumen, 751.
  Elastic, 734.
Bituminoses holz, 755.
Bituminous coal, 754.
Black copper, 136; 181.
  hematite, 180.
  manganese, 162.
  silver, 106.
  lead, 24.
Black jack, 48.
Blakeite, 652.
Blättererz, 82.
Blätterkies, v. Marcasite.
Blättertellur, 82.
Blätterzeolith, 444.
Blaubleierz, 40.
Blaueisenerz, 556.
Blaueisenstein, 243.
Blauspath, 572.
Blei-aluminat, 577.
Blei, Gediegen, 17.
Bleichromat, 629.
Bleifahlerz, v. Bournonite.
Bleigelb, v. Wulfenite.
Bleiglanz, 40.
Bleiglas, 622.
Bleiglätte, 156.
Bleigummi, 577.
Bleilasur, 663.
Bleihornerz, 703.
Bleimolybdat, 607.
Bleinière, 591.
Bleinierite, 591.
Bleioxyd, 136.
Bleischeelat, 606.
Bleischimmer, 91.
Bleisulphotricarbonat, 624.
Bleischweif, 40.
Bleivitriol, 622.
Blende, 48.
Blödite, 643.
Bloodstone, 194.
Blue asbestus, 243.
  feldspar, 572.
  iron earth, 556.
  john, 123.
  malachite, 715.
  spar, 572.
  vitriol, 648.
Blumenbachite, 46.
Blumite, 604.
Blutstein, 140.
Bobierrite, 795.
Bodenite, 289.
Bohnerz, 172.
Bog-butter, 747.
Bog-iron ore, 172, 178.
  manganese, 181.
Bole, Bolus, 476.
Bolivianite, 109.
Bolognian spar, 616.
Bolopherit, 215.
Boltonite, 255.
Bonsdorffite, 485; 301.
Boracic acid, 594.
Boracite, 595.
Borax, 597.
Borazit, 595.
Bordite, 398.
Borickite, 588.
Boric acid, 594.
Bornine, 30.
Bornite, 44.
Börnstein, v. Bernstein.

Borocalcite, 599.
Boronatrocalcit, 598.
Borosilicate of lime, 380.
Bosjemanite, 654.
Botallackite, 121.
Botryogen, 657.
Botryolite, 380.
Botryt, 657.
Boulangerite, 99, 795.
Bourboulite, 800.
Bournonite, 96; 373.
Bournonit-nickelglanz, 74.
Boussingaultite, 635.
Bowenite, 465.
Bragite, 525; 276.
Branchite, 736.
Branderz, *v.* Idrialite.
Brandisite, 508.
Braunbleierz, 535; 610.
Braunbleioxyd, 167.
Brauneisenstein, 172.
Braunite, 163.
Braunkohle, 755.
Braunspath, 682.
Braunstein, 162.
    Piemontischer, 285.
    Grauer, 165.
    Schwarzer, 162.
Braunsteinkies, 46.
Braunsteinkiesel, 268.
Bredbergite, 270.
Breislakite, 216.
Breithauptite, 61; 83.
Breunnerite, 686.
Brevicite, 426.
Brewsterite, 445.
Brewstoline, 761.
Brewsterlinite, 761.
Brittle silver ore, 106.
Brocatello, 678.
Brochantite, 664, 795.
Bromargyrite, 116.
Bromic silver, 116.
Bromite, 116.
Bromlite, 698.
Bromsilber, 116.
Bromyrite, 116.
Brogniardite, 90.
Brogniartin, 627.
Brongnartine, 664.
Bronzite, 208; 215, 508.
Brookite, 164.
Brosite, Brossite, 682.
Brown coal, 755.
    iron ore, 169.
    hematite, 169.
    ochre, 169.
    spar, 682; 685, 686.
Brücknerellite, 748.
Brucite, 175; 363.
Brushite, 552.
Bucaramangite, 741.
Bucholzite, 373.
Bucklandite, 285.
Buhrstone, 196.
Bunsenite, 184.
Buntbleierz, 535.
Buntkupfererz, 44.
Buratite, 712.
Bustamite, 225.
Buttermilcherz, 115.
Butyrellite, 747.
Butyrite, 747.
Byssolite, 234.
Bytownite, 340.

Cabocle, see Hydr. Phosphate of Alumina and Lime, 587.
Cabrerite, 561.
Cacholong, 199.
Cacoxenite, Cacoxene, 584.
Cadmia, 407.
Cadmium, Sulphuret of, 59.
Cadmium-blende, 59.
Cairngorm stone, 193.
Calaite, 580.
Calamine, 407; 692, 711.
    Electric, 407.
    Green, 712.
Calamite, 233.
Calaverite, 795.
Calcareobarite, 617.
Calcareous spar, 670.
    tufa, 680.
Calcedoine, 194.
Calcimangite, 678.
Calcinitre, 593.
Calciocelestite, 620.
Calcioferrite, 578.
Calcite, 670, 795.
Calc-sinter, 680.
Calcouranite, 586.
Calderite, 269.
Caledonite, 625.
Calk, 616.
Callainite, 572.
Callais, 580.
Calomel, 111.
Calstronbarite, 616.
Calyptolite, 273.
Campylite, 537.
Canaanite, 220, 322, 808.
Cancrinite, 329.
Candite, 147.
Canehlstein, 266.
Cannel Coal, 755.
Cantonite, 83, 84.
Caoutchouc, Mineral, 34.
Capillary pyrites, 56.
Capillose, 56.
Capnite, 692.
Caporcianite, 399.
Carbocérine, 709.
Carbonado, 22.
Carbon diamantaire, 22.
Carbunculus, 138, 147, 265.
Carchedonius, 265.
Carinthine, 235.
Carmenite, 52.
Carminite, 545.
Carminspath, 545.
Carnallite, 118.
Carnat, 474.
Carnatite, 344.
Carnelian, 194.
Carolathine, 420.
Carpholite, 419.
Carphosiderite, 661.
Carphostilbite, 424.
Carrara Marble, 680.
Carrollite, 69.
Cassinite, 356.
Cassiterite, 157, 796.
Cassiterotantalite, 514.
Castelnaudite, 528.
Castellite, 386.
Castillite, 46.
Castor, 229.
Catapleiite, 401.
Cataspilite, 483; 301.
Catilinite, 796.
Cat's-eye, 193; 640.
Cavolinite, 327.
Cawk, 616.
Celadonite, 463.
Celestite, Celestine, 619; 677
Celestobarite, 617.
Centrallassite, 796.
Cerargyrite, 114.
Cerasine, Cerasite, 120, 703.
Cerine, 285.
Cerinite, 445, 796.
Cerinstein, 413.
Cerite, 413.
Cerium, Carbonate, 709.
    Fluorid, 126.
    Silicate, 413.
Cerolite, 470.
Ceroxydulkohlensaures, 709.
Cerussite, Céruse, 700.
Cervantite, 187.
Ceylanite, Ceylonite, 147.
Chabazite, Chabasie. 434.
Chalcanthite, 648; 646.
Chalcanthum, 645.
Chalcedony, 194.
Chalchihuitl, 293.
Chalcites, 645.
Chalcocite, 52.
Chalcodite, 460.
Chalcolite, 585; 586.
Chalcophacite, 567.
Chalcophyllite, 571.
Chalcopyrite, 65.
Chalcosine, 52.
Chalcostibite, 85.
Chalcotrichite, 133.
Chalilite, 424.
Chalk, 679.
Chalkosiderit, 583.
Chalkosin, 52.
Chalybite, 688.
Chamasite, 16.
Chamoisite, 511.
Chanarcillite, 36.

Chathamite, 70.
Chaux arseniatée, 544.
  boratée siliceuse, 380.
  carbonatée, 670, 682.
  fluatée, 123.
  phosphatée, 530.
  sulfatée 621; 637.
Chelmsfordite, 319.
Chenevixite, 583.
Chenocoprolite, 798.
Cherokine, 535.
Chert, 195.
Chesterlite, 352.
Chessy copper, 715.
Chessylite, 715.
Chiastolite, 371.
Childrenite, 579.
Chileite, 612; 169.
Chilenite, 36.
Chiltonite, *v.* Prehnite.
Chimborazite, 694.
Chiolite, 128.
Chiviatite, 86.
Chladnite, 208.
Chloanthite, 70.
Chlor-apatite, 531.
Chlorastrolite, 412.
Chlorite, 497.
  ferrugineuse, 497.
Chloritoid, 504.
Chloritspath, 504.
Chlorkalium, 111.
Chlormerkur, 111.
Chloromelan, 503.
Chloropal, 461.
Chlorophæite, 510.
Chlorophane, 123.
Chlorophanerit, 462.
Chlorophyllite, 301, 485.
Chlorospinel, 147.
Chlorquecksilber, 111.
Chlorsilber, 115.
Chlorspath, 120.
Chodneffite, 128.
Chondrarsenite, 562.
Chondrodite, 363.
Chonicrite, 494.
Chrismatine, Chrismatite, 728.
Christianite, 337, 438.
Christophite, 48.
Chrombleispath, 629.
Chromchlorit, 495.
Chromeisenstein, 153.
Chrome ochre, 510.
Chromglimmer, 309.
Chromic iron, 153.
Chromite, 153.
Chromoferrite, 153.
Chromphosphorkupferbleispath
    631.
Chryolith, 126.
Chrysoberyl, 155, 796.
Chrysocolla, 402; 597, 713.
Chrysolite, 256; 272, 367, 376,
    530, 795.
Chrysolite, Titaniferous, 255.
  White, 255.
  Iron, 258.
  Iron-manganese, 259.
Chrysophane, 508.
Chrysoprase, 194, 246.
Chrysoprase earth, 510.
Chrysotile, 465.
Churchite, 555.
Chusite, 258.
Cimolite, 457.
Cinnabar, 55.
Cinnamon-stone, 266.
Cipolino, 678.
Cirrolite, 579.
Claudetite, 796.
Clausthalite, 42, 796.
Clay, 473, etc.
Clayite, 108.
Cleavelandite, 348.
Cleiophane, 48.
Clingmanite, 506.
Clinkstone, 359.
Clinoclase, Clinoclasite, 570.
Clinochlore, 497; 504.
Clinoëdrit, 101.
Clintonite, 508.
Cluthalite, 433.
Coal, Mineral, 753.
  Boghead, 742, 755.
  Brown, 755.
  Cannel, 755.
Cobalt, Arseniate of, 558.
  Arsenical, 68, 70.
  Black, 181.
  Carbonate, 711.
  Earthy, 181.
  Glance, 71.
  Gray, 70.
  gris, 70.
  ochre, 558.
  oxidé noir, 181.
  Red, 558.
  Sulphate, 647.
  Sulphuret, 47, 68.
  White, 70, 71.
Cobalt bloom, 558.
Cobalt glance, 71.
Cobaltine, Cobaltite, 71.
Cobalt-mica, 558.
Cobalt pyrites, 68.
Cobalt vitriol, 647.
Coccinite, 117.
Coccolite, 214.
Coke, 754.
Cölestin, 619.
Collyrite, 420; 476.
Collyrium, 478.
Colophonite, 268.
Columbite, 515.
Comptonite, 424.
Conarite, 405.
Condrodite, 363.
Condurrite, 36, 797.
Confolensite, 459.
Conichalcite, 565.
Conite, 682.
Connellite, 627.
Cookeite, 489.
Copal, Fossil, 739.
Copaline, Copalite, 739.
Copiapite, 655; 656.
Copper, 14.
  Antimonial, 85.
  Arsenate, 562, 564, 567.
  Arsenical, 36, 37.
  Black, 136.
  Blue, 65, 715.
  Carbonate, 713, 715.
  Chlorid, 121, 122.
  Chromate, 630.
  Emerald, 401.
  Gray, 101.
  Indigo, 83.
  Muriate, 121.
  Oxychlorid, 121, 122.
  Oxyd, 133, 136.
  Phosphate, 563, 568.
  Purple, 44.
  Pyritous, 65.
  Red, 133.
  Selenid, 46.
  Silicate, 401, 402.
  Sulphate, 648.
  Sulphato-chlorid, 627.
  Sulphuret, 52; 44, 65, 83.
  Vanadate, 611.
  Variegated, 44.
  Vitreous, 52.
Copper and lead, Selenid of, 45
Copper froth, *v.* Tyrolite.
Copper glance, 52.
Copper green, 402.
Copper mica, 571.
Copper nickel, 60.
Copper ore, 136.
  Blue, 715.
  Emerald, 401.
  Green, 713.
  Octahedral, 133.
  Velvet, 666.
  Yellow, 65.
Copper pyrites, 65.
Copper-uranite, 585.
Copper-vitriol, 648.
Copperas, 645.
  Soda, *v.* Jarosite.
  Potash, *v.* Jarosite.
  White, 650.
  Yellow, 655.
Copperasine, 660.
Coprolites, 534.
Coquimbite, 650.
Coracite, 154.
Corallinerz, 55.
Cordierite, 299.
Corindon, 137.
Cornaline, 194.
Corneine, 240.
Corneous lead, 703.

Cornubianite, *v.* **Felsite.**
Cornwallite, 569.
Corsilyte, 235.
Corundellite, 506.
Corundophilite, 504.
Corundum, 137.
Corynite, 74.
Cosalite, 797.
Cottaite, 353.
Cotunnite, 117.
Couzeranite, 326.
Covelline, Covellite, 83.
Craie de Bianςon, 45.
Crednerite, 166.
Crichtonite, 143.
Crispite, 159.
Cristianite, 337.
Crocalite, 426.
Crocidolite, 243.
Crocoite, Crocoisite, 628.
Cronstedtite, 503.
Crookesite, 40.
Cross-Stone, Crucite, 371.
Cryolite, 126, 797.
Cryophyllite, 316.
Cryptolite. 529.
Cryptoline, Cryptolinite, 762.
Cryptomorphite, 599.
Crystallus, 189.
Cuban, Cubanite, 65.
Cube ore, 578.
Cube spar, 621.
Cubizit, 432.
Cuboite, 432.
Cuivre arseniaté, 564, 571.
  arsenical, 36.
  carbonaté, 713, 715.
  gris, 101.
  hydrosiliceux, 402.
  jaune, 65.
  muriaté, 121.
  natif, 14.
  oxidé rouge, 133.
  phosphaté, 563, 568.
  pyriteux, 65.
  pyriteux hepatique, 44.
  selenié, 39, 46.
  spiciforme, 52.
  sulfaté, 648.
  sulfuré, 52.
  sulfuré argentifère, 54.
  vanadaté, 611.
  velouté, 666.
  vitreux, 52.
Cumengite, 806.
Cummingtonite, 234; 225.
Cupreine, 53.
Cupreous anglesite, 668.
  manganese, 181.
Cuprite, 133.
Cuproplumbite, 42.
Cuproscheelite, 606.
Cuprouranite, 585.
Cyanite, 375.
Cyaneus, 331.
Cyanochroite, 649.
Cyanolite, 797.
Cyanosite, Cyanose, 648.
Cyanotrichite, 666.
Cyclopeite, 216.
Cyclopite, 340.
Cymatolite, 455.
Cymophane, 155.
Cyprine, 276.
Cyprite, 52.
Cyrtolite, 275.

Dalarnite, 78.
Daleminzite, 51.
Damourite, 487.
Danaite, 78.
Danalite, 265.
Danburite, 299.
Dannemorite, 234.
Daourite, 365.
Darwinite, 37.
Dathiolite, Datolite, 380.
Datolith, 380.
Davidsonite, 245.
Davite, 649.
Davyne, Davina, 327.
Dechenite, 609.
Degeroite, 489.
Delanovite, 459.
Delawarite, 356.
Delessite, 497.
Delphinite, 181.
Delvauxite, Delvauxene, 583; 588.
Demidoffite, 402.
Demant, 21.
Demantspath, 138.
Dendrachates, 195.
Derbyshire spar, 123.
Dermatin, 471.
Descloizite, 609.
Desmin, 441, 442.
Devilline, 665.
Devonite, 575.
Deweylite, 469.
Diabase, 240; 343.
Diabase Porphyry, 843.
Diaclasite, 210.
Diadochite, 588.
Diagonite, 445
Diallage, Green, 215, 235.
  Hydrous, 221.
  Metalloidal, 208, 209.
  Talkartiger, 210.
Diallogite, 691.
Diamant, 21.
Diamond, 21.
Dianite, 516.
Diaphorite, *v.* **Allagite.**
Diaspore, 168.
Diastatite, 235.
Dichroite, 299.
Didrimite, 311.
Didymite, 311.
Digenite, 52.
Dihydrite, 563.
Dillenburgite, 402.
Dilluite, 421.
Dimagnetite, 151.
Dimorphite, Dimorphine, 28
Dinite, 736.
Diopside, 214.
Dioptase, 248, 401.
Dioryte, 240; 351.
Dioxylite, 628.
Diphanite, 507.
Diploite, 337.
Dipyre, 326.
Discrasite, 35.
Disomose, 72.
Disterrite, 508.
Disthene, 375.
Ditröyte, 328.
Dog-Tooth Spar, 672.
Doleryte, 343.
Dolomite, 681; 685.
Dolomite sinter, 708.
Domeykite, 36, 797.
Donacargyrite, 93.
Dopplespath, 677.
Dopplerite, 749; 747.
Doranite, 436.
Dreeite, 626.
Dreelite, 626.
Dry-bone, 692.
Ducktownite, 68.
Dufrenite, 583.
Dufrenoysite, 92; 87, 90.
Dumasite, 503.
Dunyte, 258.
Dyoxylite, 628.
Dysclasite, 398.
Dyscrasite, 35.
Dyskolite, *v.* **Saussurite.**
Dysluite, 149.
Dysodile, 746.
Dyssnite, 227.
Dyssyntribite, 479.

Earthy calamine, 711.
  cobalt, 181.
  manganese, 181.
Edelforsite, 212.
Edelith, 410.
Edenite, 235.
Edingtonite, 417.
Edwardsite, 539.
Egeran, 276.
Ehlite, 568.
Ehrenbergite, 458.
Eisen, Gediegen, 15.
Eisenapatit, 543.
Eisenalaun, 654.
Eisenblau, 556, 572.
Eisenblüthe, 694.
Eisenchlorid, 113.
Eisenchlorit, 497.
Eisenchrom, 153.
Eisenerde, Blaue, 572.
  Grüne, 392.

Eisenerz, Trappisches, 148.
Eisenerz, Hystatisches, 143.
Eisenglanz, 140.
Eisenglimmer, 140, 556.
Eisengymnite, 470.
Eisenkies, 62.
    Rhombischer, 75.
Eisenkiesel, *v.* Ferruginous Quartz, 193.
Eisenkobalterz, 70.
Eisenmulm, 150.
Eisennatrolith, 426.
Eisennickelkies, 47.
Eisenopal, *v.* Semiopal.
Eisenoxyd, 140.
Eisenoxydhydrat, 167, 169, 172.
Eisenoxyd, Schwefelsaures, 655, 657, 660.
Eisenpecherz, 54, 543.
Eisenperidot, 258.
Eisenplatin, 11.
Eisenphyllit, 556.
Eisenrahm, 172.
Eisenresin, 718.
Eisenrose, 143.
Eisenrutil, 169.
Eisensinter, 589.
Eisenspath, 688.
Eisenstassfurtit, 596.
Eisensteinmark, 474.
Eisentitan, 143.
Eisenvitriol, 657.
Eisspath, 355.
Eisstein, 126.
Ekebergite, 324.
Ekmannite, 490.
Elæolite, 327.
Elasmose, 44, 82.
Elasmosine, 82.
Elaterite, 734.
Electrum, 3, 740.
Elhuyarit, 419.
Eliasite, 175.
Ellagite, 430.
Embolite, 115.
Embrithite, 99.
Emerald, 245.
Emerald nickel, 710.
Emeraude, 245.
Emeril, 139.
Emery, 138.
Emerylite, 506.
Emmonite, 699.
Emplectite, 86.
Enargite, 107, 797.
Enceladite, 600.
Endellionite, 96.
Engelhardite, 273.
Enstatite, 208.
Ephesite, 507.
Epichlorite, 493.
Epidosyte, 284.
Epidote Group, 281; 290.
Epiglaubite, 554.
Epiphosphorite, 535.
Epistilbite, 443.
Epsom salt, Epsomite, 643.
Erbsenstein, 679.
Ercinite, 439.
Erdkobalt, 181.
Erdharz, 734.
Erdmannite, 285, 414.
Erdöl, 723.
Erdpech, 751.
Erdwachs, 732.
Eremite, 539.
Erinite, 569; 459.
Erlan, Erlanite, 797.
Ersbyite, 361.
Erubescite, 44.
Erusibite, 660.
Erythrine, 558.
Erythrite, 558; 852.
Escherite, 281.
Esmarkite, 301, 380, 485.
Essonite, 266.
Etain, natif, 17.
    oxydé, 157.
    sulfuré, 68.
Eucairite, 39, 797.
Euchroite, 566.
Euchysiderite, *v.* Pyroxene.
Euclase, 379.
Eucolite, 248.
Eudialyte, Eudyalite, 248.
Eudnophite, 433.
Eugenesite, *v.* Selenpalladite.
Eugenglanz, 107.
Eukairite, 39.
Eukamptite, 307, 487.
Euklas, 379.
Eukolite, 249.
Eulysyte, 259.
Eulytine, Eulytite, 391.
Eumanite, 165.
Euosmite, 743.
Euphyllite, 488.
Eupyrchroite, 530.
Eusynchit, 609.
Euxenite, 521.
Euzeolith, 443, 444.
Evansite, 585.
Exanthalose, 637.
Exitèle, Exitelite, 184.

Fäderenz, 91.
Fahlerz, Fahlite, 100.
Fahlunite, 484; 301.
    Hard, 299.
Fargite, 426.
Faröelite, 424.
Fasciculite, 240.
Faserkiesel, 373.
Fäserzeolith, 426.
Fassaite, 216.
Faujasite, 433.
Fauserite, 645.
Fayalite, 258.
Feather alum, 654.
Feather ore, 91.
Federalaun, 654.
Federerz, 91.
Feitsui, 293.
Feldspar Group, 335.
Feldspar, Blue, 572.
    Common, 352.
    Labrador, 341.
    Potash, 352.
    Soda, 348.
    Lime, 341.
    Glassy, 352.
Feldstein, 352.
Felsite, 349, 352.
Felsobanyite, 662.
Feldspath, 352.
    apyre, 371.
    tenace, *v.* Saussurite.
    nacré, 352.
Fer azuré, 556.
    arseniaté, 578.
    arsenical, 76, 77, 78.
    carbonaté, 688.
    chromaté, 153.
    hydro-oxidé, 169.
    natif, 15.
    oligiste, 140.
    oxidé, 140.
    oxidulé, 149.
    magnetique, 149.
    muriaté, 118.
    phosphaté, 556.
    speculaire, 140.
    sulfaté, 657; 646.
    sulfuré, 57, 62.
    sulfuré magnetique, 58.
Ferberite, 604.
Fergusonite, 524.
Ferrocalcite, 678.
Ferrocobaltite, 72.
Ferrotantalite, 514.
Ferrotitanite, 390.
Fettbol, 461.
Fettstein, 327.
Feuerblende, 93.
Feuerstein, 195.
Fibroferrite, 656.
Fibrolite, 373.
Fichtelite, 735.
Ficinite, 590.
Fieldite, 104.
Figure-stone, 480; 483, 452.
Fiorite, 199.
Fireblende, 93.
Fischaugenstein, 415.
Fischerite, 582.
Flexible silver ore, 55.
Fliegenstein, *v.* Arsenic.
Flint, 195.
Flintkalk, 682.
Float-stone, 199.
Flockenerz, *v.* Mimetite.
Flos ferri, 694.
Flos succini, 748.
Flucerine, 126.
Fluellite, 126.

Fluccerine, 126.
Fluocerite, 126.
Fluochlore, 512.
Fluor-apatite, 531.
Fluor, Fluorite, 123.
Fluor Spar, 123.
Flussspath, 123.
Foliated tellurium, 82.
Fontainebleau limestone, 678.
Forbesite, 560.
Forsterite, 255.
Fournetite, 42.
Fowlerite, 225.
Francolite, 530.
Franklinite, 152.
Frauenglas, *v.* Mica.
Freibergite, 101.
Freieslebenite, 93.
Fritzscheite, 587.
Frugardite. 276.
Fuchsite 309.
Fuller's Earth, 458, 473.
Fullonite, *v.* Onegite.
Funkite, 215.
Fuscite, 319.

Gabronite, 324.
Gadolin, Gadolinite, 293; 285.
Gagates, 760.
Gahnite, 149; 147, 276.
Galactite, 426.
Galapektit, 473, 475.
Galena, Galenite, 40.
Galenoceratite, 703.
Gallicinite, 647.
Gallitzenstein, 647.
Galmey, 407.
Gamsigradite, 236.
Ganomatite, 798.
Gänseköthig-erz, 798.
Garamanticus, 265.
Garnet, 265.
  Bohemian, 267.
  Oriental, 267.
  Tetrahedral, 264.
  White, 334.
Garnsdorffite, 661.
Gay-Lussite, 706.
Gearksutite, 180.
Gedrite, 231.
Gehlenite, 370.
Geierite, 77.
Gekrösstein, 621.
Gelbantimonerz, 187.
Gelbbleierz, 607.
Gelbeisenerz, 655, 660.
Gelbeisenstein, 174.
Gelberde, 172.
Gelberz, 81.
Gelferz, *v.* Chalcopyrite.
Genthite, 471.
Geocerellite, 748.
Geoceric Acid, 748.
Geocerite, 738.
Geomyricite, 739, 798.
Geocronite, 105.
Georetinic Acid, 748.
Gersdorffite, 72, 798.
Geyserite, 199.
Gibbsite, 177.
Gibraltar Stone, 680.
Gieseckite, 479; 329.
Giftkies, 78.
Gigantolite, 480; 301, 486.
Gilbertite, 798.
Gillingite, 492.
Giobertite, 686.
Girasol, 198.
Gismondine. Gismondite, 418, 798.
Glagerite, 476.
Glance copper, 52.
Glanzarsenikkies, 77.
Glanzbraunstein, 162.
Glanzkobalt. 71.
Glaserite, 615.
Glaserz, Glanzerz, 38.
Glaskopf, 140.
Glasspat, 123.
Glaubapatite, 585; 554.
Glauber salt, 636.
Glauberite, 627.
Glaucodot, 80; 81, 798.
Glaucolite, 319.
Glauconite, 462.
Glaucophane, 244.
Glaukosiderit, 556.
Glimmer, 302, 309.
Glinkite, 256.
Globosite, 584.
Glockerite, 662.
Glossecollite, 475.
Glottalite, 417.
Gmelinite, 436; 437.
Gneiss, 359.
Gökumite, 276.
Gold, 3, 799.
Gold amalgam, 14.
Goldtellur, 81.
Gongylite, 480.
Goshenite, 245.
Goslarite, 647.
Göthite, 169.
Gotthardite, 92.
Grahamite, 758.
Gramenite, 461.
Grammatite, 238.
Grammite, *v.* Wollastonite.
Granat, 265.
Granatite, 388.
Granite, 359.
Granulyte, 352.
Graphic gold, 81.
  tellurium, 81.
Graphite, 24.
Grastite, 500.
Graubräunsteinerz, 165, 170.
Grauerz, *v* Galena.
Graukobalterz, 47.
Graugiltigerz, 101.
Graukupfererz, *v.* Tennantite
Graulite, 644.
Graumanganerz, 165, 170.
Grausilber, *v.* Selbite.
Grauspiessglanzerz, 29.
Grauspiessglaserz, 29.
Gray antimony, 29.
  copper, 100.
Green diallage, 215. 285.
  earth, 462, 463.
  iron ore, 583.
  lead ore. 535.
  malachite, 713.
  vitriol, 646.
Greenmardite, 516.
Greenockite, 59.
Greenovite, 383.
Grenat, 265.
Grenatite, 388.
Grengesite. 501.
Groppite, 486.
Groroilite, 181.
Grossularite, 266.
Grothite, 386.
Grünauite, 47.
Grünbleierz. 535, 537.
Grüneisenerde, 583.
Grüneisenstein, 583.
Grünerde, 462, 463.
Grünerite, 234.
Guanite. 551.
Guano, 535.
Guarinite, 383.
Guayacanite, 107.
Gummierz, 179.
Gummispath, 577.
Gummite, 179, 475.
Gurhoflan, Gurhofite, 682.
Gurolite. 398.
Guyaquillite, 745.
Gymnite. 469.
Gyps, 637.
Gypsum, 637.
Gyrolite, 398.

Haarkies, 56; 75.
Haarsalz, 644.
Hæmachates, 195.
Hæmatoconite, 676.
Hæmatite, 140.
Hafnefjordit, 346.
Haidingerite, 552; 86.
Hair-salt, 644.
Halbazurblei, *v.* Caledonite
Halbvitriolblei, 628.
Halite, 112.
Hallite, 658.
Halloylite, 475.
Halloysite, 475.
Halochalzit, 121.
Halotrichine, 654.
Halotrichite, 654; 649.
Hammochrysos, 302.
Hampshirite, 457.
Harmotome, 439, 799.

Harringtonite, 430.
Harrisite, 53.
Hartbraunstein, 163.
Hartin, 742.
Hartite, 736.
Hartkobalterz, 71.
Hartmanganerz, 180.
Hartmannite, 61.
Hartspat, 371.
Hatchettite, Hatchettine, 731; 728.
Hauerite, 64.
Hausmannite, 162.
Haüyne, Haüynite, 332; 333.
Haydenite, 434.
Hayesine, 599; 597.
Haytorite, 196; 382.
Heavy spar, 616.
Hebetine, 262.
Hecatolite, 354.
Hedenbergite, 215.
Hedyphane, 537.
Heliolite, 355.
Heliotrope, 194.
Helleflinta, 349, 353.
Helminth, 502.
Helvetan, 801.
Helvin. Helvite, 264.
Hematite, 140; 167, 799.
  Black, 180.
  Brown, 172.
Hemichalcit, 86.
Hemimorphite, 407.
Hepatinerz, 133, 402.
Hepatite, 616.
Heraclion, 149.
Hercynite, 148.
Herderite, 546.
Hermannite, 225.
Hermesite, 101.
Herrerite, 692.
Herschelite, 437.
Hessenbergite, 762.
Hessite, 50.
Heteroclin, 163, 226.
Heteromerite, 276.
Heteromorphite, 91.
Heterosite, 542.
Heulandite, 444; 443.
Hielmite, 519.
Highgate resin, 739.
Himbeerspath, 691.
Hircine, Hircite, 747.
Hisingerite, 489.
Hislopite, 463, 678.
Hitchcockite, 577.
Hœrnesite, 556.
Hoevelit, Hövellit, 111.
Höganite, 426.
Hohlspath. 371.
Holmesite, *v.* Seybetite.
Holmite, 508.
Holz, Bituminöses, 755.
Holzkupfererz, 564.
Holzopal, *v.* Wood Opal.
Homichlin, 67.
Honey-stone, Honigstein, 750.
Hopeite, 544.
Hornblei, 703.
Hornblende, 232.
Hornerz, 114.
Hornfels, 195.
Hornmangan, 227.
Horn quicksilver, 111.
Horn silver, 114.
Hornstone, 195.
Horse-flesh ore, 44.
Hortonite, 222.
Houghite, 179.
Houille, 754.
Houille papyracée, 746.
Hovite, 709.
Howlite, 598.
Huascolite, 42.
Hübnerite, 603.
Hudsonite, 216.
Humboldtine, 718.
Humboldtilite, 280.
Humboldtite, 380.
Humite, 363.
Hunterite, 457.
Hureaulite, 561.
Huronite, 341; 301, 485.
Huyssenite, 799.
Hverlern, 478.
Hversalt, 654.
Hyacinth, 138, 266, 274, 276.
Hyalite, 199.
Hyalomelan, 245.
Hyalophane, 346, 799.
Hyalosiderite, 256.
Hyblite, 484.
Hydrargillite, 177, 580.
Hydraulic limestone, 575, 679.
Hydroapatite, 535.
Hydroborocalcit, 599.
Hydrobucholzite, 799.
Hydroboracite, 595.
Hydrochlore, 512.
Hydrodolomite, 708.
Hydrolanthanit, 709.
Hydrohæmatite, 167.
Hydrolite, 486.
Hydromagnesite. 707.
Hydromagnocalcit, 708.
Hydronickelmagnesite, 707.
Hydrophane, 199.
Hydrophite, 470.
Hydropit, 225.
Hydrosilicite, 799.
Hydrous anthophyllite, 175.
Hydrosteatite, 453.
Hydrotalc, 495
Hydrotalcite, 178, 799.
Hydrotephroite, 260.
Hydrozincite, 711.
Hypargyrite, 88.
Hypersthene, 209; 215.
Hypochlorite, 392.
Hyperyte, 343.
Hyposclerite, 349.
Hypostilbite, 441.
Hypoxanthite, 800.
Hystatite, 143.

Iaspachates. 195.
Iaspis, 194.
Iberite, 481; 301.
Ice, 135.
Ice spar, 355.
Iceland spar, 677.
Ichthyophthalmite, 415.
Idocrase, 276.
Idrialine, Idrialite, 738.
Iglesiasite, 700.
Iglite, Igloite, 694.
Ildefonsite, 515.
Illuderite, 290.
Ilmenite, 143; 525.
Ilmenorutile, 159.
Ilvaite, 296.
Indianite, 337.
Indicolite, 365.
Indigo copper, 83.
Inolite, 680.
Iodic silver, 117.
  quicksilver, 117.
Iodite, 117.
Iodquecksilber, 117.
Iodsilber, 117.
Iodyrite, 117.
Iolite, 299.
  Hydrous, 301, 484.
Iridium, Native, 12.
Iridosmine, 12.
Irite, 154.
Iron, 15.
  Arsenate, 578.
  Antimonial sulphuret, *v.* Berthierite.
  Arsenical, 76, 77.
  Borate, 600.
  Carbonate, 688.
  Carburet of, 24.
  Chlorid of, 118.
  Chromic, 153.
  Columbate, 514, 515.
  Cupreous arsenate, 574.
  Diarsenate, 589.
  Hydrous oxyds, 169.
  Magnetic, 149.
  Meteoric 15.
  Native, 15.
  Oligist, 140.
  Oxalate, 718.
  Oxyd, 140.
  Oxydulated, 149.
  Phosphates, 583, 584, 556.
  Silicates, 258, 511.
  Sulphate, 646, etc.
  Sulphid, Sulphuret, 57, 58 62.
  Tantalate, 514.
  Titaniferous, 143.
  Tungstate, 601.

Iron and Manganese Tungstate, 601.
Iron alum, 654.
Iron earth, Blue, 556.
Iron natrolite, 426.
Iron ore, Argillaceous, 141, 172.
  Arsenicated, 578.
  Axotomous, 143.
  Bog, 169, 172, 174, 178.
  Brown, 172; 169.
  Calcareous, 688.
  Clay, 141, 172, 688.
  Green, 583.
  Jaspery, 141.
  Lenticular, 141.
  Magnetic, 149.
  Micaceous, 140.
  Ochreous, 140, 169.
  Octahedral, 149.
  Pitchy, 589.
  Red, 140.
  Sparry, 688.
  Specular, 140.
  Titaniferous, 143.
Iron pyrites, 62.
  Magnetic, 58; 57.
  White, 75.
Iron rutile, 169.
Iron sand, 143, 149.
Iron sinter, 575.
Ironstone, Clay, 141, 169, 688.
  Blue, 556.
  Brown, 172.
Iserine, Iserite, 144, 145.
Isophane, *v.* Franklinite.
Isopyre, 392.
Itabiryte, 141.
Itacolumyte, 22, 195.
Ittnerite, 333.
Ivaarite, 391.
Ixiolite, 514.
Ixolyte, 736.

Jacksonite, 410.
Jade, Common, 233; 290, 292.
Jade tenace, 290.
Jadeite, 292.
Jalpaite, 39.
Jamesonite, 90, 800.
Jargon, 272.
Jarosite, 660.
Jasper, 195.
Jaulingite, 800.
Jayet, *v.* Jet.
Jefferisite, 494.
Jeffersonite, 215.
Jelletite, 268.
Jefreinoffite, 276.
Jenkinsite, 470.
Jenzschite, 201.
Jet, 760.
Jewreinowite, 273.
Johannite, 666.
Johnite, 580.
Johnstonite, 40.
Jollyte, 492.
Jordanite, 88.
Joseite, 81.
Jossaite, 631.
Junckerite, 688, 697.
Jurinite, 164.

N.B.—Many names spelt with an initial K in German, begin with C in English.

Kainit, 642.
Kakochlor, 181.
Kakoxene, 584.
Kalait, 580.
Kalamit, 233.
Kalchstein, 670.
Kalialaun, 652.
Kalifeldspath, 352.
Kalinite, 652.
Kaliphite, 172.
Kalisalpeter, 592.
Kalisalzsaures, 111.
Kalisulphat, 615.
Kalkgranat, 268.
Kalk-Harmotome, 438.
Kalk-Malachit, 715.
Kalkoligoklas, 346.
Kalksalpeter, 593.
Kalkspath, 670.
Kallait, 580.
Kallochrom, 629.
Kalomel, 111.
Kalzedon, 194.
Kämmererit, 495.
Kammkies, 75.
Kampylite, 587.
Kanelstein, 266.
Kaneite, 61.
Kaolin, 473; 324, 345, 361.
Kaolinite, 473.
Kapnikite, 225.
Kapnicite, 576.
Kapnite, 692.
Karelinite, 185.
Karneol, 194.
Karpholite, 419.
Karphosiderit, 661.
Karphostilbite, 424.
Karstenite, 621.
Kassiterit, 157.
Kastor, 229.
Katapleiit, 401.
Kataspilit, 483.
Katzenauge, 193.
Katzen-Silber, 302, 454.
Kausimkies, 76.
Keffekilite, 478
Keilhauite, 387.
Kenngottite, 88.
Keramohalite, 649.
Keraphyllite, *v.* Carinthine.
Kerargyrite, 114.
Kerasine, 120, 703.
Kerasite, 120, 703.
Kerate, 114.
Kermes, Kermesite, 186.
Kermesome, 186.
Kerolith, 470.
Kersantyte, 348.
Kibdelophan, 143.
Kiesel, 189.
Kieselcerit, 413.
Kieselgalmey, 407.
Kieselgyps, 621.
Kieselkupfer, 402.
Kieselmalachit, 402.
Kieselmangan, 225.
Kieselspath, *v.* Albite.
Kieselwismuth, 391.
Kieselzinkerz, 407
Kieserite, 641.
Kilbrickenite, 105.
Killinite, 480.
Kirwanite, 800.
Kischtimite, 703.
Klaprothine, 572.
Klaprothite, 572.
Klipsteinite, 511.
Klinoclas, 570.
Klinochlor, 497.
Knauffite, 611.
Knebelite, 260.
Knistersalz, *v.* Halite.
Kobaltarsenikkies, 78.
Kobaltbeschlag, 558.
Kobaltbleiglanz, 43.
Kobaltblüthe, 558.
Kobaltglanz, 71; 68.
Kobaltkies, 68.
Kobaltmanganerz, 181.
Kobaltnickelkies, 68.
Kobalt-Scorodit, 574.
Kobaltsulfuret, 47.
Kobaltvitriol, 647.
Kobellite, 99.
Koboldine, 68.
Kochsalz, 112.
Koelbingit, 284.
Kohle, 753.
Kohlensaurer Kalk, 686.
Kohlenvitriolbleispath, 628.
Kokkolit, 214, 215.
Kokscharoffite, 242.
Kollyrit, 420.
Kolophonit, 268.
Konarit, 405.
Kondroarsenit, 562.
Konichalcit, 565.
Konigine, 664.
Könleinite, 737.
Könlite, 737.
Korite, 484.
Korynit, 74.
Köttigite, 561.
Korund, 137.
Kotschubeit, 497.
Koupholite, 410.
Krablite, 359.
Krantzite, 741.
Kraurite, 583.

Kreittonite, 149.
Kremersite, 119.
Kreutzkristalle, 439.
Kreuzstein, 439.
Krisoberil, 155.
Krisolith, 256.
Krisuvigite, 664.
Krœberite, 59.
Krokalith, 426.
Krokidolite, 243.
Krokoit, 629.
Kryolite, 126.
Kryptolith, 529.
Kubizit, 432.
Kuboit, 432.
Kühnite, 544.
Kuboizit, 434.
Kupaphrite, 570.
Kupfer, Gediegen, 14.
  Salzsaures, 121.
Kupferantimonglanz, 85.
Kupferbleiglanz, 42.
Kupferbleispath, 663; 42.
Kupferblende, 104.
Kupferblüthe, 133.
Kupferdiaspore, 568.
Kupferfahlerz, 100.
Kupferglanz, Kupferglas, 52.
Kupferglimmer, 571.
Kupfergrün, 402.
Kupferhornerz, 121.
Kupferindig, 83.
Kupferkies, 65.
Kupferlasur, 715.
Kupferlebererz, 133.
Kupfermanganerz, 181.
Kupfernickel, 60.
Kupferpecherz, 402.
Kupferphyllit, 571.
Kupfersammterz, 666.
Kupferschaum, 570.
Kupferschwärze, 136.
Kupfferite, 230.
Kupfer-smaragd, 401.
Kupfer-uranit, 585.
Kupfer-vitriol, 648.
Kupferwasser, 645.
Kupferwismutherz, 86, 98.
Kupferwismuthglanz, 86.
Kuprein, 52.
Küstelite, 9.
Kyanite, 375.
Kymatine, 234.
Kypholite. *v.* Serpentine.
Kyrosite, 76.

Labradorite, 341.
Labrador feldspar, 341.
Labrador hornblende, 209.
Lagonite, 600.
Lagunite, 600.
Lampadite, 181.
Lamprophanite, 663.
Lanarkite, 628.
Lancasterite, 707.
Langite, 665.
Lanthanite, 709.
Lanthanocerite, 413.
Lapis-lazuli, 331.
Lapis Ollaris, 451.
Larderellite, 600.
Lardite, *v.* Pagodite.
Lasionite, 575.
Lasurfeldspath, 353.
Lasurite, 715.
Lasurstein, 331.
Latialite, 332.
Latrobite, 337.
Laumonite, Laumontite, 399.
Laurite, 74.
Lavendulan, 560.
Lavroffite, Lawrowit, 216.
Lazulite, 572.
Lazur-Apatit, 530.
Lead, 17.
  Aluminate, 577.
  Antimonial sulphuret, 96, 99.
  Antimonate, 591.
  Argentiferous, 41.
  Arsenate, 537.
  Black, 24.
  Carbonate, 700.
  Chlorid, 117.
  Chloro-carbonate, 703.
  Chromate, 628, 630.
  Corneous, 703.
  Cupreous sulphate, 663.
  Cupreous sulphato-carbonate, 625.
  Hydro-aluminous, 577.
  Molybdate, 607.
  Murio-carbonate, 703.
  Native, 17.
  Oxychlorid, 119, 120.
  Oxyds, 136, 163.
  Phosphate, 535.
  Selenate, 669.
  Selenids, 42, 44.
  Subsesquichromate, 630.
  Sulphate, 622.
  Sulphato-carbonate, 625, 628.
  Sulphato-chlorid, 627.
  Sulphato-tricarbonate, 624, 626.
  Supersulphuretted, 41.
  Sulphid, Sulphuret, 40.
  Tellurid, 44.
  Tungstate, 606.
  Vanadate, 610.
  White, 700.
Lead and Copper.
  Chromate, 630.
  Chromo-phosphate, 631.
Lead glance, 40.
Lead ochre, 136.
Lead ore, Green, 535, 537.
  Red, 628.
  White, 700.
Lead ore, Yellow, 607.
Lead vitriol, 622.
Leadhillite, 624.
Leberblende, 50.
Leberkies, 75; 58.
Leberstein, 616.
Lecontite, 635.
Ledererite, 436.
Lederite, 383.
Leedsite, 800.
Leelite, 353.
Lehmanite, 290.
Lehrbachite, 44.
Lehuntite, 426.
Lemnian Earth, 457.
Lennilite, 356.
Lenzinite, 476.
Leonhardite, 401.
Leopoldite, 111.
Lepidokrokite, 169.
Lepidolite, 314.
Lepidomelane, 307.
Lepolite, 337.
Lesleyite, 800.
Lettsomite, 666.
Leucanterite, 660.
Leucaugite, 216.
Leuchtenbergite, 500.
Leucite, 334.
Leucitophyr, 335.
Leucolite, 326, 376.
Leucocyclite, 415.
Leucopetrite, 743.
Leucophanite, 260.
Leucopyrite, 77; 76.
Leuzit, 334.
Levyne, Levynite, 431.
Lherzolyte, 147.
Libethenite, 563.
Liebenerite, 479; 329, 562.
Liebigite, 717.
Lievrite, 296.
Lignite, 755.
Ligurite, 383.
Lilalite, 314.
Lillite, 493.
Limbilite, 258.
Lime, Arsenate, 554.
  Borate, 380, 597.
  Borosilicate, 380.
  Carbonate, 670.
  Fluate, 123.
  Nitrate, 593.
  Oxalate, 718.
  Phosphate, 530.
  Silicate, 210.
  Sulphate, 621, 637.
  Titanate, 146.
  Tungstate, 605.
Lime-Malachite, 715.
Limestone, 678.
  Hydraulic, 679.
  Magnesian, 681.
Limnite, 178; 172.
Limonite, 172.

- Linarite, 663.
- Lincolnite, 444.
- Lindackerite, 590.
- Lindsayite, 340.
- Linnæite, 68.
- Linseite, 340.
- Linsenerz, 567.
- Linsenkupfer, 567.
- Liparite, 123.
- Liroconite, 567.
- Litheosphorus, 616.
- Lithionglimmer, 314.
- Lithionite, 314.
- Lithographic Stone, 679.
- Lithomarge, 460, 473, 475, 480.
- Loboit, 276.
- Loganite, 242, 496.
- Löllingite, 76; 77.
- Lomonite, 399.
- Lonchidite, 76.
- Lophoite, 501.
- Lotalite, 215.
- Löweite, Löveite, 648.
- Löwigite, 659.
- Loxoclase, 352.
- Lucullite, Lucullan, 677.
- Lumachelle, 679.
- Lunnite, 568.
- Lupus metallorum, 29.
- Lychnis, 138, 147.
- Lydian stone, 195.
- Lyellite, 665.
- Lyncurium, 272, 740.
- Lythrodes, 479.

- Macle, 371.
- Maclureite, 216, 363.
- Magneferrite, 152.
- Magnesia, Pure, 685.
  - Borate, 595.
  - Carbonate, 685.
  - Chlorid, 118, 119, 122.
  - Fluophosphate, 538.
  - Fluosilicate, 363.
  - Hydrate, 175.
  - Hydro-carbonate, 707.
  - Native, 175.
  - Nitrate, 593.
  - Sulphate, 648.
- Magnesia alum, 653.
- Magnesian limestone, 682.
  - pharmacolite, 544.
- Magnésie hydratée, 175.
  - carbonatée, 686.
  - nitratée, 593.
  - phosphatée, 538.
- Magnesinitre, 593.
- Magnesioferrite, 152.
- Magnesite, 685; 456.
- Magneteisenstein, 149.
- Magnetis, 451.
- Magnetic iron ore, 149.
- Magnetic pyrites, 58.
- Magnetite, 149, 800.
- Magnetkies, 58.
- Magnetopyrite, 58.
- Magnoferrite, 152.
- Malachite, Blue, 715.
  - Green, 713.
  - Lime, 715.
- Malacolite, 214.
- Malacon, Malakon, 275.
- Maltha, 728.
- Malthacite, 458.
- Mamanite, 642.
- Mandelato, 678.
- Manganalaun, 653.
- Mangan, Kohlensaures, 691.
- Manganamphibole, 225.
- Manganblende, 46.
- Manganepidote, 285.
- Manganerz, Grauer, 165, 170.
  - Kupferhaltiges, 166.
  - Prismatoidisches, 171.
  - Schwarzer, 162.
- Manganese, Oxyd, 162, 163, 165, 166.
  - Hydrous oxyds, 162, 170, 180.
  - Arseniuret, 61.
  - Black, 162.
  - Bog, 181.
  - Carbonate, 691.
  - Chlorid, 122.
  - Cupreous, 181.
  - Earthy, 181.
  - Gray, 165.
  - Phosphate, 541, 543.
  - Red, 225.
  - Silicates, 225, 260.
  - Sulphid, 46, 64.
- Manganese-Ore, Brachytypous, 163.
  - Prismatic, 165.
  - Pyramidal, 162.
- Manganese alum, 653.
- Manganese spar, 225.
- Manganglanz, 46.
- Mangangranat, 268.
- Manganite, 170.
- Mangankiesel, 225.
- Mangankupfererz, 166.
- Mangankupferoxyd, 166.
- Manganocalcite, 697; 678.
- Manganopal, *v.* Opal.
- Manganschaum, 181.
- Manganspath, 691.
- Marasmolite, 48.
- Marble, 670.
  - Verd-antique, 678.
- Marcasite, 75; 62, 800.
- Marceline, 163, 226.
- Marcylite, 137; 121.
- Marekanite, *v.* Pearlstone
- Margarite, 506; 489.
- Margarodite, 487; 310.
- Marialite, 326; 332.
- Marionite, 711.
- Marl, 679.
- Marmatite, 48.
- Marmolite, 465.
- Martinsite, 112, 641.
- Martite, 142.
- Mascagnine, Mascagnite, 635
- Maskelyne, 665.
- Masonite, 504.
- Massicot, 136.
- Matlockite, 119.
- Mauilite, *v.* Labradorite.
- Medjidite, 667.
- Meerschaum, 456.
- Megabasite, 604.
- Megabromite, 115.
- Mehl-Zeolith, 426, 430.
- Meionite, 318.
- Melaconite, 136, 804.
- Melanasphalt, 753.
- Melanchlor, 543.
- Melanchym, 744, 750.
- Melanellite, 750.
- Melanglanz, *v.* Stephanite.
- Melanhydrit, 483.
- Melanite, 267.
- Melanochroite, 630.
- Melanolite, 490.
- Melanteria, 645.
- Melanterite, 646, 800.
- Melilite, Mellilite, 280; 750.
- Melinite, 477.
- Melinophane, 263.
- Meliphanite, 263.
- Mellate of alumine, 750.
- Mellite, 750.
- Melinose, 607.
- Melonite, 801.
- Melopsite, 478.
- Menaccanite, 143.
- Menakerz, 383.
- Mendipite, 120.
- Mendozite, 653.
- Meneghinite, 105.
- Mengite, 525; 539.
- Menilite, 199.
- Mennige, 163.
- Mercure argental, 13.
  - sulfuré, 55.
  - ioduré, 117.
- Mercury, Antimonite, 547.
  - Amalgam, 13.
  - Chlorid, 111.
  - Horn, 111.
  - Iodid, 117.
  - Native, 13.
  - Selenid, 56.
  - Sulphid, 55.
- Merda di Diavolo, 746.
- Merkurblende, 55.
- Merkurglanz, 56.
- Meroxene, 307.
- Mesitine, Mesitite, 687; 688.
- Mesitinspath, 687.
- Mesole, 424.
- Mesolin, 431.
- Mesolite, 430.
- Mesotype, 424, 426, 430.

Mesotype epointée, 415.
Messingblüthe, 712.
Metabrushite, 558.
Metachlorite, 503.
Metaxite, 465.
Metaxoite, 494.
Miascyte, 328, 359.
Miargyrite, 88.
Mica Group, 801.
Mica, Hexagonal, 304.
  Lithia, 314.
  Oblique, 309.
  Rhombic, 302.
Mica des peintres, 24.
Mica pictoria, 24.
Mica schist, 359.
Micaphilit, 371.
Micarelle, 324.
Michaelite, 199.
Michaelsonite, 289.
Microbromite, 115.
Microclin, 355.
Microcosmic salt, 551.
Microlite, 513.
iddletonite, 745.
iemite, 682.
iesite, 535.
ikroklin, 355.
illerite, 56.
iloschin, Miloschite, 510.
imetene, Mimetite, 587.
imetese, Mimetesite, 537.
ineral caoutchouc, 734.
  coal, 753.
  charcoal, 755.
  oil, 728, 728, 737.
  pitch, 728, 751.
  resin, 739–747.
  tallow, 731.
  tar, 728.
  wax, 727, 730.
inium, 168; 55.
irabilite, 636.
isenite, 615.
ispickel, 78.
isy, 655; 645, 660.
izzonite, 325.
ocha Stone, 195.
odumite, 71.
ohsine, 76, 77.
ohsite, 143.
ollit, 572.
olochites, 713.
olybdänbleispath, 607.
olybdänglanz, 32.
olybdänochre, 185.
olybdänsilber, 32.
olybdate of lead, 607.
olybdate of iron, 186.
olybdena, sulphid of, 32.
olybdène sulfuré, 32.
olybdenite, 32.
olybdic ochre, 185.
  silver, 32.
ybdine, Molybdite, 185.
Molysite, 118.
Monazite, 539.
Monazitoid, 539.
Mondstein, *v.* Moonstone.
Monheimite, *v.* Kapnite.
Monimolite, 546.
Monophan, 443.
Monradite, 221, 406.
Monrolite, 378.
Montanite, 668, 801.
Monticellite, 255.
Montmartite, 637.
Montmorillonite, 459.
Moonstone, 347, 350, 352, 640.
Morasterz, 172, 174, 178.
Mordenite, 446.
Morenosite, 648.
Moresnetite, 409.
Mornite, 341.
Moronolite, 660.
Moroxite, 539.
Morvenite, 439.
Mosandrite, 295.
Mossottite, 694.
Mountain green, 713.
  cork, 234.
  leather, 234.
Muldan, 853.
Muller's glass, 199.
Mullerine, Mullerite, 8[illegible]
Mullicite, 556.
Mundic, 62.
Murchisonite, 352.
Muriacite, 621.
Muromontite, 289.
Murrhina, 194.
Muscovite, 309, 801.
Muscovy glass, 309.
Müsenite, *v.* Siegenite.
Mussite, 214, 702.
Myelin, 378.
Mysorin, 715.

Nacrite, 309; 455, 473.
Nadeleisenerz, 169.
Nadelerz, 100.
Nadelstein, 694.
Nadelzeolith, 426.
Nagyagererz, 82.
Nagyagite, 82.
Naphtha, 723.
Naphthadil, 734.
Naphthaline, 727, 738.
Nasturan, *v.* Pitchblende.
Natrocalcite, 677.
Natrolite, 426; 324.
Natrolite, Iron, 426.
Natron, 705.
  alaun, 653.
  salpeter, 592.
Natroborocalcite, 598.
Natronspodumen, 346.
Naumannite, 39.
Necronite, 352.
Needle ore, 100.
Needle spar, *v.* Aragonite.
Needlestone, 426.
Nefelina, 327.
Neft-gil, 734.
Nemalite, 175.
Neoctese, 574.
Neolite, 406.
Neoplase, 657.
Neotokite, 491.
Neotype, 678.
Nepheline, 327.
Nephelite, 327.
Nephrite, 233; 237, 290, 292, 801.
Nephelindoleryte, 328.
Nertschinskite, 476.
Neurolite, 482.
Newjanskite, 12.
Newkirkite, 171.
Niccolite, 60.
Nickel, Antimonial, 61.
  Arsenate, 561; 548.
  Arsenical, 60, 72.
  Bismuth, 47.
  Carbonate, 710.
  Copper, 60.
  Emerald, 710.
  Hydrate, 710.
  Oxyd, 134.
  Silicate, 404, 471, 510.
  Sulphate, 648.
  Sulphid, Sulphuret, 56.
  White, 77.
Nickel glance, 72.
  green, 560.
  ochre, 560.
  stibine, 73.
  vitriol, 648.
Nickel & cobalt, Arsenate of, 560.
Nickel & iron, Sulphuret or Sulphid of, 47.
Nickelantimonglanz, 73.
Nickelarsenikglanz, 72.
Nickelarsenikkies, 72.
Nickelblüthe, 560.
Nickelglanz, 72.
Nickel-Gymnite, 471.
Nickeliferous gray antimony, 73.
Nickeline, 60.
Nickelkies, 56.
Nickelocker, 560.
Nickeloxydul, 134.
Nickelspiessglanzerz, 73.
Nickelwismuthglanz, 47.
Nicopyrite, 47.
Nierenstein, 233.
Nigrine, 159.
Niobite, 515.
Nipholite, 128.
Nitratine, 592.
Nitre, 592.
Nitrocalcite, 593.
Nitromagnesite, 593.
Nontronite, 461.

Noralite, 236.
Nordenskiöldite, 233.
Nordmarkite, 389.
Nosean, Nosin, Nosite, 333.
Notite, 484.
Nussierite, 535.
Nuttallite, 319.

Obsidian, 359.
Ochran, 477.
Ochre, Antimony, 187, 188.
    Bismuth, 185.
    Brown, 172.
    Chrome, 510.
    Iron, 140.
    Molybdic, 185.
    Plumbic, 136.
    Red, 140, 167.
    Tantalic, 188.
    Telluric, 188.
    Tungstic, 186.
    Uranic, 668.
    Yellow, 172.
    Vitriol, 662.
Ochroite, 413.
Ockergelb, 172.
Octahedrite, 161.
Odontolite, 580.
Œllacherite, 489.
Œrstedite, 275.
Ogcoite, 502.
Oil, Genesee or Seneca, 725.
Oisanite, 161, 281.
Okenite, 398.
Oktibehite, 16.
Olafit, 349.
Oligist iron, 140.
Oligoclase, 346.
Oligoklasalbit, 349.
Oligon spar, 688.
Oligophyre, 348.
Olivenchalcit, 563.
Olivenerz, 563, 578.
Olivenite, 564.
Olivine, 257.
Omphacit, 223.
Onegite, 169.
Oncosin, 480.
Onofrite, 56, 802.
Onyx, 195; 680.
Oolite, 679.
Oösite, 480.
Opal, 198.
Opal-allophane, 421.
Operment, 27.
Ophiolite, 465.
Ophite, 464; 468.
Opsimose, 511.
Or natif, 3.
    graphique, 81.
Orangite, 413.
Oravitzite, 477.
Orichalcite, 712.
Ornithite, 553.
Oropion, 476.
Orpiment, 27.
Orthite, 285.
Orthoclase, 352, 802.
Orthose, 352.
Oserskite, 694.
Osmelite, 396.
Osmiridium, 12.
Osteocolla, 680.
Osteolite, 530.
Ostranite, 278.
Ottrelite, 506.
Ouvarovite, 270.
Owenite, 507.
Oxacalcite, 718.
Oxalite, 718.
Oxhaverite, 415.
Ozarkite, 424; 829.
Ozocerite, Ozokerit, 732; 728, 731, 733.

Pachnolite, 129.
Pacite, 81.
Paederos, 198.
Pagodite, 480; 454.
Paisbergite, 225.
Palæo-Natrolith, 426.
Palagonite, 483; 222, 802.
Paligorskite, 406.
Palladium, Native, 12.
Palladium gold, 4.
Panabase, 100.
Paracolumbite, 143.
Paradoxite, 353.
Paraffin, 730.
Paragonite, 487.
Paralogite, 325.
Paraluminite, 661.
Paranthine, Paranthite, 318; 319.
Parasite, 595.
Parastilbite, 444.
Parathorite, 763.
Pargasite, 255.
Parisite, 702.
Parophite, 479.
Partschin, Partschinite, 293.
Partzite, 188.
Passauite, 324.
Pastreite, 656.
Pateraite, 608.
Patrinite, 100.
Pattersonite, 801.
Paulit, 209.
Pazit, 81.
Pearl-mica, 506.
Pearl sinter, 199.
Pearl-spar, 682; 685.
Pearlstone, 359.
Peastone, v. Pisolite.
Pechblende, Pecherz, 154.
Pechkohle, 755.
Pechopal, 198.
Pechstein, 359.
Pechuran, 154.
Pectolite, 396.
Peganite, 582.
Pegmatolite, 352.
Pektolith, 396.
Pélé's Hair, 360.
Peliom, 299.
Pelicanite, 457.
Pelokonite, 181.
Pencatite, 708.
Pennine, Penninite, 495.
Pennite, 708.
Pentaklasit, 213.
Pentlandite, 47.
Peplolit, 485.
Percylite, 122.
Periclase, Periclasite, 134.
Peridot, 256, 867.
Peridoto bianco, 255.
Periklas, 134.
Periklin, 349.
Peristerite, 349.
Perlglimmer, 506.
Perlit, 359.
Perlstein, 359.
Perthite, 356.
Perofskite, 146.
Perowskine, 541.
Perowskit, 146.
Petalite, 229.
Petrified wood, 196.
Petrolene, 729, 751.
Petroleum, 723.
Petrosilex, 349, 353.
Pettkoite, 631.
Petuntze, 475.
Petzite, 51.
Pfaffite, 91.
Pfeifenstein, v. Catlinite.
Phacolite, 434.
Phæstine, 469.
Pharmacolite, 554; 544.
Pharmakochalcit, 564.
Pharmacosiderite, 578.
Phenacite, Phenakit, 263.
Phengite, 309.
Phillipsite, 438.
Phlogopite, 302.
Phœnicite, 630.
Phœnikochroite, 630.
Phœstine, 209.
Pholerite, 472, 473; 421
Phonite, 327.
Phonolyte, 359.
Phosgenite, 703.
Phosphid of iron and nickel, 6
Phosphocerite, 529.
Phosphochalcite, 568.
Phosphorblei, v. Pyromorphite
Phosphoreisensinter, 588.
Phosphorgummite, 179.
Phosphorite, 530.
Phosphorkupfererz, 563, 568.
Phosphorsaures, 568, 572.
Photicite, 227.
Photizit, 227.
Photolite, 396.

Phrenitoid, 326.
Phthanyte, 195.
Phyllite, 506.
Phylloretin, 737; 736
Physalite, 376.
Piauzite, 758.
Pickeringite, 653.
Picotite, 147.
Picranalcime, 433.
Picrofluite, 512.
Picrolite, Pikrolit, 465.
Picromerite, 642.
Picropharmacolite, 554.
Picrophyll, Pikrophyll, 220, 406.
Picrosmine, Pikrosmin, 405.
Picrotanite, 144.
Picrotephroite, 259.
Picrothomsonite, 426.
Picryte, 258.
Pictite, 383.
Piddingtonite, 232.
Piedmontite, 285.
Pierre grasse, 327.
Pigotite, 750.
Pihlite. 455.
Pilsenite, 32.
Pimelite, 510.
Pinguite, 461.
Pinite, 479; 301.
Pinitoid, 480.
Piotine, 472.
Pipestone, *v.* Catlinite.
Pirenäit, 269.
Pirop, 267.
Pisanite, 646.
Pisolite, 679.
Pissophane, Pissophanite, 661.
Pistacite, Pistazit, 281.
Pistomesite, 688.
Pitch, Mineral, 728, 751.
Pitchblende, 154; 179.
Pitchstone, 359.
Pitchy iron ore, 589.
Pitkarandite, 221, 406, 452.
Pittasphalt, 751.
Pitticite, Pittizit, 589.
Pittinerz, 175.
Pittinite, 175.
Pittolium, 728.
Plagioclase, 802.
Plagionite, 89.
Planerite, 576.
Plasma, 194.
Plaster of Paris, 637.
Plata azul, 804.
  bismutal, 36.
  cornea, 115.
  verde, 115, 116.
Platinum, Native, 10.
Platiniridium, 11.
Plattnerite, 167.
Platyophthalmon, 29.
Pleonaste, 147.
Plessite, 73.
Pleuroclase, 538.
Plinian, 80.
Plinthite, 477.
Plomb antimonié sulfuré, 96, 99.
  arseniaté, 537.
  carbonaté, 700.
  chloro-carbonaté, 703.
  chloruré, 117, 119, 120.
  chromaté, 628, 630.
  hydro-alumineux, 577.
  molybdaté, 607.
  natif, 17.
  oxychlorioduré, 120.
  oxidé, 136, 163.
  seleniuré, 42, 44.
  sulfaté, 622.
  sulfuré, 40.
Plombgomme, 577.
Plombierite, 802.
Plumbeine, 42.
Plumbago, 24.
Plumbic ochre, 136.
Plumbocalcite, 678.
Plumbogummite, 577.
Plumboresinite, 577.
Plumbostib, 99.
Plumbum candidum, 17.
  nigrum, 17.
Plumites, 91.
Plumose ore, 91.
Plumosit, 91.
Poikilit, 44.
Poikilopyrite, 44.
Poix minerale, 728.
Polianite, 165.
Pollucite, Pollux, 249.
Polyadelphite, 268.
Polyargite, 480; 340.
Polybasite, 107.
Polycrase, 523.
Polychroilite, 485.
Polychrom, 535.
Polyhalite, 641.
Polyhydrite, 493.
Polykras, 523.
Polylite, 216.
Polymignyte, 523.
Polysphærite, 535.
Polytelite, 104; 101, 804.
Polyxen, 10.
Poonahlite, 428.
Porcelain clay, 473.
Porcelain spar, 324.
Porcellophite, 464.
Porphyry, 359.
Porpezite, 4.
Porricin, *v* Pyroxene.
Portite, 458.
Porzellanerde, 473.
Porzelanit, 324.
Portor, 679.
Potash alum, 652.
Potash, Muriate, 111; 118.
  Nitrate, 592.
  Sulphate, 614, 615.
Potassium, chlorid, 111, 118.
Potstone, 451.
Pounxa, *v.* Borax.
Prase, 194.
Prasin, 568.
Praseolite, 485; 301.
Prasilite, 503.
Predazzite, 708.
Pregattit, 487.
Prehnite, 410.
Prehnitoid, 326.
Preunnerite, 677.
Prochlorite, 501.
Prosopite, 130.
Protheite, 215.
Protobastite, 208.
Proustite, 96.
Prussian blue. Native, 558.
Przibramite, 169; 48.
Psathyrit, 742.
Psaturose, 106.
Pseudoalbite, 344.
Pseudoapatite, 531.
Pseudogalena, 48.
Pseudomalachit, 568.
Pseudonepheline, 327.
Pseudolibethenit, 563.
Pseudophite, 496.
Pseudosommite, 327.
Pseudotriplite, 542.
Psilomelane, 180.
Psimythite, 624.
Pterolite, 808.
Puflerite, 441.
Pumice, 359.
Purple copper, 44.
Puschkinite, 281.
Pycnite, 376.
Pyrallolite, 220, 406, 451.
Pyrantimonite, 186.
Pyrargillite, 485.
Pyrargyrite, 94.
Pyrauxite, 454.
Pyreneite, 268.
Pyrgom, 216.
Pyrite, 62, 802.
Pyrites, Arsenical, 78; 76.
  Auriferous, 62.
  Capillary, 56.
  Cellular, 75.
  Cockscomb, 75.
  Copper, 65.
  Erubescent, 44.
  Hepatic, 75.
  Hydrous, 75.
  Iron, 62.
  Magnetic, 58; 57.
  Prismatic Iron, 75, 76.
  Radiated, 75.
  Spear, 75.
  Tin, 68.
  Variegated, 44.
  White iron, 75.
Pyraurite, 179.
Pyrochlore, 512; 513.
Pyrochroite, 177.

Pyroclasite, 535.
Pyroguanite, 535.
Pyrolusite, 165.
Pyromelane, 803.
Pyromeline, 648.
Pyromorphite, 535; 537.
Pyrope, 267.
Pyrophyllite, 454.
Pyrophysalite, 376.
Pyropissite, 734.
Pyroretin, 744, 745.
Pyroretinite, 744.
Pyrorthite, 285.
Pyroscheererite, 737.
Pyrosclerite, 493.
Pyrosiderite, 169.
Pyrosmalite, 414.
Pyrostibite, 186.
Pyrostilpnite, 93.
Pyrotechnite, 615.
Pyroxene, 212, 803.
Pyroxenyte, 220, 359.
Pyrrhite, 763.
Pyrrholite, 480.
Pyrrhosiderite, 169.
Pyrrhotine, 57.
Pyrrhotite, 58; 57, 803.

Quartz, 189, 803.
    Ferruginous, 193.
    Granular, 195.
    nectique, 199.
    resinite, 198.
Quecksilberfahlerz, 101.
Quecksilberbranderz, 738; 55.
Quecksilberhornerz, 111.
Quecksilberlebererz, 55.
Quellerz, 178.
Quicksilver, Native, 13.
    Antimonite, 547.
    Chlorid, 111.
    Horn, 111.
    Iodid, 117.
    Sulphuret, 55.
    Selenid, 56.
Quincite, 406.

Rabenglimmer, 314.
Radauite, 341.
Rädelerz, 96.
Radiated pyrites, 75.
Radiolite, 426.
Rahtite, 48.
Raimondite, 656.
Rammelsbergite, 77; 70.
Randanite, 199.
Raphanosmite, 43.
Rapidolite, 319.
Raphilite, 233.
Raseneisenstein, 172, 174, 178.
Rastolyte, 486.
Ratholite, 396.
Ratofkit, 123.
Rauhkalk, 682.
Raumit, 485.
Rauschgelb, 26, 27.
Rautenspath, 682.
Razoumoffskin, 460.
Realgar, 26.
Red antimony, 186.
    chalk, 141.
    copper ore, 133.
    hematite, 140.
    iron ore, 140.
    iron vitriol, 657.
    lead ore, 628.
    manganese, 691.
    ochre, 141, 167.
    silver ore, 94, 96.
    vitriol, 647.
    zinc ore, 135.
Reddle, 141.
Redruthite, 52.
Reichite, 677.
Reissacherite, 181.
Reissbley, 24.
Refdanskite, 803.
Remingtonite, 711.
Remolinite, 121.
Rensselaerite, 451.
Resigallum, 26, 27.
Resin, Mineral, etc., 739–747.
    Highgate, 739.
Retinasphalt, 748.
Retinalite, 464.
Retinellite, 748.
Retiuic Acid, 748.
Retinite, 739; 753.
Retzbanyite, 100.
Retzite, *v.* Ædelforsite.
Reussin, 637.
Reussinite, 744.
Rhætizite, 375.
Rhodalose, 647.
Rhodalite, 459.
Rhodium gold, 41.
Rhodizite, 596.
Rhodochrome, 495.
Rhodochrosite, 691.
Rhodoial, 558.
Rhodonite, 225.
Rhodophyllite, 495.
Rhombenglimmer, 302, 304.
Rhomb-spar, 682.
Rhyacolite, 352.
Richmondite, 803.
Richterite, 234; 215.
Riemannite, 419.
Ripidolite, 497; 501.
Risigallum, 26.
Rittingerite, 94.
Rock cork, *v.* Hornblende.
    crystal, 193.
    meal, 680.
    milk, 680.
    salt, 112.
    soap, 476.
Rochlandite, *v.* Serpentine.
Rochlederite, 744.
Rœmerite, 655.
Rœsslerite, 556.
Rohwand, 685.
Rogenstein, 679.
Romanzovit, 266.
Romeine, Romeite, 547.
Röschgewachs, 106.
Rose quartz, 193.
Roselite, 560.
Rosellan, *v.* Rosite.
Rosite, 340; 85, 480.
Rothbleierz, 628.
Rothbraunstein, 225.
Rotheisenerz, 140.
Rother vitriol, 647.
Rothgültigerz, 94, 96.
Rothkupfererz, 133.
Rothnickelkies, 60.
Rothoffit, 268.
Rothspiessglanzerz, 186.
Rothspiesglaserz, 186.
Rothzinkerz, 135.
Röttisite, 471.
Rubellan, 304.
Rubellite, 365.
Ruberite, 133.
Rubicelle, 147.
Rubin, 138.
Rubinblende, 94.
Rubinglimmer, 170.
Ruby, Spinel, Balas, Almandine, 147.
    Oriental, 138.
Ruby-blende, 94.
Ruby silver, 94, 96.
Ruby sulphur, *v.* Realgar.
Ruthenium, Sulphuret, 74.
Rutherfordite, 526.
Rutile, 159.
Ryacolite, 352.

Saccharite, 344.
Safflorite, 70.
Sagenite, 159, 193.
Sahlite, 215.
Sal ammoniac, 114.
    gemme, 112.
Salamstein, *v.* Sapphire.
Saldanite, 649.
Salmare, 112.
Salmiak, 114.
Salt, Common, 112.
Saltpeter, 592.
Salts of Iron, 750.
Salzkupererz, 121.
Samarskite, 520.
Samian Earth, 473.
Sammetblende, 169.
Sammeterz, 666.
Samoite, 478.
Samteisenerz, 169.
Sandaraca, 26.
Sandbergerite, 104.
Sandstone, 195.
Sanidin, 352.
Saponite, 472; 459.

Sappare, 375.
Sapphire, 138.
  d'eau, 299.
Sapphirine, 391.
Sapphirus, 331.
Sarcolite, 317, 436.
Sard, 194.
Sardachates, 195.
Sardinian, 622.
Sardonyx, 195.
Sartorite, 87.
Saspachite, 447.
Sassolite, Sassolin, 594.
Satin spar, 637, 678.
Sätersbergite, 76.
Saualpit. 290.
Saussurite, 290; 321, 341.
Saustein, 677.
Savite, 426.
Saynite, 47.
Scarbröite, 421.
Scapolite Group, 317.
Schaalstein, 210.
Schabasit, 434.
Schapbachite, 36.
Schätzellit. 111.
Schaumspath, 678.
Scheelbleispath, 606.
Scheelin calcaire, 605.
  ferruginé, 601.
Scheelite, 605, 803.
Scheelitine, 606.
Scheelsaure, 186.
Scheelsaures blei, 606.
Scheelspath. 605.
Scheererite, 727.
Schefferite, 215, 242.
Schieferspath, 678.
Schilfglaserz, 93.
Schiller-spar, 469; 209, 210, 221.
Schillerstein, 221.
Schlanite, 745.
chmelzstein, 326.
chmirgel, 139.
chneiderite, 399.
chönit, 642.
chörl, 205, 365.
chörl rouge, 159.
chorlartiger beril, 376.
chorlite, 377.
chorlomite, 390.
chorza, 281.
chreibersite, 61.
chrifterz. Schrift-tellur, 81.
chrötterite, 421.
chulzit, 105.
chuppenstein, 316.
chützit, 619.
chwarzbraunstein, 162.
chwartzembergite, 120.
chwarzerz. 46, 100, 106.
chwarzgiltigerz. 101, 106.
chwarzmanganerz, 162.
chwarzspiessglaserz, 96.
Schwatzite, 101.
Schwefel, Natürlicher, 20.
Schwefelantimonblei, 99.
Schwefelkies, 62.
Schwefelkobalt, 47.
Schwefelnickel, 56.
Schwefelquecksilber, 55.
Schwefelsäure, 614.
Schwefelsilber, 38, 51.
Schwerbleierz, 167.
Schwerspath, 616, 619.
Schwerstein, 605.
Schweruranerz, 154.
Schwimmkiesel, 199.
Scleretinite, 744.
Scleroclase, 87, 92.
Scolecite, 428.
  Anhydrous, 361.
Scolexerose, 361.
Scorodite, 574.
Scorza, 281.
Scotiolite, 489.
Scoulerite, 424.
Sebesite, 238.
Seeerz, *v.* Limonite.
Seifenstein, 472.
Seladonite, 468.
Selbite, 804.
Selenblei, 42.
Selenbleikupfer, 43.
Selenbleispath, 669.
Selenite, 637.
Selenkobaltblei, 43.
Selenkupfer, 46.
Selenkupferblei, 43.
Selenkupfersilber, 39.
Selenmercur, 56.
Selenpalladium, 12.
Selenquecksilber, 56.
Selenquecksilberblei, 44.
Selenschwefelquecksilber, 56.
Selensilber, 39.
Selensulphur, 21.
Selwynite, 509.
Séméline, 383.
Semi-opal, 199.
Senarmontite, 184.
Seneca oil, 725.
Sepiolite, 456.
Serbian, 510.
Sericite, 487.
Sericolite, *v.* Satin spar.
Serpentine, 464, 804.
Severite, 476; 460.
Seybertite, 508.
Sexangulites, 42.
Shepardite, 62.
Siberite, 365.
Sicilianite, 619.
Sideretine, 589.
Siderite, 688; 193, 572.
Sideritis, 149.
Sideroborine, 600.
Siderochalcit, 570.
Siderochrome, 153.
Sideroclepte, 258.
Siderocouite, 676.
Siderodot, 688.
Sideroferrite, 16.
Sideromelane, 360.
Sideroplesite, 688.
Sideroschisolite, 504.
Siderosilicite, 484.
Siderose, 688.
Siderotantal, 514.
Sideroxene, 762.
Siegelerde, 458.
Siegelstein, 149.
Siegenite, 68, 69.
Sienite, 240, 359.
Silber, Gediegen, 9.
Silberamalgam, 13.
Silberfahlerz, 101.
Silberglanz, 38.
  Biegsamer, 55.
Silberglas. 38.
Silberhornerz, 114.
Silberkupferglanz, 54.
Silberphyllinglanz, 83.
Silberspiessglanz, 35.
Silberwismuthglanz, 36.
Silex, 189.
Silice gelatineuse, *v.* Hyalite.
Silicified wood, 196.
Siliceous sinter, 195.
Silicite, 341.
Silicoborocalcite, 598.
Sillimanite, 373.
Silvanite, 81; 19.
Silver, Antimonial, 35.
  Antim. sulphuret, 93, 92.
  Arsenical, 35.
  Bismuthic, 36.
  Black, 106.
  Brittle sulphuret, 106.
  Bromic, 116.
  Carbonate, 804
  Chlorid, 114.
  Chlorobromid, 115.
  Cupreous sulphuret, 54.
  Flexible sulphuret, 55.
  Gray (Freieslebenite), 93.
  Horn, 114.
  Iodic, 117.
  Muriate, 114.
  Native, 9.
  Red, or Ruby, 94, 96.
  Selenic, 39.
  Sulphuret, 38, 51.
  Sulphuret of Copper and 54.
  Telluric, 50.
  Vitreous, 38.
Silver glance, 38.
Silver ore, Brittle, 106.
  Flexible, 55.
  Red, or Ruby, 94, 96.
Sinopite, 477.
Sinter, Siliceous, 195, 199.
Sismondine, 504.

Sisserskite, 12.
Skapolith, 318.
Skleroklas, 87, 92.
Skogbölit, 514.
Skolezit, 428.
Skolopsite, 333.
Skorodit, 574.
Skutterudite, 71.
Slate-spar, 678.
Sloanite, 446.
Smaltine, Smaltite, 70.
Smaragdus, 245, 581.
Smaragdite, 215, 235.
Smaragdochalcit, 121, 401.
Smectite, 458; 475.
Smelite, v. Kaolin.
Smirgel, 138.
Smithsonite, 692; 407.
Smyris, 139.
Snarumite, 316.
Soapstone, 451, 472.
Soda, Borate of, 597.
    Carbonate of, 705; 706.
    Muriate of, 112.
    Nitrate of, 592.
    Sulphate, 615; 636.
Soda alum, 653.
Soda copperas, v. Jarosite.
Soda nitre, 592.
Soda spodumene, 346.
Sodaite, 324.
Sodalite, 330.
Sodium, Chlorid, 112.
Soimonite, v. Corundum.
Solfatarite, 649, 653.
Sombrerite, 535.
Somervillite, 280, 402.
Sommite, 327.
Sonnenstein, v. Sunstone.
Soude, v. Soda.
Sordawalite, 244.
Sory, 645.
Soufre, 20.
Spadaite, 405.
Spaniolite, 101.
Spargelstein, 530.
Spärkies, v. Speerkies.
Sparry or Spathic iron, 683.
Spartaite, 678.
Spartalite, 135.
Spatheisenstein, 688.
Spear Pyrites, 75.
Speckstein, 451.
Specular Iron, 140.
Speerkies, 75.
Spessartite, 268.
Speiskobalt, Weisser, 70.
Sphærite, 587.
Sphærosiderite, 690.
Sphærostilbite, 442.
Sphærulite, 359.
Sphalerite, 48.
Sphene, 383.
Sphenoclase, 280.
Sphragidite, Sphragid, 458.
Spiauterit, 59.
Spiegelglanz, 32.
Spiesglanzsilber, 35.
Spiessglanz, Gediegen, 18.
Spiessglanzocher, 187.
Spiesglanzweiss, 184.
Spiessglanzblei, 96.
Spiessglanzblende, 186.
Spiesglas, 18.
Spiessglaserz, 29.
Spiesglassilber. 35.
Spilyte, 352.
Spinel, 147.
Spinel ruby, 147.
Spinellan, 333.
Spinelle zincifère, 149.
Spinthère, 383.
Spodumene, 228.
    Soda, 346.
Spreustein, 426.
Sprödglanzerz, 106.
Sprödglaserz, 106; 107
Sprudelstein, 696.
Staffelite, 534.
Stahlkobalt, 72.
Stahlstein, 688.
Stalactite, 679.
Stalagmite, 679.
Stanekite, 745.
Stangenschörl, Weisser, 376.
Stangenspath, 616.
Stangenstein, 376.
Stannine, Stannite, 68.
Stannite, 159.
Stanzait, 371.
Stassfurtit, 595.
Staurolite, 388; 439.
Staurotide, 388.
Steargillite, 459.
Steatite, 451, 472.
Steel ore, 688.
Steinheilite, 299.
Steinkohle, 754.
Steinmannite, 41.
Steinmark, 474, 475.
Steinöl, 723.
Steinsalz, 112.
Stellite, 396.
Stephanite, 106.
Stercorite, 551.
Sternbergite, 54.
Stetefeldtite, 188.
Stibi, 29.
Stibiconite, 188.
Stibine, 29.
Stibiogalenite, 591.
Stibium, 29.
Stiblite, Stiblith, 188.
Stibnite, 29.
Stilbite, 442; 444.
Stilbit anamorphique, 444.
    Blättriger, 444.
Stillolite, v. Opal.
Stilpnomolane, 460.
Stilpnosiderite, 172.
Stinkkohle, 746.
Stimmi, 29.
Stinkstone, 677.
Stolpenite, 459.
Stolzite, 606.
Strahlbaryt, 616.
Strahlenkupfer, 570.
Strahlerz, 570.
Strahlkies, 75.
Strahlstein, 233, 281, 581.
Strahlzeolith, 442.
Strakonitzite, 221, 406.
Stratopeite, 491; 227.
Striegisan, 575, 582.
Stroganovite, 323.
Stromeyrite, 54.
Strömit, v. Rhodochrosite.
Stromnite, 699.
Strontia, Carbonate, 699.
    Sulphate, 619.
Strontianite, 699.
Strontianocalcite, 678.
Struvite, 551.
Stübelite, 492.
Studerite, 104.
Stylobat, 370.
Stylotyp, Styloptypite, 98.
Stypterite, 649.
Stypticite, 656.
Succinellite, 748.
Succinite, 740; 266.
Succinic acid, 748.
Sulphatite, 614.
Sulphur, Native, 20.
    Selenic, 21.
Sulphuric acid, 614.
Sumpferz, 172, 174, 178.
Sundvikite, 340.
Sunstone, 346, 355.
Susannite, 626.
Svanbergite, 590.
Swinestone, 677.
Syenite, 240, 359.
Syepoorite, 47.
Syhedrite, 442.
Sylvan, Gediegen, 19.
Sylvane graphique, 81.
Sylvanite, 81; 19.
Sylvine, Sylvite, 111.
Symplesite, 558.
Syntagmatite, 235.
Szaibelyite, 594.

Tabergite, 493, 495, 497.
Tabular spar, 210.
Tachhydrite, 119.
Tachylyte, 245.
Tachyaphaltite, 275.
Tænite, 16.
Tafelspath, 210.
Tagilite, 566.
Talc, 451.
Talc-apatite, 535.
Talc phosphorsäurer, 588.

Talc zographique, *v.* Celadonite.
Talc chlorite, 500.
Talcite, 309.
Talcoid, 454.
Talkeisenerz, 150.
Talkerde-Alaun, 653.
Talkspath, 680.
Talkhydrat, 175.
Talksteinmark, 378.
Tallingite, 122.
Tallow, Mineral, 731.
Taitalite, 365.
Tamarite, 571.
Tannenite, 86.
Tantalic ochre, 188.
Tankite, 337.
Tantale oxydé yttrifère, 519.
Tantalite, 514; 518.
Tapiolite, 518.
Targionite, 40.
Tarnowitzite, 694.
Tasmanite, 746.
Tauriscite, 644.
Tautoklin, 685.
Tautolite, 285.
Tavistockite, 582.
Taylorite, 614.
Tecticite, 644.
Tekoretin, 735.
Télésie, 138.
Tellur, Gediegen, 19.
Tellurbismuth, 30.
Tellurblei, 44.
Tellure auro-argentifère, 81.
    auro-plombifère, 81.
    natif auro-ferrifère, 19.
Tellurgoldsilber, 51.
Telluric bismuth, 30.
Telluric ochre, 188.
Telluric silver, 50.
Tellurige saure, 188.
Tellurite, 188.
Tellurium, Bismuthic, 30, 31, 32.
    Black, 82.
    Foliated, 82.
    Graphic, 81.
    Native, 19.
    White, Yellow, 81.
Tellurium glance, *v.* Nagyagite.
Tellurous acid, 188.
Tellursilber, 50.
Tellursilberblei, *v.* Sylvanite.
Tellurwismuth, 30, 31, 32.
Tengerite, 710.
Tennantite, 104.
Tenorite, 136, 804.
Tephroite, 259.
Teratolite, 473.
Terenite, 323.
Ternärbleierz, 624.
Terre verte, 462, 463.
Teschomacherite, 705.
Tesselite, 415.
Tesseralkies, 71.
Tetartine, 348.
Tetradymite, 30; 31, 32, 804.
Tetrahedrite, 100, 804.
Tetraphyline, 541.
Texalith, 175.
Texasite, 710.
Thalheimit, 78.
Thalite, 472.
Thallite, 281.
Tharandite, 682.
Thenardite, 615.
Thermonatrite, 705.
Thermophyllite, 465.
Thierschite, 718.
Thiorsauite, 337.
Thomaite, 697.
Thomsenolite, 129.
Thomsonite, 424; 329.
Thoneisenstein, 688.
Thonerde Schwefelsaure, 681, 649, 658.
Thonerdephosphat, 575.
Thorite, 413; 763.
Thraulite, 492.
Thrombolite, 562.
Thulite, 290.
Thumite, Thummerstein, 297.
Thuringite, 507.
Tiemannite, 56, 805.
Tile ore, 133.
Tikerodite, 43.
Tin, Native, 17.
    Oxyd, 157.
    Sulphuret, 68.
Tin ore, 157.
Tin pyrites, 68.
Tinder ore, 91.
Tinkal, 597.
Tinkalzit, 598.
Tirolite, 570.
Titaneisen, 143.
Titane anatase, 161.
    oxydé, 159, 161, 164.
    silico-calcaire, 383.
Titanic acid, 159, 161, 164.
    iron, 143.
Titanite, 383, 805.
Tiza, *v.* Ulexite.
Tombazite, 72.
Topaz, 376.
    False, 193.
    Oriental, 138.
Topazolite, 268.
Topazosème, 378.
Topfstein, *v.* Potstone, 451.
Torbanite, 742.
Torbernite, Torberite, 585.
Torrelite, 515.
Touchstone, 195.
Tourbe papyracée, 746.
Tourmaline, 365.
Towanite, 65.
Trachyte, 359.
Traubenblei, 585.
Traversellite, 214, 221, 406.
Travertine, 680.
Tromenheerite, 25.
Tremolite, 233.
Trichalcite, 562.
Trichite, 805.
Trichopyrit, 56.
Triclasite, 484.
Tridymite, 805.
Trinacrite, 484.
Tripestone, 621.
Triphane, 228.
Triphylite, Triphyline, 541.
Triplite, 543.
Triploklas, 424.
Tripolite, 199.
Tritomite, 412; 272.
Troilite, 57.
Trolleite, 577.
Trombolite, 562.
Trona, 706.
Troostite, 262.
Tscheffkinite, 387.
Tschermigite, 651.
Tuesite, 474.
Tufa, Calcareous, 680.
Tungstate of iron, 601.
    of lead, 606.
    of lime, 605.
Tungsten, 605.
Tungstic acid or ochre, 186.
Tungstite, 186.
Turgite, 167.
Türkis, 580.
Turmalin, 365.
Turnerite, 540.
Turquois, 580; 572.
Tyrite, 524.
Tyrolite, 570.

Uddevallite, 144.
Uigite, 412.
Ulexite, 598.
Ullmannite, 73.
Ultramarine, 331.
Unghwarite, 461.
Unionite, 290.
Uraconise, Uraconite 668.
Uralite, 222.
Uralorthite, 285.
Uranatemnite, 154.
Uranblüthe, 667.
Urane oxydulé, 154.
Uranglimmer, 585; 586.
Urangreen, 667.
Urangrün, 667.
Urangummi, 179.
Uranin, Uraninite, 154.
Uranisches Pittin-Erz, 175.
Uranisches Gummi-Erz, 179.
Uranite, 585; 586.
Uranium, Carbonate, 717.
    Oxyd, 154.
    Phosphate, 585, 586.
    Sulphate, 666, 667, 668.
Urankalk-Carbonat, 717.
Uranmica, 585.

Uranochalcite, 667.
Uranochre, 668.
Uranoniobit, 520; 154.
Uranophane, 805.
Uranotantal, 520.
Uranoxyd, 154.
Uranpecherz, 154, 175. 179.
Uranphyllit, 585.
Uranvitriol, 666.
Urao, 706.
Urdite, 539.
Urpethite, 731.
Uwarowit, 270.

Valaite, 805.
Valencianite, 352.
Valentinite, 184.
Vanadite, 610.
Vanadic ochre, 167.
Vanadinbleierz, 610.
Vanadinite, 610.
Vargasite, 220.
Variegated copper, 44.
Variolyte, 344, 359.
Variscite, 582.
Varvacite, 166, 171, 182.
Vauqueline, Vauquelinite, 630.
Velvet copper ore, 666.
Verd-antique, 465, 678.
Vermiculite, 493.
Vermilion, 56.
Vermontite, 78.
Vestan, 806.
Vesuvianite, 276.
Vesuvian salt, 615.
Vierzonite, 477.
Villarsite, 409.
Villemite, 262.
Vilnite, 210.
Violan, 223.
Vitreous copper, 52.
    silver, 38.
Vitriol, Blue, 648
    Green, 646.
    Lead, 622.
    Nickel, 648.
    Red, or Cobalt, 647.
    Red Iron, 657.
    White, or Zinc, 647.
Vitriolgelb, 660.
Vitriol ochre, 662.
Vitriolbleierz, 622.
Vivianite, 556.
Voglianite, 668.
Voglite, 717.
Voigtite, 807, 486.
Völknerite, 178.
Volborthite, 611.
Volcanic glass, 213.
Volcanite, 359.
Volgerite, 188, 806.
Voltaite, 652.
Voltzite, Voltzine, 50.
Voraulite, 572.
Vorhauserite, 464.
Voegite, 343.
Vulpinite. 621.

Wad, 181.
Wagit, 407.
Wagnerite, 538.
Walchowite, 741.
Waldheimite, 242.
Walkthon, Walkerde, 458.
Wallerian. 236.
Walmstedtite, 686.
Wandstein, 685.
Warringtonite, 664.
Warwickite, 600.
Washingtonite, 143.
Wasite, 806.
Wasserblei, 32.
Wasserbleisilber, 32.
Wasserkies, 75.
Water, 135.
Wavellite, 575.
Websterite, 658.
Wehrlite, 32, 296.
Weichbraunstein, 165.
Weicheisenkies, *v.* Wasserkies.
Weichmangan, 165.
Weissbleierz, 700.
Weisserkies, 75.
Weisserz, 76.
Weissgolderz, 81.
Weissgültigerz, 101, 104.
Weissian, *v.* Scolecite.
Weissigite, 353.
Weissite, 301, 485.
Weisskupfer, 36.
Weisskupfererz, 75.
Weissnickelkies, 70, 77.
Weisspiessglanzerz, 184.
Weissstein, 352.
Weiss-Sylvanerz, 81.
Weisstellur, 81.
Wernerite, 319; 318, 324, 806.
Wheel-ore, 96.
Whewellite, 718.
White antimony, 184.
    arsenic, 183.
    copperas, 647, 650.
    iron pyrites, 75.
    lead ore, 700.
    nickel, 77.
    tellurium, 81.
    vitriol, 647.
Whitneyite, 37.
Wichtine, Wichtisite, 244.
Wiesenerz, 172, 174, 178.
Wilhelmite, 262.
Willemite, 262.
Williamsite, 262, 465.
Wilsonite, 480; 323.
Wiluite, 266, 276.
Wiserin, 528.
Wismuth, Gediegen, 19.
Wismuthblende, 391.
Wismuthbleierz, 36.
Wismuthglanz, 30.
Wismuth-Kupfererz, 86, 98.
Wismuthochre, 185.
Wismuthoxyd, Kolens., 716.
Wismuthsilber, 36.
Wismuthspath, 716.
Withamite, 281.
Witherite. 697.
Wittichenite Wittichite, 98.
Wittingite, 491.
Wocheinite, 174.
Wodankies, *v.* Gersdorffite.
Wöhlerite, 261, 806.
Wölchite, 96.
Wolchonskoite, 509.
Wolfram, 601.
Wolframite, Wolframine, 601
    186.
Wolframbleierz, 606.
Wolframochre, 186.
Wolfsbergite, 85; 91.
Wollastonite, 210; 396.
Wolnyn, 618.
Wood, petrified, 196.
Wood-opal, 199.
Woodwardite, 666.
Wörthite, 373.
Wulfenite, 607.
Wundererde, *v.* Teratolite.
Würfelerz, 578.
Würfelgyps, 621.
Würfelspath, 621.
Würfelzeolith, 432, 434.
Wurtzite, 59.

Xanthitan, *v.* Titanite.
Xanthite, 276.
Xanthoconite, 108.
Xanthokon, 108.
Xanthophyllite, 508.
Xanthopyrites, 62.
Xanthorthit, 285.
Xanthosiderite, 174; 655.
Xenolite, 373.
Xenotime, 528.
Xonaltite, 397.
Xylite, Xylotile, 406.
Xylochlore, 415.
Xylokryptit, *v.* Scheererite?
Xyloretinite, 742.

Yanolite, 297.
Yellow copperas, 655.
    copper ore, 65.
    lead ore, 607.
    tellurium, 81.
Yenite, 296.
Ypoléime, 568.
Ytterbite, 293.
Yttererde, Phosph., 528.
Yttergranat, 268.
Ytterflussspath, 125.
Ytterspath, 528, 710.
Yttria, Fluate, 125.
    Phosphate, 528.
    Tantalate, 519.

Yttria, Silicate, 804.
Yttrocalcit, 125.
Yttrocerite, 125.
Yttrocolumbite, *v.* Yttrotantalite.
Yttroilmenite, 519, 520.
Yttrotantalite, 519.
Yttrotitanite, 387.

Zala, *v.* Borax.
Zamtite, 710.
Zaratite, 710.
Zeagonite, 418.
Zeasite, *v.* Opal.
Zeilanite, 147.
Zellkies, 75.
Zeolite Section, 421.
Zeolite, Feather, 426.
  Foliated, 442, 444.
  Efflorescing, 399.
  Needle, 426.
  Pyramidal, 415.
  Cubic, 432, 434.
Zeugite, 553.
Zeuxite, 370.
Zeylanite, 147.
Zianite, *v.* Kyanite.
Ziegelerz, 133.
Zietrisikite, 783.
Ziguoline, 133.
Zillerthite, 234.
Zinc, Arsenate, 561.
  Carbonate, 692, 711.
  hydraté cuprifère, 570.
  Iodid and Bromid, 122.
  Native, 17.
  oxidé, 135.
  oxidé silicifère, 262.
  Oxysulphuret, 50.
  Phosphate, 544.
  Red Oxyd, 135.
  Silicate, 262, 406.
  Siliceous Oxyd, 407.
  Sulphate, 624, 647.
  Sulphid, Sulphuret, 48.
Zinc blende, 48.
Zinc bloom, 711.
Zincfahlerz, 104.
Zinc vitriol, 647.
Zinc ore, Red, 135.
Zincite, 135.
Zinconise, 711.
Zinkarseniat, 561.
Zinkazurite, 718.
Zinkblüthe, 711.
Zinkenite, 88.
Zinkglas, 407.
Zinkit, 135.
Zinkkieselerz, 407.
Zinkosite, 624.
Zinkoxyd, 135.
Zinkphyllit, 544.
Zinkspath, 692.
Zinkvitriol, 647.
Zinn, Gediegen, 17.
  Geswefeltes, 68.
Zinnerz, 157.
Zinnkies, 68
Zinnober, 55.
Zinnstein, 157.
Zinnwaldite, 314.
Zippeite, 667.
Zircon, 272.
Zirconite, 273.
Zoisite, 290, 806.
Zölestein, 619.
Zorgite, 43.
Zundererz, 91.
Zurlite, 280.
Zwieselite, 543.
Zygadite, 352.

APPENDIXES

TO

DANA'S MINERALOGY.

I—II.

APPENDIX

TO THE

FIFTH EDITION

OF

DANA'S MINERALOGY,

BY

GEORGE J. BRUSH,

PROFESSOR OF MINERALOGY IN THE SHEFFIELD SCIENTIFIC SCHOOL OF YALE COLLEGE.

COMPLETING THE WORK TO 1872.

NEW YORK:
JOHN WILEY & SONS,
15 ASTOR PLACE.
1877.

Entered according to Act of Congress, in the year 1872, by
JOHN WILEY & SON,
In the Office of the Librarian of Congress, at Washington.

PREFATORY NOTE.

THIS Appendix, prepared with the co-operation of Professor DANA, is intended as one of a series to be published from time to time. It includes descriptions of 87 minerals announced as new, and also some important facts regarding a few old species, published since the appearance of the Mineralogy in 1868.

An alphabetical arrangement is adopted for convenience of reference. The species included, arranged according to the general subdivisions in the classification of minerals, are as follows:—

1. *Native Elements.*

1. Diamond.
2. Maldonite.

2. *Sulphids*, *Arsenids*, *etc.*

3. Arsenical Cobalt, Einfach-Arsenik-Cobalt.
4. Beyrichite.
5. Diaphorite.
6. Dyscrasite: Stibiotriargentite, Stibiohexargentite.
7. Epiboulangerite.
8. Epigenite.
9. Glaucopyrite.
10. Julianite.
11. Klaprotholite.
12. Metacinnabarite.
13. Orileyite.
14. Osbornite.
15. Polyargyrite.
16. Rionite.
17. Tellurwismuthsilber.
18. Wolfachite.
19. Sylvanite.

3. *Chlorids*, *Fluorids.*

20. Nadorite, Sb, Pb, Cl, O.
21. Nantokite, Cu^2 Cl.
22. Ralstonite, Al, Fl, H.
23. Sellaite, Mg Fl.

4. *Oxyds.*

24. Chrompicotite (Spinel group).
25. Ilsemannite, $\ddot{\mathrm{Mo}}+4\dddot{\mathrm{Mo}}$.
26. Jacobsite (Spinel group).
27. Lithiophorite (near Asbolan).
28. Namaqualite (near Hydrotalcite).
29. Rabdionite.
30. Brookite.
31. Tridymite.

5. *Anhydrous Silicates.*

32. Amblystegite (Hypersthenite).
33. Aspidolite (Mica Group).
34. Asteroite (Pyroxene).
35. Barettite.
36. Bismutoferrite.
37. Hortonolite (Chrysolite Group).
38. Monzonite.
39. Roepperite (Chrysolite Group).

6. *Hydrous Silicates.*

40. Antillite (near Serpentine).
41. Aquacreptite (near Hydrophite).
42. Cyanochalcite (near Chrysocolla).
43. Diabantachronnyn (Chlorite Group).
44. Ephesite.
45. Epiphanite (near Eukamptite).
46. Euralite (near Delessite).
47. Gümbelite (near Pinite).
48. Hallite.
49. Hypochlorite.
50. Ivigtite.
51. Milarite (a Zeolite ?).
52. Næsumite.
53. Nigrescite.
54. Plumballophane.
55. Restormelite.
56. Reissite (near Monophane).
57. Taloosite.
58. Uranotil.
59. Westanite (near Wörthite).
60. Lesleyite.
61. Pattersonite.
62. Selwynite.

7. *Tantalates, Columbates.*

63. Ferroilmenite (Columbite).
64. Kochelite (near Fergusonite).

8. *Phosphates, Arsenates, etc.*

65. Andrewsite.
66. Cœruleolactite.
67. Durangite.
68. Guano Phosphates.
69. Isoclasite.
70. Kollophan.
71. Lime-Wavellite.
72. Lünebergite.
73. Montebrasite (Amblygonite).
74. Redondite.
75. Sarcopside (Triplite).
76. Trögerite.
77. Walpurgite.
78. Zepharovichite.

9. *Borates.*

79. Sussexite.
80. Winkworthite.

10. *Tungstates, Molybdates, Vanadates.*

81. Wolframite.
82. Eosite.
83. Pucherite.
84. Vanadiolite.

11. *Sulphates, Chromates.*

85. Guano Sulphates.
86. Caledonite.
87. Simonyite.
88. Laxmannite.
89. Phosphochromite.

12. *Carbonates, Oxalates.*

90. Bastnaesite (Hamartite).
91. Guano-oxalates.

13. *Carbo-hydrogen Compounds.*

92. Ambrosine.
93. Rosthornite.
94. Trinkerite.
95. Wollongongite.

APPENDIX I.[*]

---

1. *Minerals described as new species.*

411. *Antillite.*—A name given by C. U. Shepard to a substance he considers to be a hydrated bronzite. It occurs both massive and crystalline, presenting minute coppery aminæ, with a fibrous cleavage. H.=3·5–4. G.=2·52. Color dark greenish-brown. An nalysis gave $\ddot{\mathrm{Si}}$ 39·30, $\dot{\mathrm{Mg}}$ 36·12, $\dot{\mathrm{Fe}}$ 6·70, $\dot{\mathrm{H}}$ 16·79, with traces of $\dot{\mathrm{Cr}}$, $\dot{\mathrm{Ca}}$, $\dot{\mathrm{K}}$=98·91. This omposition approaches that of serpentine or deweylite. (Appendix to Catalogue of Meteortes, Amherst, Mass., January 1, 1872).

235. AMBLYSTEGITE.—*G. vom Rath*, Pogg. Ann., cxxxviii. 531.
Orthorhombic: $i\text{-}\bar{i} \wedge I = 135°\ 50'$, $i\text{-}\bar{i} \wedge 1\text{-}2 = 119°\ 26'$, $\frac{1}{4}\text{-}\breve{i} \wedge \frac{1}{4}\text{-}\bar{i} = 163°\ 47'$, $i\ \breve{i} \wedge \frac{1}{2}\ \bar{i} =$ 8 6½′. Cleavage not observed. Hardness nearly equal to quartz. G.=3·454. Lustre damantine-vitreous. Color brown to reddish-brown. Streak greenish-gray. Translucent. racture conchoidal. Analysis, G. vom Rath (l. c.):

$\ddot{\mathrm{Si}}$	$\ddot{\bar{\mathrm{A}}}\mathrm{l}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$
49·8	5·05	25·6	17·7	0·15=98·30

Only half a gram was available for analysis, and the state of oxydation of the iron was ot determined. B. B. difficultly fusible without intumescence to a black glass. Not deomposed by muriatic acid. Found at Lake Laach. Amblystegite is closely related to ypersthenite in form and chemical composition. V. v. Lang has recently discovered crysals of hypersthenite in the meteorite of Breitenbach which give the same planes as amblyegite, and vom Rath now announces (Jahrb. Min., 1871, 642) the identity of his supposed ew species with hypersthenite.

799 B. AMBROSINE. *C. U. Shepard*, Rural Carolinian, i. p. 311.
In rounded masses. Color yellowish to clove-brown. Fracture conchoidal. Lustre, sinous. Becomes electric on friction. Melts at about 460°F. to a clear yellowish liquid; ftens at a lower temperature. Gives off "succinic acid" before melting; on fusion gives an reeable balsam odor, unlike that from the resins of ordinary pines, and a dark brown nonlatile fluid remains as long as the melting heat is kept up. Combustible, leaves no ash. luble for the most part in oil of turpentine, alcohol, ether, and chloroform, as also in poth. Found in the phosphatic beds near Charleston, S. C., having originated in the eocene rmation.

ANDREWSITE. *N. S. Maskelyne*, Chem. News, xxiv. 99.
In globular disks with radiated structure resembling wavellite. G.=3·475. Color bluisheen. Composition, a hydrous phosphate of iron and copper. An average of four deternations gave 10·82 per cent. of copper; and according to Maskelyne the analyses (not en in the article quoted) "justify the formula 3 ($\ddot{\bar{\mathrm{F}}}\mathrm{e}\ \bar{\ddot{\mathrm{P}}}$, $\ddot{\bar{\mathrm{F}}}\mathrm{e}\ \dot{\mathrm{H}}^3$) + $\dot{\mathrm{C}}\mathrm{u}^3\ \bar{\ddot{\mathrm{P}}}$, in which, hower, a portion of the ferric phosphate is replaced by ferrous phosphate, as in vivianite is quently the case with the two phosphates."
ccurs in Cornwall on a quartzose veinstone associated with limonite and göthite, and erpenetrated with a mineral resembling, if not identical with, dufrenite. Requires further cription.

1 A. *Arsenical cobalt.* Under the title *Einfach-arsenik-cobalt*, Kenngott calls attention a mineral which appears to be hexagonally crystallized arsenid of cobalt, occurring with ite and quartz at Bieber (Jahrb. Min., 1869, 754).

---

[*] This appendix contains descriptions of minerals announced as new since the publication of this work in 1868. w notes are added at the end, on previously described species. It has been prepared by Prof. G. J. Brush. The k-faced figures indicate the number of the species, as arranged in the classification adopted in the Mineralogy.— r HAVEN, March 1, 1872

288 A. ASPIDOLITE.—Aspidolith, *F. v. Kobell*, Ber. Ak. München, March 6, 1869.

Orthorhombic: in prisms giving approximatively 120° and 60°. The smaller sides show reëntering angles from twinning, or an aggregation of several crystals, giving the base an oval shield-like appearance. Optically biaxial, with the divergence angle 11° 55′ for the red rays. Bisectrix normal to cleavage plane. H.=1—2. G.=2·72. Lustre pearly, submetallic. Color olive-green, in thin leaves brownish-yellow. Foliated, leaves flexible, but not elastic. An analysis afforded von Kobell:

$\ddot{\text{Si}}$	$\dddot{\text{Al}}$	$\dot{\text{Mg}}$	$\dot{\text{Fe}}$	$\dot{\text{Na}}$	$\dot{\text{K}}$	$\dot{\text{H}}$
46·44	10·50	26·30	9·00	4·77	2·52	1·33=100·86

The oxygen ratio of $\dot{\text{R}}$, $\dddot{\text{R}}$, and $\ddot{\text{Si}}$ is 14·16 : 4·91 : 24·66, or 3 : 1 : 5. The composition approaches that of a soda phlogopite.

B. B. exfoliates like vermiculite, giving water in the closed tube. In the forceps difficultly fusible to a dirty gray-white glass. Entirely decomposed by muriatic acid, leaving the silica in pearly scales.

Found in Zillerthal, in Tyrol, associated with chlorite.

238. *Asteroite*—A name given to a variety of stellate radiated pyroxene, from Nordmark, in Sweden, by L. J. Igelström (B. and H. Ztg. xxix. 8, 1870). It is ash-gray to white in color, has a silky lustre, is opaque, becomes bronze color on exposure. Analysis gave $\ddot{\text{Si}}$ 48·48, $\dot{\text{Fe}}$ 22·24, $\dot{\text{Mn}}$ 4·12, $\dot{\text{Ca}}$ 17·00, $\dot{\text{Mg}}$ 4·18, ignition 2·83=98·85. The oxygen ratio of $\dot{\text{R}}$ to $\ddot{\text{Si}}$ is 1:2. It is a pyroxene near hedenbergite, but containing a portion of the iron replaced by manganese.

415 B. AQUACREPTITE.—*C. U. Shepard*, Am. J. Sci. II. xlvii. 256.

Massive, occurring in irregular polyhedral fragments, with flat or concave surfaces. H.=2·5. G.=2·05—2·08. Lustre dull. Color yellowish-brown. Streak orange-yellow. Brittle. Adheres to the tongue. Falls to pieces in water, with a crackling noise.

Analyses—1. C. U. Shepard; 2. J. H. Eaton (l. c.):

	$\ddot{\text{Si}}$	$\dddot{\text{Al}}$	$\dot{\text{Mg}}$	$\dot{\text{Fe}}$	$\dot{\text{H}}$
1.	41·00	4·00	17·60	13·30	23·00=98·90
2.	43·03	5·56	19·58	12·30	17·40=97·87

Decomposed by muriatic acid. Found in a vein in serpentine, at Westchester, Pa. It is near hydrophite. Needs further investigation.

732 A. BASTNÄSITE. *Huot, Min.* i. 296 (1841). Basiskfluorcerium, *Hisinger*, Œf. Ak. Stockh., 1838, 189. Hamartite, *A. E. Nordenskiöld*, Œf. Ak. Stockh., 1868, 399.

The so-called basic fluorid of cerium, from Bastnäs, examined by Hisinger, has been reëxamined by A. E. Nordenskiöld, and shown to be a fluo-carbonate. As the name basic fluorid, or hydrofluocerite, conveys an incorrect idea of the composition of the mineral. Nordenskiöld gives it the new name *hamartite*, overlooking the fact that Huot had already named the mineral *bastnäsite*, after the locality.

Orthorhombic?—Found in small masses imbedded between allanite crystals. Shows distinct cleavage. H.=4. G.=4·93. Lustre greasy. Color wax-yellow.

Composition Ce F+2 ($\dot{\text{Ce}}$, La) $\ddot{\text{C}}$=$\dot{\text{La}}$ 46·15, $\dot{\text{Ce}}$ 3·87, Ce 21·12, $\ddot{\text{C}}$ 20·20, F 8·72=100. Analysis by Nordenskiöld (l. c.)—

$\ddot{\text{C}}$	La	$\dot{\text{Ce}}$	$\dot{\text{H}}$	F—O
19·50	45·77	28·49	1·01	(5·23)=100

Nordenskiöld, having shown by direct determination that but 1·01 per cent. water exists in the mineral, and that the balance of loss on ignition is carbonic acid, finds, on recalculating Hisinger's early results with this correction, a close correspondence with the above, viz., $\dot{\text{La}}$, $\dot{\text{Ce}}$, 73·59, $\ddot{\text{C}}$, $\dot{\text{H}}$ 19·11, F—O, 5·76, $\ddot{\text{Si}}$ 1·25=99·71. The direct determination of fluorine by Hisinger gave 9·95 per ct.

In the closed tube gives but little water, blackens, then becomes whitish-yellow and opaque; also gives a weak reaction for fluorine. Infusible. With acids effervesces slightly. With sulphuric acid gives off fluohydric acid, even after ignition. Found only at the Bastnäs Mine, Riddarhyttan, Sweden. The percentage composition brings this mineral near kischtimite (p. 703). It also resembles kischtimite in some of its physical characters, and further investigation may prove these minerals to be identical.

Barettite. A name given by Bombicci to a mineral from Traversella in the province of Ivrea, having the following characters:—Occurs in nodular, radiated, and fibrous masses. H.=2·5. G.=2·5. Color apple-green. Streak white. Feel soapy. Analysis gave $\ddot{Si}$ 30·00, $\dot{Ca}$ 33·70, $\dot{Mg}$ 10·00, $\dot{Fe}$ 7·20, $\ddot{\bar{Al}}$ 1·60, $\ddot{C}$ 9·1, $\dot{H}$ 1·2, with a small amount of sulphuric acid, and probably also containing phosphoric acid and alkalies. (Atti della Soc. Ital. di Sc. Nat. xi., in Jahrb. Min., 1868, 750.

66 A. BEYRICHITE. *K. Th. Liebe*, Jahrb. Min., 1871, 340.

Hexagonal? Occurring in screw-shaped groups, radiated in structure, the constituent prisms of which are about 70 mm. long and 8 mm. wide. One terminal plane makes an angle of 81° with the vertical axis; a second, rarer, inclines to the first at an angle of 144°, the angle of the rhombohedron of millerite. Cleavage rather perfect parallel to the first of these planes, and no other cleavage direction observed, so that the rhombohedral character of the crystals is not certain.

H=3—3·5. G.=4·7. Lustre metallic. Color lead-gray. Composition $3\,Ni\,S+2\,Ni\,S^2$=S 43·21, Ni 56·79=100. An analysis by Liebe gave:

S	Fe	Ni
42·86	2·79	54·23=99·88

B. B. in the closed tube decrepitates and gives a sublimate of sulphur, on charcoal fuses to a brass-yellow magnetic globule. Soluble in nitro-muriatic acid, yielding an emerald green solution.

From Lammrichs Kaul Mine in Westerwald, where it is associated with millerite.

Bismutoferrite. *A. Frenzel*, J. pr. Chem., II., iv. 355. This name has been given to a so-called hypochlorite from Schneeberg, having H.=1–2. G.=4·47, and containing $\ddot{Si}$ 23·08 $\ddot{\bar{Fe}}$ 33·33, $\ddot{\bar{Bi}}$ 43·26=99·67. Frenzel further distinguishes two varieties of hypochlorite, *antimony-hypochlorite* from Bräunsdorf, and *bismuth-hypochlorite* from Schneeberg; both of these are stated to be mixtures, and not homogeneous minerals.

189. *Chrompicotite.* *T. Petersen*, J. pr. Ch., cvi. 137.

A variety of chromite occurring in rounded octahedrons. H=8. G.=4·115. Lustre vitreous to greasy. Color black. Analysis by T. Petersen and K. Senftor (l. c.) afforded:

$\ddot{\bar{Cr}}$	$\ddot{\bar{Al}}$	$\dot{Fe}$	$\dot{Mn}$	$\dot{Co}$, $\dot{Ni}$	$\dot{Mg}$
56·54	12·13	18·01	0·46	tr.	14·08=101·22

This composition does not differ much from that of the magnesian alumina chromite from Baltimore, analyzed by Abich (Anal. 3. 4, p. 153), and that from Lake Memphramagog, examined by Hunt. If this variety is to have a new name it should have reference to chromite rather than picotite, a magnesia iron alumina spinel with only 7 per cent. of chromic oxyd. Its hardness is the chief character which favors its being classed with picotite.

From Dun Mountain, New Zealand.

554 C. COERULEOLACTITE. Cœruleolactin, *T. Petersen*, Jahrb. Min., 1871, 353.

Crypto-crystalline to micro-crystalline. Fracture uneven to conchoidal. H.=5. G.=2·552–2·593. Color milk-white passing into light copper-blue. Streak white. Composition: $\ddot{\bar{Al}}^3$, $\dddot{\bar{P}}^2+10\,\dot{H}$=$\dddot{\bar{P}}$ 36·74, $\ddot{\bar{Al}}$ 39·37, $\dot{H}$ 23·29. Analysis by Petersen (l. c.):

$\dddot{\bar{P}}$	$\ddot{\bar{Al}}$	$\ddot{\bar{Fe}}$	$\dot{Cu}$	$\dot{Zn}$	$\dot{Ca}$	$\dot{Mg}$	$\ddot{Si}$	F	$\dot{H}$
36·33	35·11	0·93	1·40	tr.	2·41	0·20	1·82	tr.	21·23=99·43

Excluding the iron (supposed to exist as limonite), the silica, and copper, lime and magnesia with sufficient phosphoric acid (=3·27 $\dddot{\bar{P}}$) to make an ortho-phosphate, and calculating the remaining constituents (89·26 p. c.) up to 100 we have for the true composition of the mineral, according to Petersen, $\dddot{\bar{P}}$ 37·04, $\ddot{\bar{Al}}$ 39·34, $\dot{H}$ 23·62, corresponding very closely with the above formula. B. B. decrepitates, infusible, on charcoal turns reddish-gray. With cobalt solution gives a deep blue. Moistened with sulphuric acid colors the flame green. With the fluxes gives a faint reaction for copper. Soluble in mineral acids, also in fixed caustic alkalies.

From the Rindsberg Mine near Katzenellnbogen, Nassau.

346. CYANOCHALCITE. *R. Hermann*, J. pr. Chem., cvi. 65.

Massive. H.=4·5. G.=2·79. Lustre glistening to dull. Color azure-blue. Fracture even and compact. Brittle. Analysis by R. Hermann:

$\ddot{\mathrm{Si}}$	$\overset{\cdot\cdot\cdot\cdot\cdot}{\not{\mathrm{P}}}$	$\dot{\mathrm{Cu}}$	$\dot{\not{\mathrm{H}}}$
26·90	6·95	49·63	16·52.

According to Hermann, this shows the composition to be equivalent to 1 atom of libethenite, and 9 atoms of chrysocolla. It is evidently a substance of like character with the demidoffite of Nordenskiöld. In the tube gives off water and becomes black. With the fluxes reacts for copper. Decomposed by acids without gelatinization.

Occurs at Nischne-Tagilsk.

452. *Diabantachronnyn.* A name given by Liebe (Jahrb. Min., 1870, 1) to a chlorite-like mineral occurring in the diabase of Voigtland and Frankenwald, and which contributes to the green color of the rock. It is found in seams and clefts, sometimes in amygdules and lining cavities in the rock. In some occurrences of diabase it forms the chief binding or cementing material, and is apparently a product of the alteration of the augitic constituent of the diabase. Compact, breaks with a conchoidal fracture, sometimes fibrous. Lustre dull. Color greenish-black, in thin splinters chrome-green. H.=2. G.=2·81–2·93. Composition, analyses by Liebe:

	$\ddot{\mathrm{Si}}$	$\dddot{\not{\mathrm{A}}}\mathrm{l}$	$\dddot{\not{\mathrm{F}}}\mathrm{e}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Mg}}$	$\dot{\not{\mathrm{H}}}$
1. Reinsdorf	30·27	11·16	——	26·94	21·22	10·20=99·79
2. Landesfreude	29·37	12·00	——	25·63	21·01	11·27=99·28
3. Höllethal	29·85	9·07	——	26·60	17·92	15·81=99·25
4. Trilloch	31·25	10·03	3·47	23·52	19·73	11·37=99·37
5. Gräfenwart (fibrous)	31·56	12·08	——	21·61	22·44	11·78=99·47

Oxygen ratio for $\dot{\mathrm{R}}$, $\dddot{\not{\mathrm{R}}}$, $\ddot{\mathrm{Si}}$, $\dot{\not{\mathrm{H}}}$ in the last analysis is 13·8 : 5·8 : 16·4 : 10·5. In the closed tube yields water. B. B. turns brown and fuses readily to a grayish-black glass, gives with salt of phosphorus reactions for iron and silica. Soluble in cold muriatic acid with deposition of pure white silica, with nitric acid gives off red nitrous fumes leaving a reddish-brown residue of silica.

113 A. DIAPHORITE. *V. v. Zepharovich*, Sitzb. Ak. Wien, lxiii. 130.

In endeavoring to ascertain the cause of the difference of the views of crystallographers in regard to the crystallization of freieslebenite, Zepharovich has discovered that the specimens referred to this species belong to two distinct crystalline systems, although chemically they are identical. He retains the name of freieslebenite for the monoclinic form, and names the new orthorhombic mineral *diaphorite*. The following planes were observed: $i\text{-}\breve{i}$, $i\text{-}\bar{i}$, $i\text{-}\breve{3}$, I, $i\breve{2}$-, $i\text{-}\breve{\tfrac{12}{5}}$, $i\text{-}\breve{3}$, $i\text{-}\breve{5}$, $i\text{-}\breve{11}$, $\frac{1}{2}\text{-}\bar{i}$, $1\text{-}\bar{i}$, $\frac{1}{2}\text{-}\breve{i}$, $1\text{-}\breve{i}$, $\frac{3}{2}\text{-}\breve{i}$, $\frac{5}{3}\text{-}\breve{i}$, $2\text{-}\breve{i}$, $4\text{-}\breve{3}$, $5\text{-}\breve{\tfrac{5}{3}}$, $\frac{1}{4}$, $\frac{1}{2}$, $1\text{-}\breve{2}$, $\frac{3}{2}\text{-}\breve{3}$, 1-4. Cleavage not observed. Fracture uneven to sub-conchoidal. H.=2·5–3. G.=5·902. (Freieslebenite G.=6·35). Lustre metallic. Color steel-gray. Brittle. An analysis of the mineral from Przibram gave Helmhacker (B. and H. Jahrb. xiii. 379):

S	Sb	Pb	Ag	Fe	Cu
20·18	26·43	28·67	23·44	0·67	0·73=100·12

corresponding closely with the earlier analysis by Payr (this Min. Anal. 4. p. 93). These analyses Zepharovich refers to diaphorite, as no freieslebenite occurs at Przibram. The pyrognostic characters of both species are the same. Diaphorite occurs at Przibram and Bräunsdorf exclusively, while at Freiberg it is found with freieslebenite. The name diaphorite was formerly used for an altered rhodonite related to allagite.

503 A. DURANGITE. *G. J. Brush*, Am. J. Sci., II. xlviii. 179, Sept., 1869.

Monoclinic. Form of crystal like that of keilhauite (p. 387), omitting O and $-2i$, and adding $4i$. Cleavage parallel to I, distinct, giving 110° 10′, J. M. Blake. H.=5. G.=3·95–4.03. Lustre vitreous. Color bright orange-red. Streak cream-yellow. Analysis, G. J. Brush (l. c.):

$\overset{\cdot\cdot\cdot\cdot\cdot}{\not{\mathrm{A}}}\mathrm{s}$	$\dddot{\not{\mathrm{A}}}\mathrm{l}$	$\dddot{\not{\mathrm{F}}}\mathrm{e}$	$\dot{\mathrm{Mn}}$	$\dot{\mathrm{Na}}$	$\dot{\mathrm{Li}}$	F—O
55·10	20·68	4·78	1·30	11·66	0·81	(5·67)=100.
53·22[a]	20·09	5·06	1·28	11·86	0·70	——

[a] Too low.

The oxygen ratio of $\dot{\mathrm{R}}$, $\ddot{\mathrm{R}}$ and $\dddot{\mathrm{A}}\mathrm{s}$ is 3·74 : 11·07 : 19·16, or nearly 1 : 3 : 5, giving the formula ($\frac{1}{4}\dot{\mathrm{R}}^3 + \frac{3}{4}\ddot{\mathrm{R}}$) $\dddot{\mathrm{A}}\mathrm{s}$, in which a portion of the oxygen is replaced by fluorine.

In the closed tube blackens at a moderate temperature, but regains its color on cooling; at a higher heat fuses easily to a yellow glass and gives a faint white volatile sublimate, etching the tube slightly. The same in the open tube, with evolution of acid fumes, reddening litmus paper. On charcoal, B. B. fuses readily and gives a white sublimate with a strong arsenical odor in R. F. With soda and charcoal powder in a matrass yields a sublimate of metallic arsenic. With the fluxes reacts for iron and manganese. In the forceps fuses at 2, giving an intense soda flame. Decomposed by sulphuric acid with evolution of fluohydric acid.

Found near Durango in Mexico. The chemical composition of this mineral places it near amblygonite, an analogous fluo-phosphate, although the form of durangite is monoclinic while amblygonite is triclinic.

35. *Dyscrasite.* *T. Petersen* (Pogg. Ann., cxxxvii. 377), in a review of the analyses of dyscrasite, endeavors to show that there are two native compounds of antimony and silver, to one of which he gives the name *stibiotriargentite* ($\mathrm{Ag}^3\ \mathrm{Sb}^2$), and the other, *stibiohexargentite* $\mathrm{Ag}^6\ \mathrm{Sb}^2$. The former has a density of 9·611–9·77, and the latter 10·027. All recorded analyses that do not give one of these formulas he considers either to be erroneous or to have been made on a mixture of the above minerals.

617 A. **EOSITE.** *A. Schrauf*, Min. Beobachtungen, ii. 20, in Sitzb. Ak. Wien, February, 1871.

Tetragonal, in minute octahedrons ($\frac{1}{2}$ mm. diam.) a : b : c=1·3758 : 1 : 1. (Basal angle of octahedron 125° 40′). Inclination of basal plane to octahedral 117° 10′. H.=3–4 Color deep aurora-red, between that of crocoite and realgar, and much darker than red wulfenite. Streak brownish orange-yellow. Heated in the closed tube darkens, but regains its color on cooling. Fused with bi-sulphate of potash gives a mass which is light yellow while hot, becomes, on cooling, first reddish-brown and finally brownish orange-yellow. This dissolved in water and boiled with tin-foil colors the solution faint greenish-blue. Not so rapidly acted upon by muriatic acid as crocoite or wulfenite. When a splinter of eosite is placed on a glass plate, and treated with muriatic acid, with subsequent addition of alcohol, and then gently evaporated, it affords a blue to bluish-green coating, with a green precipitate on the edges. From these reactions, and a series of comparative tests made with crocoite, wulfenite, and vanadinite, Schrauf concludes that eosite is vanadio-molybdate of lead. Found implanted in very minute crystals on pyromorphite and cerussite at Leadhills, Scotland.

122 A. **EPIBOULANGERITE.** *M. Websky*, ZS. G. Ges., 1869, p. 747.

Orthorhombic? occurring in striated prismatic needles G.=6·309. Lustre metallic. Color dark bluish gray, almost black. Structure granular, acicular. Analyses, 1.2, Websky (l. c.):

	S	Sb	Pb	Ni	Fe	Zn
1. Granular.	21·89	20·77	56·11	0·20	0·60	0·29=99·86
2. Needles.	21·31	20·23	54·88	0·30	0·84	1·32=98·88

Websky considers the mineral as probably a product of the decomposition of Boulangerite, from which it differs in containing more sulphur and correspondingly less antimony. Found with galena, pyrite, blende, and mispickel, at Altenberg in Silesia.

132 A. **EPIGENITE.** *T. Petersen*, Pogg. Ann., cxxxvi. 502, Arsenikkupferwismutherz, Epigenit. *Sandberger.*

Orthorhombic, observed planes, *I*, 1-ĭ, 1-ī. *I*∧1-ī=110° 50′. H.=3·5. Lustre feebly metallic. Color steel-gray. Streak black. Fracture granular.

Composition $6\mathrm{R}\ \mathrm{S} + \mathrm{As}^2\ \mathrm{S}^5$. Analysis, Petersen (l. c.):

	S	As	Fe	Cu	Bi	Ag Zn
1.	31·57	12·09	13·43	40·32	2·12	tr. =99·53
2.	32·34	12·78	14·20	40·68=100·00		

No. 2 is No. 1 after deducting the 2·12 Bi which was present as intermingled wittichenite; and as such was combined with 1·84 Cu and 0·98 S. In the closed tube gives first sulphur then sulphid of arsenic. B.B. on charcoal gives an arsenic reaction and a magnetic slag with copper globules. Soluble in nitric acid with separation of sulphur.

Occurs sparingly at Neuglück Mine in Wittichen.

289. *Epiphanite.* *Igelström*, Œfv. Ak. Stockh., 1868, p. 29. This name has been given to a chlorite-like mineral from Tväran in Wermland, Sweden. The composition Igelström found to be $\ddot{\text{Si}}$ 37·10, $\dddot{\text{Al}}$ 21·13, $\dot{\text{Fe}}$ 20·00, Mn tr, $\dot{\text{Mg}}$ 14·03, $\dot{\text{H}}$ 7·83=100·09. It approaches Kenngott's eukamptite (p. 307) and gives the same formula plus one atom of water $\dot{\text{R}}^3\ddot{\text{Si}}+\dddot{\text{Al}}\,\ddot{\text{Si}}+2\dot{\text{H}}$.

449. *Euralite.* A name given by F. J. Wiik to a chloritic mineral occurring in seams in clefts of hyperite rock in the parish of Eura, Finland. It is apparently amorphous, but breaks under the hammer into prismatic fragments. H.=2·5. G.=2·62. Color dark-green to black. B. B. fuses easily to a magnetic globule. Soluble in muriatic acid. An analysis gave $\ddot{\text{Si}}$ 33·68, $\dddot{\text{Al}}$ 12·15, $\dddot{\text{Fe}}$ 6·80, $\dot{\text{Fe}}$ 15·66, $\dot{\text{Mg}}$ 17·92, $\dot{\text{Ca}}$ 1·34, $\dot{\text{H}}$ 11·49=99·04. Wiik suggests that this composition is near delessite, which it also resembles in its mode of occurrence. (Jahrb. Min. p. 357.)

474. *Ferro-ilmenite*, a name given to a variety of columbite from Haddam, Connecticut (Hermann, J. pr. Chem., II. ii. 118).

93 A. GLAUCOPYRITE. *F. Sandberger*, J. pr. Chem., II. i. 230. Orthorhombic. Planes *i-ī*, *I*, *m-ī*. H.=4·5. G.=7·181. Lustre metallic. Color light lead-gray to tin-white. Streak grayish-black. Composition Fe S^2+12 (Fe, Co, Cu) $(\text{As, Sb})^2$=S 2·47, As 69·45 Fe 28·08. Analysis R. Senfter (l. c.):

S	As	Sb	Fe	Co	Cu
2·36	66·90	3·59	21·38	4·67	1·14=100·04

In the closed tube gives a sublimate of arsenic with only a small amount of sulphid. B. B. on charcoal gives arsenic fumes with an antimony coating. After roasting yields with soda a magnetic slag with spangles of metallic copper. With the fluxes reacts for iron and cobalt. Decomposed by nitric acid leaving a residue of antimonic acid. Found in the mines of Guadalcanal in Andalusia, Spain. Belongs near Lölingite, p. 77.

Guano Minerals. C. U. Shepard, Rural Carolinian, i. 470. The substances described occur in the guano of Guanape Island, 400 miles north-east of the Chincha Islands.

Guanapite occurs in irregular balls and veins looking like red rock-salt but having a rhombic cleavage. H.=1–2. G.=2 3. Soluble in 4–5 pts. of water at 60°. Taste bitter and saline. Analysis gave sulphate of potash 67·75, sulphate of ammonia 27·88, oxalate of ammonia 3·75=99·38. It loses ammonia on exposure to the air. Heated to redness leaves a residue of about 70 pr. ct. of sulphate of potash. It is near Taylorite (p. 614) in composition. *Guanoxalate* is stated to be a pseudomorph of birds' eggs; the specimens are exteriorly white, "and seem to retain portions of the original shell, but these when tested seemed to be a mixture of phosphate and oxalate of lime." Within the substance is foliated and has a rhombic cleavage. Color cream white; lustre pearly; translucent. H.=1–2. G.=1·58. When heated swells up, turns black, partially fuses, gives off ammonia fumes, and leaves a white residue of sulphate of potash. Composition stated to be sulphate of potash 40·20, oxalate of ammonia 29·57, water 30·46=100·23—a very doubtful compound. *Oxammite*, *phosphammite*, and *biphosphammite* are other names given by Shepard for supposed new species consisting of oxalate of ammonia, phosphate of ammonia, and biphosphate of ammonia.

422 A. GÜMBELITE. *F. von Kobell*, Ber. Ak. München, March 5th, 1870.

In thin, short fibrous layers in clay slate. Color light greenish-white. Translucent. Lustre pearly. Soft and flexible. Analysis, v. Kobell (l. c.):

$\ddot{\text{Si}}$	$\dddot{\text{Al}}$	$\dddot{\text{Fe}}$	$\dot{\text{Mg}}$	$\dot{\text{K}}$	$\dot{\text{H}}$	X[a]
50·52	31·04	3·00	1·88	3·18	7·00	1·46=98·08.

[a] Undecomposed mineral.

The oxygen ratio of $\dot{\text{R}}$, $\dddot{\text{R}}$, $\ddot{\text{Si}}$ and $\dot{\text{H}}$ is as 1 : 12 : 21 : 5, which scarcely leads to a satisfactory formula. In the closed tube yields water. B. B. exfoliates somewhat like pyrophyllite. Fuses at 4. Not acted upon by acid.

Found at Nordhalben near Steben, in Oberfranken. The composition approaches that of pinite or neurolite (p. 482).

Hallite. A name given by A. R. Leeds to a flexible micaceous mineral of a brown color occurring in Chester Co., Pa., and supposed to possess distinguishing optical properties (Jour. Frank. Inst., III. lxii. 70.)

Hamartite. See Bastnaesite.

259 A. HORTONOLITE. *G. J. Brush*, Am. J. Sci. II., xlviii. 17., July, 1869.

Orthorhombic. Observed planes *O*, *i*-ĭ, *i*-2̆, 1-ī, 1-ĭ, 1-2̆ and 1-4 (J. M. Blake, l. c.), *i*-ĭ ∧ *i*-2̆ =65° (normals) 1-4 ∧ *i*-ĭ=77°–80°, *i*-ĭ ∧ 1-2̆=69°–70°. *i*-ĭ ∧ 1-ĭ 40° 45′. Acute bisectrix perpendicular to *i*-ĭ, optic axes in a plane parallel to *O*, angle between axes 83°–86, measured in olive oil (J. M. Blake). H.=6·5. G.=3·91. Lustre vitreous, subresinous. Color yellow to yellowish-green, in large masses almost black. Composition $\dot{\mathrm{R}}^2\,\ddot{\mathrm{Si}}$. Analysis, W. G. Mixter (l. c.):

S̈i	Ḟe	Ṁn	Ṁg	Ċa	K̇	Ign.
⅔ 33·59	44·37	4·35	16·68	tr.	0·39	0·26=99·64

B. B. in the open tube and on charcoal becomes dull and magnetic. F=4. With the fluxes reacts for iron and manganese. Gelatinizes with muriatic acid.

Found in abundance at the O'Niel Mine, Orange Co., N. Y., associated with magnetite and calcite. The mineral is a member of the chrysolite group, and is intermediate between hyalosiderite and fayalite.

Hypochlorite. See Bismutoferrite.

224 A. ILSEMANNITE. *H. Höfer*, Jahrb. Min., 1871, p. 566.

Crypto-crystalline. Color blue-black to black, on exposure becoming blue. Found imbedded in barite. It is soluble in water, giving a deep-blue solution, and leaving a colorless residue of barite. The solution contained on analysis chiefly a molybdate of molybdic oxyd, and yielded on evaporation deep-blue crystals, which were considered to be the salt M̈o + 4 Mo, which is also supposed to be the composition of the mineral. Ilsemannite is a product of the decomposition of metallic molybdates, and occurs associated with wulfenite at Bleiberg in Carinthia.

431 A. IVIGTITE. *T. D. Rand*, Proc. Acad. Sci. Philad., 1868, 142.

In films and seams in massive cryolite. Granular, approaching micaceous. H.=2–2·5. G.=2·05. Color pale yellowish-green to yellow (Rand). Also in gold yellow to pale green radiated elastic plates imbedded in cryolite (Hagemann). Analyses: 1. T. D. Rand (l. c.); 2. 3. G. Hagemann, Am. J. Sci., II. xlvii. 133:

	S̈i	Ä̶l	F̶e	Ṅa	K̇	F	Ḣ
1.	36·49	24·09	7·54	16·03	—	0·75	3·42
2. Yellow	40·00	38·47		10·27	1·05	tr.	3·06
3. Green	42·82	27·03	13·06	*undet.*	*undet.*	tr.	3·93

The loss in No. 1, exclusive of fluorine, is 11·68 per cent., while the average of Nos. 2 and 3 gives a loss of almost 5 per cent. In the closed tube yields acid water, and B. B. according to Rand fuses easily, while Hagemann states that when free from cryolite it does not fuse. With the fluxes gives iron and silica reactions.

Found with pachnolite and cryolite in the Greenland cryolite. Hagemann's analysis of the green mineral, which he considers the purest variety, gives with the alkalies of No. 2 the oxygen ratio of Ṙ, R̶, S̈i and Ḣ of 1 : 6 : 8 : 1. Needs further investigation.

520 A. ISOCLASITE. Isoklas, *F. Sandberger*, J. pr. Chem., II. ii. 125.

Monoclinic. Occurring planes *I*, *i*-ì, *O*. Planes dull; crystals minute (10 mm. diam.), Associated with pseudomorphic crystals 3·7 c. m. long. Habit columnar. Clinodiagonal cleavage perfect. H.=1·5. G.=2·92. Lustre vitreous to pearly. Colorless to snow-white. Composition: Var. 1. fresh crystals; 2. altered mineral, by Köttnitz, l. c.:

	P̶	Ċa	Ṁg	Ṅa	F̶e Ä̶l	Ḣ(a)	Ḣ(b)	Ins.
1.	29·90	49·51		—	——	2·06	18·53	——=100·0
2.	34·00	1·00	17.30	9·80	0·36	24·26	9·22	0·18=96·12

(a) at 100° C., (b) on ignition.

The fresh crystals give the formula $\dot{\mathrm{C}}\mathrm{a}^3\,\overline{\mathrm{P}} + \dot{\mathrm{C}}\mathrm{a}\,\dot{\mathrm{H}} + 4\dot{\mathrm{H}}$. Analogous in composition to tagilite, but containing more water.

In the closed tube both varieties give off neutral water. B. B. the fresh mineral glows and fuses. Soluble in muriatic acid.

Found with hornstone and brown-spar on specimens from Joachimsthal, obtained eighty years ago, and now in the Würzburg Museum.

188 A. JACOBSITE. *A. Damour*, C. R., lxix. 168.

Isometric, in distorted octahedrons, H.=6? (scratches glass). G.=4·75. Lustre brilliant metallic. Color deep black. Streak blackish-brown. Magnetic.

Composition: $\dot{\mathrm{R}}$, $\dddot{\overline{\mathrm{R}}}$, or ($\dot{\mathrm{Mn}}$ $\dot{\mathrm{Mg}}$) ($\dddot{\overline{\mathrm{Fe}}}$ $\dddot{\overline{\mathrm{Mn}}}$)

$\dddot{\overline{\mathrm{Fe}}}$	$\dot{\mathrm{Mn}}$	$\dot{\mathrm{Mg}}$
‡ 68·25	24·35	6·41=99·01

As the mineral evolves chlorine feebly when acted upon by muriatic acid, Damour considers a portion of the manganese to exist as $\dddot{\overline{\mathrm{Mn}}}$, giving for the true composition of the mineral, in correspondence to the spinel formula, $\dddot{\overline{\mathrm{Fe}}}$ 68·25, $\dddot{\overline{\mathrm{Mn}}}$ 4·21, $\dot{\mathrm{Mn}}$ 20·57, $\dot{\mathrm{Mg}}$ 6·41=99·44.

B. B. infusible. It does not lose weight when ignited. With the fluxes reacts for iron and manganese. Soluble in muriatic acid, with a slight evolution of chlorine.

From Jacobsberg, in Nordmark, Sweden, where it occurs associated with white mica and native copper in a crystalline limestone

127 A. JULIANITE. *M. Websky*, ZS. G. Ges., 1871, p. 486.

Isometric. Cubic with octahedral and dodecahedral planes. Also dodecahedral. Planes much rounded.

G.=5·12. Very soft. Lustre metallic-adamantine. Color dark, somewhat reddish lead-gray, iron black on exposure. Brittle. Fracture splintery to subconchoidal.

Analysis by Websky (l. c.):

S	As	Sb	Fe	Ag	Cu
26·50	16·78	1·42	0·79	0·54	52·30=98·33

Giving a composition approaching tennantite or enargite. It agrees with the former in crystalline form, but differs in density from both these species.

B. B. Same as tennantite. Found in the Frederick-Julian Mine at Rudelstadt, in Silesia.

121 A. KLAPROTHOLITE. Klaprothit, *Petersen* and *Sandberger*, Jahrb. Min., 1868, 415. Klaprotholite, *G. J. Brush.*

This name is given to the Kupferwismutherz analyzed by Schneider, and recorded in this Mineralogy under Wittichenite, p. 99, anal. 7. Sandberger gives the following characters:—Orthorhombic, habit in long furrowed prisms. Planes I, i-$\bar{i}$, m-$\bar{i}$; $I \wedge I=107°$. Cleavage i-$\bar{i}$ very distinct. In twins, composition-face I. Fracture granular. H.=2·5. G.=4·6 approx. (Petersen). Lustre metallic. Color steel-gray inclining to yellow, tarnishing brass-yellow. Streak black. Composition, $3\,\overline{\mathrm{Cu}}\,\mathrm{S}+\mathrm{Bi}^2\,\mathrm{S}^3$=S 19·22, Bi 55·54, Cu 25·24=100. The mean of three analyses by Petersen gave, on mineral from the Daniel Mine, S 18·66, Bi 53·87, Cu 23·96, Fe 1·70=98·19. Occurs at many localities in the Black Forest, and distinguished from wittichenite by its distinct cleavage, and in its larger content of bismuth. Klaprotholite is generally associated with a cobalt-tetrahedrite, while wittichenite is usually found with smaltite. The name klaprothite was given to lazulite by Beudant in 1824, we therefore change Petersen's name to klaprotholite.

483 A. KOCHELITE. *M. Websky*, ZS. G. Ges., xx. 250, 1868.

Tetragonal? In columnar incrustations passing into rounded, apparently square octahedrons, occasionally showing prismatic planes. Color brownish isabella-yellow to honey-yellow. Translucent. Lustre dull greasy. H.=3–3·5. G.=3·74, taken on 0·'373 grm.

Composition. An imperfect analysis gave $\ddot{\mathrm{Si}}$ 4·49, $\dddot{\overline{\mathrm{Al}}}$ 1·41, $\overset{.....}{\mathrm{Cb}}$ 29·49, $\ddot{\mathrm{Zr}}$ 12·81, $\ddot{\mathrm{Th}}$ 1·23, $\dot{\mathrm{Y}}$ 17·22, $\dot{\mathrm{Ca}}$ 2·10, $\dddot{\overline{\mathrm{U}}}$ 0·43, $\dddot{\overline{\mathrm{Fe}}}$ 12·48, $\dot{\mathrm{H}}$ 6·52, $\dot{\mathrm{Pb}}$? $\dot{\mathrm{Na}}$? Loss 11·82=100.

In the closed tube yields water, and the mineral turns reddish. B. B. in the forceps fuses only on the edges to a black glass, coloring the flame yellow. With salt of phosphorus reacts for iron, but in R. F. fuses to a clear bead, showing only a faint reaction for uranium. With soda on charcoal yields a yellowish-white enamel, but no metallic globules, although giving a lead coating on the coal. Occurs as an incrustation upon a mixture of titanic iron and crystals of fergusonite in a coarse granite in the Kochelwiesen, near Schreiberhau in Silesia.

The composition is near that of fergusonite, but further investigation is needed. The density is remarkably low for a mineral containing so large a percentage of metallic acids.

518 A. *Kollophan.* This name has been given by Sandberger to a gymnite-like looking substance found with Sombrero guano. It is a tri-basic phosphate of lime with one atom of water, mixed with about 8 per cent. of carbonate of lime. G.=2·70. H.=5. J. pr. Chem., II. ii. 129.

644 A. LAXMANNITE. *A. E. Nordenskiöld*, Pogg. Ann., cxxxvii. 299, 1869.

Monoclinic. C.=69° 46′. $a:b:c=1{\cdot}3854:0{\cdot}7400:1$. Occurs in wedge-shaped forms with sharp edges. H.=3. G.=5·77. Color dark olive-green to pistachio-green and greenish-gray. Streak pistachio-green. Fracture, crystalline to compact and earthy. Composition $(\frac{2}{3}\dot{\text{C}}\text{u}+\frac{1}{3}\dot{\text{H}})^3\,\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\text{P}}}+3\,(\dot{\text{P}}\text{b},\dot{\text{C}}\text{u})^2\,\dddot{\text{C}}\text{r}=\dot{\text{P}}\text{b}\ 61{\cdot}48,\ \dot{\text{C}}\text{u}\ 13{\cdot}13,\ \dddot{\text{C}}\text{r}\ 16{\cdot}57,\ \overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\text{P}}}\ 7{\cdot}83,\ \dot{\text{H}}\ 0{\cdot}99=100$. Analyses 1. 2. Nordenskiöld (l. c.):

	$\dddot{\text{C}}\text{r}$	$\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\text{P}}}$	$\dot{\text{P}}\text{b}$	$\dot{\text{C}}\text{u}$	$\dddot{\bar{\text{F}}}\text{e}$	$\dot{\text{H}}$
1.	15·26	8·05	61·26	12·43	1·09	1·31=99·40
2.	16·76	8·57	61·06	10·85	1·28	0·90=99·42

Hermann has reviewed these results (J. pr. Chem., II. i. 447), and called attention to the close correspondence of this species in physical characters with vauquelinite, and also to the fact that the analyses were made on material from the very specimens from which Berzelius obtained the vauquelinite. By assuming that what Berzelius weighed as chromic acid was really phosphate of chromium, the results of the analysis are made to approximate very closely to those of Nordenskiöld; and Hermann believes that laxmannite is probably identical with vauquelinite. But Nordenskiöld shows in his investigation that there is associated with laxmannite a chromate free from phosphoric acid corresponding to the vauquelinite of Berzelius.

Hermann has also analyzed a phospho-chromate from Beresof, to which he gives the name *phosphochromite*, a mineral resembling *laxmannite* in physical characters, but containing

	$\dddot{\text{C}}\text{r}$	$\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\text{P}}}$	$\dot{\text{P}}\text{b}$	$\dot{\text{C}}\text{u}$	$\dot{\text{F}}\text{e}$	$\dot{\text{H}}$
G.=5·80	10·13	9·94	68·33	7·36	2·80	1·16=99.72

This mineral occurs in rounded masses of half a pound weight, made up of globular particles, which exteriorly are covered with small tabular crystals with rounded terminations. It would seem possible that this aggregate might be a mixture rather than a distinct species; and this may perhaps also be true in regard to laxmannite. A chromo-phosphate of lead and copper from the same locality was described by John (this Min., p. 631) as early as 1845, but was thought to be an impure vauquelinite.

554. *Lime-Wavellite.* Kalkwavellit, *Kosmann*, Z. G. Ges., xxi. 795 (1869).

This name has been given to a mineral occurring in concentric radiated spherical and hemispherical aggregations, sometimes in acicular crystals, as binding material in phosphorite-breccia; also found botryoidal and reniform. G.=2·45. Lustre feeble. Color white. Analysis, Kosmann (l. c.):

$\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\text{P}}}$	$\dddot{\bar{\text{A}}}\text{l}$	$\dddot{\bar{\text{F}}}\text{e}$	$\dot{\text{C}}\text{a}$	$\dot{\text{M}}\text{g}$	$\dot{\text{N}}\text{a}$	$\dot{\text{K}}$	$\dot{\text{H}}$	$\ddot{\text{S}}\text{i}$	$\ddot{\text{C}}$	Ca Fl
24·10	30·26	0·29	16·16	0·12	3·58	0·89	17·90	3·59	2·78	0·37=100·04

Considering the carbonic acid to exist as carbonate of lime, and assuming the silica combined with the alkalies, Kosmann takes the remainder of the constituents $\dot{\text{C}}\text{a}$ 12·62, $\dddot{\bar{\text{A}}}\text{l}$ 30·26, $\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\text{P}}}$ 24·11, and $\dot{\text{H}}$ 17·90=84·88, and averages them up to 100 pts. as follows, $\dot{\text{C}}\text{a}$ 14·86, $\dddot{\bar{\text{A}}}\text{l}$ 35·65, $\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\text{P}}}$ 28·39, $\dot{\text{H}}$ 21·09=99·99, from which composition he concludes that the mineral is a *lime-wavellite.* In the closed tube yields water. B. B. fuses on the edges. Decomposed by muriatic acid with separation of gelatinous silica.

Found with phosphorite at Dehrn and Ahlbach. Needs further examination to determine its exact chemical composition.

218 D. LITHIOPHORITE (*Breithaupt*). *A. Frenzel*, J. pr. Chem., II. ii. 203 and iv. 353.

This is the substance already noticed by v. Kobell (Ber. Ak. München, Jan. 8, 1870, p. 49) as a lithia manganese ore in an examination of a so-called Asbolan from Saalfeld. Occurs in fine scales, also compact, botryoidal, H.=3. G.=3·65 (v. Kobell) 3·14—3.36 (Frenzel). Lustre dull to metallic. Color bluish-black. Streak blackish-gray. Composition: 1. 2. C. Winckler, J. pr. Chem., II. iv. 353.

	$\bar{\text{F}}\text{e}$	$\ddot{\bar{\text{A}}}\text{l}$	Mn	$\dot{\text{C}}\text{u}$	$\dot{\text{C}}\text{o}$, $\dot{\text{N}}\text{i}$		$\dot{\text{B}}\text{a}$	$\dot{\text{L}}\text{i}$	$\dot{\text{K}}$	O	$\dot{\text{H}}$	Ins	
1.	1·48	10·54	55·12	1·74	2·42		2·78	1·23	0·73	10·28	12·64	—	=98·96
2.	2·43	15·53	49·87	0·96	0·64	0·30	1·26	1·42	1·50	7·77	15·42	3·08	=100·18

with traces of lime and bismuth. G. of No. 1=3·36, both specimens were from Schneeberg Saxony. In a partial analysis v. Kobell obtained (l. c.) $\ddot{\text{M}}\text{n}$ 54·00, $\dot{\text{C}}\text{o}$ 4·00, $\dot{\text{C}}\text{u}$ 0·61, $\ddot{\bar{\text{A}}}\text{l}$ 23·00 $\dot{\text{H}}$ 13.4.

Gives water in the tube. Infusible, colors the flame carmine-red. With the fluxes reacts for manganese; with salt of phosphorus in R. F. gives reactions for copper and cobalt. Soluble in muriatic acid with evolution of chlorine.

Found associated with quartz in many localities in the Schneeberg mining district, also occurs at Sayn, and near Siegen. Supposed to be a product of the decomposition of psilomelane. The large percentage of alumina and its content of lithia distinguish it readily from asbolite and lampadite.

598 A. *Lüneburgite.* C. Nöllner. Ber. Ak. München, 1870, 291.

This name has been applied by Nöllner to a salt from Lüneburg having the following composition: $\bar{\text{P}}$ 29·8, $\dddot{\text{B}}$ 12·7, $\dot{\text{M}}\text{g}$ 25·3, $\dot{\text{H}}$ 32·2=100. It also contains 0·7 Fl. Nöllner gives as formula for this substance (2 $\dot{\text{M}}\text{g}$, $\dot{\text{H}}$) $\bar{\text{P}}$ + $\dot{\text{M}}\text{g}$ $\dddot{\text{B}}$ + 7 $\dot{\text{H}}$. No physical characters are stated.

1 A. MALDONITE. *G. H. F. Ulrich*, Contrib. to Mineralogy of Victoria, 1870, (pamphlet 32 pp. 8vo.).

In small particles in quartz, cleavage apparently cubical. H.=1·5–2. G.=8·2–9·7 (made on less than one grain of impure mineral). Color pinkish-white, but tarnishing on exposure to copper-color and then black. Malleable. An assay by C. Newbery showed the composition to be Au 64·5, Bi 35·5. or nearly Au^2 Bi. B. B. fuses easily; on charcoal coats the coal yellow and yields a globule of gold.

From Nuggety Reef, Maldon.

64 A. METACINNABARITE. *G. E. Moore*, J. pr. Chem. II. ii. 319 (1870). Am. J. Sci. III. iii. 36.

Amorphous, also found in small apparently isometric crystals, perhaps pseudomorphic. H.=3. G.=7·70–7·748. Lustre metallic. Color grayish-black. Streak black. Fracture sub-conchoidal, uneven. Very brittle. Composition: Hg S. Analyses 1. 2., G. E. Moore (l. c.):

	S	Hg	Fe	quartz
1.	13·79	85·69	0·33	0·26=100·07
2.	13·84	85·89	0·45	0·24=100·42

Blowpipe characters like cinnabar. Occurs at the Redington Mine, Lake Co., California, with cinnabar, quartz and marcasite. It differs from cinnabar in its amorphous character, in color, streak, specific gravity and lustre, while in these respects it is identical with the black artificial mercuric sulphide of the laboratory.

MILARITE. *A. Kenngott*, Jahrb. Min., 1870, 81.

Hexagonal. Occurring form a hexagonal prism with a plane of a hexagonal pyramid on each angle, and a narrow termination of the lateral edges; observed angle over a terminal edge of the pyramid 144° 46½′ (mean of results), and over a basal edge 74° 40′; the latter gives for the former, by calculation, 144° 42′.

H.=5·5–6. Lustre vitreous. Colorless to greenish, resembling the datholite crystals from Bergen Hill. Brittle. B. B. in the closed tube becomes white and gives off water. In the forceps fuses with intumescence to a white blebby glass. In salt of phosphorus slowly but completely soluble to a colorless glass. A partial qualitative analysis gave evidence of the presence of an alkali and besides probably lime. Kenngott considers it a zeolitic hydrous silicate of alumina, lime, and soda, but on uncertain evidence.

Found in Val Milar near Rueras, Switzerland.

503. *Montebrasite.* *Des Cloizeaux*, C. R. lxxiii. 306, 1247. *L. Moissenet*, Ann. d. Mines, VI x. 1 (1871). *F. Pisani*, C. R. lxxiii, 1479. *F. von Kobell*, Ber. Ak., München. Feb. 3, 1872

This supposed fluo-phosphate from Montebras in France has recently been shown by Pisani and von Kobell to be identical with amblygonite. Des Cloizeaux found it to be triclinic, with two cleavages giving 105° 44′, and in the optical examination the bisectrix of the acute angle was positive, while in the Hebron amblygonite it is negative. Analyses by Moissenet (1), Pisani (2), and v. Kobell (3) afforded:

	F	$\overset{\cdot\cdot\cdot\cdot\cdot}{\text{P}}$	$\overset{\dots}{\text{Al}}$	$\overset{\dots}{\text{Mn}}$	$\dot{\text{Ca}}$	$\dot{\text{Na}}$	$\dot{\text{Li}}$	$\ddot{\text{Si}}$	Ign.	
1.	26·50	21·80	38·20	—	2·00	6·70	6·50	2 25	0·60=104·55.	M
2.	8·20	46·15	36·32	0·40	—	2·58	8·10	—	1·10=102·85.	P
3.	9·00	45·91	35·50	—	0·50	5·30	6·70	0·60	0·70−104·21.	K.

Pisani's and v. Kobell's results give essentially the composition of amblygonite as analyzed by Rammelsberg, and as the physical and pyrognostic characters are also those of amblygonite, there can be no question as to the identity of the Montebras mineral with this species.

MONZONITE. *F. v. Kobell*, Ber. Ak. München, 6 May, 1871.

Compact. H.=6. G.=3. Color light grayish-green. Translucent on thin edges. Fracture splintery to sub-conchoidal. Resembles green hornstone. Analysis by v. Kobell (l. c.):

$\ddot{\text{Si}}$	$\overset{\dots}{\text{Al}}$	$\dot{\text{Fe}}$	$\dot{\text{Mg}}$	$\dot{\text{Ca}}$	$\dot{\text{Na}}$	$\dot{\text{K}}$	$\dot{\text{H}}$
52·60	17·10	9·00	2·10	9·65	6·60	1·90	1·50=100·45

Giving the oxygen of $\dot{\text{R}}$, $\overset{\dots}{\text{R}}$, and $\ddot{\text{Si}}$ as 1 : 1 : 3·5.

B. B. fuses at 3 to a lustrous grayish-green glass. Not decomposed by acids after fusion. Not attacked by muriatic or sulphuric acids. Soluble in concentrated phosphoric acid.

Found on the Monzoni Mt. in the valley of Fassa, Tyrol. A microscopic examination of a thin plate of the mineral showed it to be homogeneous.

Næsumite. *C. W. Blomstrand*, Œf. Ak. Stockh., 1868, p. 197.

A chalk-white mineral, from Näsum, Sweden. It occurs mixed with the phosphate attacolite. After calculating out the phosphoric acid as $\overset{\dots}{\text{Al}}$ $\overset{\cdot\cdot\cdot\cdot\cdot}{\text{P}}$, the analysis gave $\ddot{\text{Si}}$ 50·91, $\overset{\dots}{\text{Al}}$ 27·86, $\overset{\dots}{\text{Fe}}$ 1·36, $\dot{\text{Mn}}$ 0·36, $\dot{\text{Ca}}$ 13·82, $\dot{\text{H}}$ 4·39=98·70. The oxygen ratio of $\dot{\text{R}}$, $\overset{\dots}{\text{R}}$, $\ddot{\text{Si}}$, $\dot{\text{H}}$ is as 1 : 3 : 7 : 1. It may perhaps be classed near fahlunite.

510. NADORITE. *Flajolot*, C. R., lxxi. 237, 406. *F. Pisani*, C. R., lxxi. 319; *Des Cloizeaux*, Ann. d. M., VI. xx. 32, 1871.

In flattened tabular orthorhombic crystals, $I \wedge I=132°\ 51'$. Cleavage macrodiagonal, very easy. H.=3. G.=7·02. Lustre resinous to adamantine. Color smoky-brown to brownish-yellow. Streak yellow. Translucent. Analyses: 1. Pisani (l. c.); 2. Flajolot (l. c.):

	Sb	Pb	O	Cl
1.	31·24	51·89	8 14	9·00=100·27
2.	32·25	51·60	8·00	8·85=100·70

Pisani considers the mineral to correspond to the formula $\overset{\dots}{\text{Sb}}$ $\dot{\text{Pb}}$ + Pb Cl, while Flajolot looks upon it as a compound of oxychlorid of antimony with oxyd of lead. Pisani suggests its analogy with mendipite 2 $\dot{\text{Pb}}$ + Pb Cl.

In the closed tube decrepitates and gives a white sublimate. B. B. on charcoal yields an antimony coating and a globule of metallic lead. Added to a bead of salt of phosphorus saturated with copper gives the blue coloration of the flame due to chlorid of copper. Soluble in muriatic acid; also in nitric acid diluted with tartaric acid.

From Djebel-Nador, in the province of Constantine, Algiers.

214 A. NAMAQUALITE. *A. H. Church*, Jour. Chem. Soc., II., viii. 1 (1870).

In silky fibres and thin layers. H.=2·5. G.=2·49. Lustre silky. Color pale-blue. Transparent to translucent. Analysis by Church (l. c.):

$\overset{\dots}{\text{Al}}$	$\dot{\text{Cu}}$	$\dot{\text{Mg}}$	$\dot{\text{Ca}}$	$\ddot{\text{Si}}$	$\dot{\text{H}}$
15·29	44·74	3·42	2·01	2·25	32·38=100·09

Giving the oxygen ratio of $\dot{\text{R}}$, $\overset{\dots}{\text{R}}$ and $\dot{\text{H}}$ as 4 : 3 : 11, or 4 $\dot{\text{R}}$ $\dot{\text{H}}$ + $\overset{\dots}{\text{Al}}$ $\dot{\text{H}}^3$ + 4 $\dot{\text{H}}$.

In the closed tube gives off water and turns black. B. B. reacts for copper.

From Namaqualand, S. Africa. It is analogous in composition to hydrotalcite (p. 178).

146 A. NANTOKITE. An anhydrous sub-chlorid of copper from Nantoko in Chile. Occurs in a copper vein with atacamite and oxydized ores at the surface, while lower down in the vein this anhydrous chlorid is found with chalcopyrite and chalcocite. The mineral is white, resembles cerussite in physical characters. It oxydizes on exposure to the atmosphere, and is converted into atacamite. W. Hermann considers all atacamite the product of the alteration of nantokite (*Breithaupt* in B. and H. Ztg. xxvii. 3).

247 D. NIGRESCITE. *F. Hornstein*, ZS. G. Ges., 1867, 342.

Amorphous. Fracture uneven and splintery. H.=2. G.=2·845. Color, when fresh, apple-green; on exposure becomes gray to black; opaque and earthy, and, on drying, as ligh as wad. Loses 16·5 per cent. hygroscopic water.

Analysis:

	$\ddot{\text{Si}}$	$\dddot{\bar{\text{Al}}}$	$\dot{\text{Fe}}$	$\dot{\text{Mn}}$	$\dot{\text{Mg}}$	$\dot{\text{Ca}}$	$\dot{\text{H}}$
§	52·29	5·14	15·71	0·23	18·11	2·59	6·29=100·36

Perhaps the product of the alteration of a magnesia-iron augite or amphibole.

Found in rounded masses in basalt, at Dietesheim, in the valley of the Maine.

Orileyite. *D. Waldie*, Proc. Asiatic Society, Bengal, p. 279. September, 1870.

Massive. H.=5·5. G.=7·34—7·42. Color steel-gray, on fresh fracture with purplish tint. Lustre metallic. Streak dark-gray. Analysis, D. Waldie (l. c.):

As	Sb	Cu	Fe	X	Insol.
38·45	0·54	12·13	42·12	6·19	0·12=99·55

X, oxydized matters soluble in dilute muriatic acid = $\dot{\text{Cu}}$ 1·21, $\dot{\text{Fe}}$ 1·97, $\dot{\text{Pb}}$ 1·89, $\dddot{\bar{\text{As}}}$ 1·12=6·19. B. B. in the closed tube yields no arsenic. Soluble in nitric acid.

From Burmah, but exact locality not known. Needs further investigation.

Osbornite.—This name has been given by Maskelyne to small gold-yellow octahedrons occurring in augite in a meteorite from Busti, India. It is supposed to be an oxysulphid of titanium and calcium.

Phosphorchromite. See Laxmannite.

374. *Plumballophane.* A name given by Bombicci to a plumbiferous allophane from Monte Vecchio in Sardinia. Occurs in small stalactitic cylinders, rough and opaque on the surface, but interiorly glassy. Color grayish-yellow with a white streak. H.=2·5. G.=1·9. Analysis gave $\ddot{\text{Si}}$ 23·8, $\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\text{P}}}$ 2·6, $\dddot{\bar{\text{Al}}}$ 32·9, $\dddot{\bar{\text{Fe}}}$ 0·5, $\dot{\text{Ca}}$ 2·4, $\dot{\text{H}}$ 35·2, $\dot{\text{Pb}}$, $\dot{\text{Mg}}$ and alkalies 2·5=99·9 (Atti della Sc. Ital. di Sc. Nat. xi., in Jahrb. Min. 1868, p. 750.

40 C. POLYARGYRITE. *F. Sandberger*, Jahrb. Min., 1869, 311. *T. Petersen*, Pogg. Ann., cxxxvii. 386. 1869.

Isometric. Observed planes 1 *O i*, *m-m*. Cleavage cubic. H.=2·5. G.=6·974. Lustre metallic. Color iron-black to dark blackish-gray. Streak black to blackish-gray. Malleable, flattening more under the hammer than argentite.

Composition: 12 Ag S + Sb_2S_3=Ag. 78·16, Sb 7·37, S 14·47=100·00.

Analysis, Petersen (l. c.):

	S	Sb	Ag	Pb	Fe	Zn
§	14·78	6·98	76·70	tr.	0·36	0·27*=99·09

* Corrected.

B. B. on charcoal fuses easily to a black globule, giving off antimony fumes, and yielding a brittle globule of silver. Soluble with difficulty in nitric acid with separation of sulphur. Fuming acid dissolves it readily with separation of antimonate of silver.

Occurs at Wolfach in Baden.

The mineral is between argentite and pyrargrite in composition. If homogenous it would be classified chemically near polybasite; but its isometric form, and the fact that in another analysis Petersen found 78·85 Ag, suggests that it may possibly be a mixture.

624. PUCHERITE. *A. Frenzel*, J. pr. Chem., II. iv. 227, 361.

Orthorhombic. Observed planes *I*, *O*, 1-*ĭ*, *m-u*. Cleavage basal. H.=4. G.=5·91. Lustre vitreous adamantine. Color reddish-brown. Streak yellow. Translucent to opaque. Composition: $\dddot{\bar{\text{Bi}}}$ $\overset{\cdot\cdot\cdot\cdot\cdot}{\text{V}}$=$\dddot{\bar{\text{Bi}}}$ 71·67 $\overset{\cdot\cdot\cdot\cdot\cdot}{\text{V}}$ 28·33=100. Analyses, 1. 2. Frenzel (l. c.):

	$\overset{\cdot\cdot\cdot\cdot\cdot}{\text{V}}$	$\dddot{\bar{\text{Bi}}}$
1.	27·31	73·39=100·70
2.	27·07	72·93=100 —

In the closed tube decrepitates. B. B. on charcoal fuses and gives a coating of bismuth-oxyd, with soda yields a globule of metallic bismuth. With salt of phosphorus a chrome-green bead in R. F. becoming light yellow in O. F. (vanadium). Soluble in muriatic acid with evolution of chlorine to a deep-red solution, which on dilution becomes green and deposits a yellow basic chlorid.

Named pucherite from the locality, the Pucher Mine, Schneeberg, Saxony. Found associated with bismite and asbolite.

218 E. RABDIONITE. *F. von Kobell*, Ber. Ak. München, January 8, 1870.

Stalactitic, in columnar or rod-like forms. Very soft, soiling the fingers. G.=2·80. Lustre dull, after rubbing is greasy to submetallic. Color black. Streak dark-brown. Composition:

$\dddot{\bar{\text{Fe}}}$	$\dddot{\bar{\text{Mn}}}$	$\dddot{\bar{\text{Al}}}$	$\dot{\text{Cu}}$	$\dot{\text{Mn}}$	$\dot{\text{Co}}$	$\dot{\text{H}}$
45·00	13·00	1·40	14·00	7·61	5·10	13·50=99·61

The oxygen ratio of $\dot{\text{R}}$: $\dddot{\bar{\text{R}}}$: $\dot{\text{H}}$ is 1 : 3 : 2, and v. Kobell writes the formula ($\dot{\text{Cu}}$, $\dot{\text{Mn}}$, $\dot{\text{Co}}$) ($\dddot{\bar{\text{Fe}}}$, $\dddot{\bar{\text{Mn}}}$) + 2 $\dot{\text{H}}$.

In the closed tube gives neutral water. B. B. fuses at 3 to a steel-gray, magnetic-globule, and colors the flame green. With borax gives a cobalt blue bead. Soluble in muriatic acid with evolution of chlorine, giving an emerald-green colored solution.

From Nischne Tagilsk in Ural. The mineral is near asbolite (p. 181), but differs from it in chemical composition, in containing a large percentage of iron, and in being easily fusible.

163 A. RALSTONITE. *G. J. Brush*, Am. J. Sci., III. ii. 30. July, 1871.

Isometric. Habit octahedral. Observed planes 1, *O* (this Min. fig. 7, p. 21). H.=4·5. G.=2·4 (on 25 milligrams). Composition, a hydrous fluorid of aluminum, with possibly small quantities of calcium and sodium.

In the closed tube whitens, yields water at first, then a copious white sublimate which etches the tube. The water reacts acid. B. B. on charcoal a faint white sublimate. In the forceps whitens, colors the flame yellow, but does not fuse. With cobalt solution gives a deep blue. In salt of phosphorus dissolves completely to a colorless bead in both flames. Soluble with effervescence in a carbonate of soda bead. Decomposed by sulphuric acid with evolution of fluohydric acid.

Occurs with cryolite and thomsenolite at Arksut Fiord, Greenland.

Redondite. A name given by C. U. Shepard to a hydrous phosphate of alumina and iron 'rom Redonda, W. I. Found in nodular aggregations. Translucent to opaque. Color graysh to yellowish white. H.=3·5. G.=1·90–2·07. Specimen analyzed contained 8·8 per ent. $\ddot{\text{Si}}$, 40·192 $\bar{\text{P}}$ and 24·73 $\dot{\text{H}}$ (Am. J. Sci. II. l. 96). An earlier analysis gave $\bar{\text{P}}$ 43·20, e 14·40, $\dddot{\bar{\text{Al}}}$ 16·60, $\dot{\text{H}}$ 24·00, $\ddot{\text{Si}}$ 1·60, $\dot{\text{Ca}}$ 0.57=100·37, contained also traces of $\dddot{\text{S}}$, Na, Cl, nd $\dot{\text{Mg}}$. B. B. infusible. Heated with solution of cobalt gives a deep blue color (Am. J. ci., II. xlvii. 428.

422. *Restormelite.* A name given by A. H. Church (Jour. Chem. Soc. II. viii. 166) to a nassive grayish-green agalmatolite-like mineral from Restormel Mine in Cornwall. H.=2. .=2·58. Mean results of analysis gave $\ddot{\text{Si}}$ 45·66, $\dddot{\bar{\text{Al}}}$ 35·10, $\dot{\text{Fe}}$ 1·11, $\dot{\text{Mg}}$ 0·85, $\dot{\text{K}}$ 2·30, $\dot{\text{Na}}$ ·39, $\dot{\text{H}}$ 11·68=101·09. This composition is near that given by Lehunt and Blythe for killiite (anal. 29 and 30, under pinite, p. 481). Church does not consider the mineral worthy to ank as a distinct species, but speaks of it as an "*immature* kaolinite."

261 A. ROEPPERITE. Iron, manganese, zinc, chrysolite. *W. T. Roepper*, Am. J. Sci., . 1. 35. Roepperite, *G. J. Brush*.

Orthorhombic, observed planes i-2, i-$\breve{i}$, 1-$\bar{i}$, i-$\bar{i}$, 1-$\breve{i}$, 1-$\breve{4}$, *O*, 2-2. i-2 ∧ i-2 (over i-$\bar{i}$) 130°, i-$\breve{i}$ i-2=115° 1-$\bar{i}$ ∧ 1-$\bar{i}$=77°. Cleavage in three directions rectangular, *O* and i-$\breve{i}$ eminent, i splintery. H.=5·5–6. G.=3·95–4·08. Lustre on cleavage planes vitreous to sublamantine. Color dark-green to black, mottled. In thin splinters translucent and paleellow color. Streak yellow to reddish-gray. Slightly magnetic. Composition: $\dot{\text{R}}^2\ddot{\text{Si}}$. $\dot{\text{R}}$:$\dot{\text{Fe}}$, $\dot{\text{Mn}}$, $\dot{\text{Zn}}$ and $\dot{\text{Mg}}$. Analyses 1. 2. 3., W. T. Roepper (l. c.):

	$\ddot{\text{Si}}$	$\dot{\text{Fe}}$	$\dot{\text{Mn}}$	$\dot{\text{Zn}}$	$\dot{\text{Mg}}$	Insol.*
1. Cryst.	30·76	33·78	16·25	10·96	7·60	——=99·35
2. Cryst. ½	30·23	35·52	16·91	10·68	5·63	1·04=100.01
3. Mass. ½	30·54	34·78	17·74	9·48	6·09	2·02=100·65

* Spinel.

B. B. fuses with difficulty on the thin edges to a black slag. With the fluxes reacts for n, manganese, and silica; on charcoal with soda gives a zinc coating. Gelatinizes with ids readily and completely, leaving sometimes a bright-green residue of spinel.

Occurs at Stirling Hill, Sussex Co., N. J., with willemite, franklinite, jeffersonite, and inel; also found at Franklin Furnace with gahnite.

393 A. *Reissite.* A name given by K. v. Fritzsch to a zeolitic mineral from Santorin. According to Hessenberg (his Min. Notizen, No. 9, p. 22) it is orthorhombic with the axial relation for the brachydiagonal, macrodiagonal, and vertical axis. 0·4231 : 1 : 0·2866. Observed planes *I*, *i*-ī, 1-ī, 2-2̄. Cleavage brachydiagonal. Lustre vitreous. Colorless to white. Fusible with intumescence to a blebby enamel. Gelatinizes with acids more readily after fusion than before. The solution contains lime and alkalies. Hessenberg considers it probable that reissite is identical with Breithaupt's species monophane, and distinct from epistilbite.

125. *Rionite.* A name given by Brauns to a bismuth-tetrahedrite from Cremenz, Einfischthal in Wallis Canton, Switzerland. It has a conchoidal fracture, an iron-black color, black streak, and greasy-metallic lustre. An analysis gave S 29·10, As 11·44, Sb 2·19, Bi 13·07, Cu 37·52, Ag 0·04, Fe 6·51, Co 1·20=101·07. Found associated with chalcopyrite. It is worked as an ore of bismuth. The composition places it near annivite, p. 103. (T. Petersen in Jahrb. Min., 1870, 590).

The name *Rionite* was used formerly for a supposed selenid of zinc, described by Del Rio, and *Riolite* for a supposed selenid of silver as well as the preceding, but both names have been dropped from the science, the material on which they were founded being only a mixture.

807 A. ROSTHORNITE. *H. Höfer*, Jahrb. Min., 1871, p. 561.

In lenticular masses in coal. G.=1·076. Lustre greasy. Color brown, with garnet-red reflections: in thin splinters wine-yellow. Composition : $\mathrm{C}_{24}\,\mathrm{H}_{40}\,\mathrm{O}$. Analysis by Mitteregger (l. c.):

	C	H	O
§	84·42	11·01	4·57=100·00

At 96°C. commences to melt to a viscous brownish-red mass, which at 160° gives off bubbles and at 205° white fumes, heated to 225° the evolution of gas ceases, leaving a thin dark purplish-red fluid. Insoluble in dilute nitric acid as also in potash or alcohol. Slightly soluble in warm ether and entirely so in warm oil of turpentine. Completely soluble in benzole at ordinary temperatures. From Sonnberge, Carinthia. Resembles jaulingite in physical characters, while it is near euosmite in chemical composition.

499. SARCOPSIDE. Sarkopsid, *M. Websky*, ZS. G. Ges., xx. 245, 1868.

Monoclinic? occurring in irregular ellipsoids, sometimes in distorted six-sided plates.

H.=4. G.=3·692–3·730. Lustre glistening to silky and greasy. Color, on fresh surface, flesh-red to lavender-blue. Translucent in thin splinters. Streak straw-yellow, some grains give a green color. Composition : $4\dot{\mathrm{R}}^{3}\,\ddot{\overline{\mathrm{P}}} + (\mathrm{R}\ \mathrm{Fl} + \overline{\overline{\mathrm{R}}}\ \dot{\mathrm{H}})$ Websky :

	$\ddot{\overline{\mathrm{P}}}$	$\ddot{\overline{\mathrm{F}}}\mathrm{e}$	$\dot{\mathrm{F}}\mathrm{e}$	$\dot{\mathrm{M}}\mathrm{n}$	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\mathrm{H}}$	Fl
§	34·73	8 83	30·53	20·57	3·40	(1·64)	undet.

In the closed tube gives water which reacts for fluorine, turns dark-brown and assumes a sub-metallic lustre. Fuses very easily, may be melted to a bead on platinum wire, and this imparts a blue-green color to the outer flame. With the fluxes reacts for iron and manganese, and fused with bi-sulphate of potash in a closed tube reacts for fluorine, coloring brazil-wood paper and etching the tube. Soluble in dilute muriatic and sulphuric acids.

Occurs with vivianite and hureaulite in a granite vein on a ridge between Michelsdorf and the valley of the Mühlbach in Silesia. This mineral corresponds so closely to triplite (p. 543) in chemical composition and pyrognostic characters, as also in density and hardness, as to make it exceedingly probable that it may be a variety of that species.

163 B. SELLAITE. *Strüver*, Atti della R. Accad. di Torino, iv. 1868, 35.

Tetragonal, *I* on 1=123° 30′, *i-i* on *i*-3 161° 34′. Cleavage parallel to *I* and *i-i* perfect. H.=5. G.=2·972. Lustre vitreous. Fracture conchoidal. Colorless. Transparent. Composition : MgFl? In small fragments melts in the flame of a candle with intumescence. Insoluble in water, also in acids, except concentrated sulphuric acid, with this it evolves fluohydric acid. The sulphuric solution gave 39·64 pr. ct. of magnesia, which with the other chemical and physical properties of the mineral leads Strüver to consider the mineral a fluorid of magnesium analogous to fluorite in composition.

Found with anhydrite at Geibroula in Piedmont.

659 A. SIMONYITE. *G. Tschermak*, Ber. Ak. Wien, November Heft, 1869.

Monoclinic. Ratio of orthodiagonal, clinodiagonal, and vertical axis 1 : 0·7453 · 0·5041 ; inclination of axis$=C=101°\ 29'$. Observed planes *I*, *O*, *i*-2, 1, 1-*i*. $I \wedge I=105°\ 15'$, $O \wedge 1\text{-}i=146°\ 28'$, $O \wedge 1=142°\ 5'$, $I \wedge i\text{-}2=160°\ 34'$. Crystals minute. Also massive. H.$=2{\cdot}5$. G.$=2{\cdot}244$. Color of the massive mineral bluish-green to reddish-yellow. The crystals sometimes colorless and transparent. Taste faint, saline, and bitter. Unaltered on exposure to the air.

Analysis: G. Tschermak (l. c.):

$\dddot{\text{S}}$	$\dot{\text{Mg}}$	$\dot{\text{Na}}$	$\dot{\text{H}}$
47·17	12·65	18·86	21·82=100·50

This yields the oxygen ratio for $\dot{\text{R}} : \dddot{\text{S}} : \dot{\text{H}}$, 1 : 3 : 2 or $\dot{\text{R}}\,\dddot{\text{S}} + 2\dot{\text{H}}$, the same as the formula given for Blœdite (p. 643), which mineral it also resembles in crystalline form. Tschermak remarks that simonyite differs from blœdite in not efflorescing on exposure to air, and losing only a portion of its water (4·90 pr. ct.) on being heated for two hours in a water-bath. Occurs at Hallstadt.

A mineral of the same composition and form, likewise unalterable in air, found at Stassfurth, has been referred by Groth and Hintze to blœdite, these authors assuming that the efflorescence of blœdite, noticed by earlier observers, was due to mixture with some efflorescent salt. ZS. G. Ges. 1871, 870.

Stibiotriargentite, *Stibiohexargentite*, see Dyscrasite.

595 A. SUSSEXITE. *G. J. Brush*, Am. J. Sci., II. xlvi. 140, 240, 1868.

In fibrous seams or veins. H.$=3$. G.$=3{\cdot}42$. Lustre silky to pearly. Color white with a tinge of pink or yellow. Translucent.

Composition: $(\dot{\text{Mn}}, \dot{\text{Mg}})^2\,\dddot{\text{B}} + \text{H}$ or $(\frac{2}{3}\,(\dot{\text{Mn}}, \dot{\text{Mg}}) + \frac{1}{3}\,\dot{\text{H}})^3\,\dddot{\text{B}}$. Analysis: G. J. Brush (l. c.):

$\dddot{\text{B}}$	$\dot{\text{Mn}}$	$\dot{\text{Mg}}$	$\dot{\text{H}}$
31·89	40·10	17·03	9·59=98·61

In the closed tube darkens in color and yields neutral water. If turmeric paper is moistened with this water, and then with dilute muriatic acid, it assumes a red color (boric acid). In the forceps fuses in the flame of a candle (F=2), and B. B. in O. F. yields a black crystalline mass, coloring the flame intensely yellowish-green. With the fluxes reacts for manganese. Soluble in chlorhydric acid.

Found on Mine Hill, Franklin Furnace, Sussex Co., N. J., associated with franklinite, zincite, willemite, and other manganese and zinc minerals. This species approaches in composition the mineral szaibelyite.

TALCOSITE. *G. H. F. Ulrich*, Contributions to the Mineralogy of Victoria, Melbourne, 1870 (pamphlet of 32 pp. 8vo.).

In thin seams and threads with scaly structure, the scales apparently rhombic plates. H. $=1-2$. G.$=2{\cdot}46-2{\cdot}5$. Lustre pearly. Color silver-white, faint greenish, or yellowish. Scales flexible but not elastic. Resembles talc. Analyses 1. 2 by C. Newbery (l. c.):

	$\ddot{\text{Si}}$	$\dddot{\bar{\text{A}}}\text{l}$	$\dddot{\bar{\text{C}}}\text{r}$	$\dot{\text{Fe}}$	$\dot{\text{Mg}}$	$\dot{\text{Na}}$	$\dot{\text{H}}$
1.	49·01	45·10	tr.	tr.	tr.	tr.	4·98=99·09
2.	49·07	46·96	tr.	tr.	tr.	tr.	3·73=99·76

The oxygen ratio of anal. 1 for $\dot{\text{H}}$, $\dddot{\bar{\text{A}}}\text{l}$, $\ddot{\text{Si}}$ is 1 : 5 : 6. This mineral is perhaps related to selwynite, with which it occurs, and also to westanite (described in this appendix).

Obs. From Mount Ida near Heathcote, Victoria.

Tellurwismuthsilber. *C. Rammelsberg*, ZS. G. Ges., xxi. 81.

Granular. G.$=7{\cdot}803$. Lustre metallic. Color gray, tarnished. Cuts with a knife, but sufficiently brittle to be readily pulverized. Composition: analysis by Rammelsberg, l. c.:

S	Te	Bi	Ag	Cu
3·32	24·10	48·50	23·35	tr.=99·27

Rammelsberg gives the relation of S : Ag : Bi : Te as 1 : 2·08 : 2·24 : 1·8, but thinks it may be more correctly expressed by 1 : 2 : 2 : 2, as the bismuth obtained was not free from ellurium, and the formula of this new tellurium mineral may then be written $\text{Ag}^2\,\text{S} + \text{Bi}^2\,\text{Te}^2$ or $\text{Ag}^2\,\text{S} + 2\,\text{Bi Te}$?. He also questions whether the mineral may not be a mixure of argentite and tellurid of bismuth, or of native silver and sulphotellurid of bismuth, but finds nothing in the physical properties of the mineral to indicate a mixture.

Obs. From Sierra de Tapalpa, Mexico.

817 A. TRINKERITE. *G. Tschermak*, J. pr. Chem., II. ii. 258, and Jahrb. G. Reichs., 1870, xx. 279.

Compact and amorphous. H.=1·5—2. G.=1·025. Lustre greasy. Color hyacinth-red to chestnut-brown. Transparent to translucent. Analysis, 1. Hlasiwetz (l. c.); 2. Niedzwiedzki, Jahrb. Min., 1871, 641:

	C	H	S	O	Ash
1. Carpano	81·1	11·2	4·7	3·0	None=100
2. Gams	81·9	10·9	4·1	3·1	——=99·0

Fuses at 168°—180°C., at a higher temperature gives off choking fumes. Insoluble in water, and only slightly in alcohol and ether. Soluble in hot benzole.

Occurs in large compact masses in brown coal at Carpano near Albona in Istria; also found at Gams near Hieflau in Styria. Resembles in composition the tasmanite of Church (p. 746).

573 B. TRÖGERITE. *A. Weisbach*, Jahrb. Min., 1871, 870.

Monoclinic, in thin tabular crystals. Cleavage perfect, parallel to the broad tabular plane. G.=3·3. Lustre on the cleavage-plane pearly. Color lemon-yellow. Composition, $\dddot{\mathrm{U}}^3 \overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{As}}{}^2 + 20\,\dot{\mathrm{H}}$ (Winckler). No analysis is given. Occurs with walpurgite and other uranium minerals at the Weisser Hirsch Mine in Neustädtel near Schneeberg, Saxony.

URANOTIL. *E. Boricky*, Jahrb. Min., 1870, 780.

Orthorhombic, in acicular crystals. Occurring form *I*, *i*-$\breve{\imath}$, *m*-$\breve{\imath}$; angle of prism *I* about 164° (Zepharovich). In radiated or stellated groups. Cleavage probably basic. G.=3·9595. Color lemon-yellow. Streak lighter. The mean of three analyses gave Boricky:

$\ddot{\mathrm{Si}}$	$\dddot{\mathrm{U}}$	$\underbrace{\dddot{\mathrm{Al}}\ \dddot{\mathrm{Fe}}}$	$\dot{\mathrm{Ca}}$	$\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{P}}$	$\dot{\mathrm{H}}$
13·78	66·75	0·51	5·27	0·45	12·67=99·43

Giving a composition near that of uranophane (p. 805). It also resembles it in crystalline form, the angle of prism *I* of uranophane 146°, giving 162° for the prism *i*-2.

B. B. turns black. Soluble in warm muriatic acid with separation of flocky silica.

Found with fluorite, uranite, and quartz at Wölsendorf, Bavaria.

622 B. VANADIOLITE. *Hermann*, J. pr. Chem., II. i. 445.

Form not determined. Occurs in small crystals, partly in druses. Color dark-green, almost black, in small fragments dark emerald-green. Streak grayish-green. Lustre vitreous, brilliant. G.=3·96. Analysis gave

$\ddot{\mathrm{Si}}$	$\dddot{\mathrm{Al}}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Mg}}$	$\dddot{\mathrm{V}}$
15·61	1·10	1·40	34·43	2·61	44·85=100.00

which Hermann considers as representing a compound of three atoms of augite, and one of subvanadate of lime. He gives for this the formula $3\dot{\mathrm{R}}\,\ddot{\mathrm{Si}} + \dot{\mathrm{Ca}}^6\,(\mathrm{VO}^4 + 2\mathrm{VO}^5)$. B. B. fuses to a black slag with cauliflower-like intumescences. With salt of phosphorus gives a dark-green bead, and a silica skeleton. Decomposed on fusion with a mixture of carbonate of soda and nitre. From Slüdänka near Lake Baikal associated with lavroffite.—A substance containing as this does over 70 per cent. of a vanadate, with the balance a silicate corresponding to augite can scarcely be looked upon as a homogeneous simple mineral. It is here classed with the vanadates.

573 A. WALPURGITE. Walpurgin, *A. Weisbach*, Jahrb. Min., 1871, 870.

Monoclinic, in thin scaly crystals. G.=5·8. Lustre adamantine to greasy. Color pomegranate and wax-yellow. Composition $\dddot{\mathrm{R}}^4\,\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{As}} + 5\dot{\mathrm{H}}$ in which $\dddot{\mathrm{R}} = \frac{4}{5}\,\dddot{\mathrm{Bi}} + \frac{1}{5}\,\dddot{\mathrm{U}}$ (Winckler). No analysis is given. Occurs with trögerite and other uranium ores at the Weisser Hirsch Mine in Neustädtel near Schneeberg, Saxony.

323 A. WESTANITE. *C. W. Blomstrand*, Œf. Ak. Stockh., 1868, p. 197, in J. pr. Ch., cv. 341.

In radiated crystalline masses, sometimes in prismatic crystals. H.=2·5. Color brick red. An analysis gave:

$\ddot{\mathrm{Si}}$	$\dddot{\mathrm{Al}}$	$\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{P}}$	$\dddot{\mathrm{Fe}}$	$\dot{\mathrm{H}}$
(42·53)	51·14	1·15	1·01	4·17=100·00
42·91	$\underbrace{\qquad}_{51·92}$		1·56	——

This composition is near wörthite, a hydrous fibrolite, but it differs from that mineral in inferior hardness.

B. B. swells up; infusible and turns white. Not acted upon by acids.

Associated with pyrophyllite at Westana, Sweden.

601 A. WINKWORTHITE. *H. How*, Phil. Mag., April, 1871.

In imbedded nodules, crystalline on fracture. Glistening. Colorless to white. Translucent. H.=2—3. Composition: analyses 1. 2., H. How, l. c.:

	$\ddot{\mathrm{Si}}$	$\dddot{\overline{\mathrm{B}}}$	$\dddot{\mathrm{S}}$	$\dot{\mathrm{Ca}}$	$\dot{\overline{\mathrm{H}}}$
1.	3·31	(10·13)	36·10	31·66	18·80=100
2.	4·98	(14·37)	31·51	31·14	18·00=100

In the closed tube gives water. B. B., decrepitates and fuses readily to a clear bead, coloring the flame green; on continued blowing froths, becomes opaque and no longer shows the green coloration.

Found in gypsum at Winkworth, Nova Scotia. How considers No. 1 to be represented by 11 $\dot{\mathrm{Ca}}$, 1$\ddot{\mathrm{Si}}$, 9$\dddot{\mathrm{S}}$, 3$\dddot{\overline{\mathrm{B}}}$ and 20$\dot{\overline{\mathrm{H}}}$, while No. 2 is the same with substitution of 8$\dddot{\mathrm{S}}$ and 4$\dddot{\overline{\mathrm{B}}}$. He suggests that the mineral is intermediate between selenite and howlite. May it not be a mixture?

92 A. WOLFACHITE. *F. Sandberger*, Jahrb. Min., 1869, 313.

T. Petersen, Pogg. Ann. cxxxvii. 397. Orthorhombic, in small crystals coating niccolite Observed planes *I*, *m*-ĭ. H.=5·5. G.=6.372. Lustre metallic. Color silver-white to tin-white. Streak black. Analysis by Petersen (l. c.):

S	As	Sb	Pb	Ag	Fe	Ni	Co, Cu, Zn
14·43	38·46	13·17	1·32	0·12	3·71	29·53	traces=100.74

The lead and silver were believed to be due to a small amount of intermingled galena and dyscrasite. The results give the formula $\mathrm{Ni\,S^2 + Ni\,(As\,Sb)^2}$ exactly the same as given for the isometric corynite (p. 74), showing this compound to be dimorphous. Corynite has a lower density (5·95—6·03) and less hardness (4·5—5.). The pyrognostic characters are the same for both minerals and both are soluble in nitric acid. From Wolfach in Baden.

830 B. *Wollongongite.* *B. Silliman*, Am. J. Sci., II. xlviii. 85.

This name has been given provisionally to a hydro-carbon from New South Wales. Occurs in cubical blocks, without lamination. Fracture broad conchoidal. Color greenish to brownish-black. Lustre resinous. Translucent in thin shavings, showing under the microscope an amber-yellow light.

Alone in the tube does not melt but decrepitates and gives off oil and gas. Ignites readily and yields, when heated out of access of air, 82·5 volatile matter, coke 6·5, and when burned 11·0 per cent of ash. Insoluble in ether and benzole, but slightly acted upon by bi-sulphid of carbon.

550 A. ZEPHAROVICHITE. *E. Boricky*, Sitzb. Ak. Wien, lix. 593, 1869.

Crystalline to compact, horn-like in aspect. H.=5·5. G.=2·37. Color greenish, yellowish or grayish-white. Translucent. Fracture conchoidal. Composition:

	$\overset{\cdot\cdot\cdot\cdot\cdot}{\overline{\mathrm{P}}}$	$\dddot{\overline{\mathrm{Al}}}$	$\dddot{\overline{\mathrm{Fe}}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Mg}}$	$\dot{\overline{\mathrm{H}}}$	Quartz
1.	35·56	29·77	——	1·07	0·41	26·70	5·46=98·97
2.	37·46	28·44	——	0.54	tr.	26·57	6 05=99·06
3.	37·80	29·60	0·85	1·38	——	28·98	0·46=99.07

Nos. 1 and 2 contained intermingled wavellite, and No. 3 an earthy gibbsite. Boricky thinks the analyses prove the mineral to be essentially a phosphate having the formula $\dddot{\overline{\mathrm{Al}}}\,\overset{\cdot\cdot\cdot\cdot\cdot}{\overline{\mathrm{P}}} + 6\dot{\overline{\mathrm{H}}}$, and that in analysis 2 this phosphate is mixed with $\frac{1}{17}$ of wavellite, while in No. 3 is associated with $\frac{1}{10}$ of gibbsite and $\frac{1}{33}$ of tribasic phosphate of lime. The formula $\dddot{\overline{\mathrm{Al}}}\,\overset{\cdot\cdot\cdot\cdot\cdot}{\overline{\mathrm{P}}} + 6\dot{\overline{\mathrm{H}}}$ differs from Callainite (p. 572) only in containing 1 atom more of water, and analysis 2, after deduction of the 6·04 of quartz, gives $\overset{\cdot\cdot\cdot\cdot\cdot}{\overline{\mathrm{P}}}$ 40·28, $\dddot{\overline{\mathrm{Al}}}$ 30·57, $\dot{\mathrm{Ca}}$ 0·58, $\dot{\overline{\mathrm{H}}}$ 28·56, a result which approaches the figures given by Damour in his analysis of callainite.

Occurs in sandstone at Trenic in Bohemia.

2. *Notes on a few previously described species.*

198. *Brookite.* A. Schrauf announces that his recent crystallographic studies have proved brookite to be monoclinic and isomorphous with wolframite (Jahrb. Min., 1871, 163).

636. *Caledonite.* Schrauf has found this species to be monoclinic in crystallization. He makes $a \wedge m = 132° 32'$, and $a \wedge c = 90° 30'$, a, m, c, being the planes so lettered in Miller's Mineralogy, and corresponding, a to $i\text{-}\bar{i}$, m to I, and c to O, in this work. (Jahrb. Min., 1871, 374.)

Ephesite, see Lesleyite below.

24. *Diamond.* P. v. Jeremejew has discovered minute crystals of diamonds irregularly distributed through plates of xanthophyllite from the Schischimskian Mountains near Slatoust. They are readily recognized when magnified 30 diameters, and with 200 diameters their crystalline form is seen to be that of the hexa-tetrahedron 3-$\frac{3}{2}$ combined with the tetrahedron, the first four being distinctly convex, while the tetrahedral plane is flat (like fig. 59 p. 21, except that there are also small flat tetrahedral planes). Most of the crystals are colorless. They are symmetrically disposed in their matrix, their trigonal intermediate axes being vertical to the foliation of the xanthophyllite. The green plates of this mineral, nearest the rounded masses of the talcose slate and serpentine enclose unusually large numbers of them and they are likewise found in the two rocks themselves. Jahrb. Min., 1871, p. 275 in Am. J. Sci., III. iii. 57.

Lesleyite. The mineral named lesleyite by I. Lea (see p. 800) has been analyzed by S. P. Sharples (Am. J. Sci., II. xlvii. 319) and J. L. Smith (ib. xlviii. 254). Sharples examined two varieties, one white (anal. 1), and the other red (anal. 3). Smith analyzed the white mineral (anal. 2).

	$\ddot{\mathrm{Si}}$	$\dddot{\overline{\mathrm{Al}}}$	$\dddot{\overline{\mathrm{Fe}}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Na}}$	$\dot{\mathrm{K}}$	$\dot{\mathrm{H}}$
1 white,	33·59	55·41	tr	——	tr	7·43	4·30=100·73
2 "	31·18	55·00	——	0·45	1·20	7·28	4·80=99.91
3 red,	47·00	33·27	2·84	——	——	9·97	6·71=99.79

The analysis of the red variety was made under Sharples's direction by C. W. Roepper. It is an entirely different substance from the white mineral, and was properly referred to pinite by Sharples.

Smith compares the composition of the white variety with that of his ephesite (see Min., p. 507) of which he gives the following new analysis.

	$\ddot{\mathrm{Si}}$	$\dddot{\overline{\mathrm{Al}}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Na}}$	$\dot{\mathrm{K}}$	$\dot{\mathrm{H}}$
Ephesite	30·70	55·67	2·55	5·52	1·10	4·91=100.45

There is also a very close correspondence in the physical as well as in the chemical characters of the two minerals, and they are evidently closely related. Lesleyite is found associated with diaspore and both minerals have a peculiarity in regard to their hardness that suggests a want of homogeneity. They are easily scratched with a knife, but they both contain particles which scratch topaz. Under the magnifier they both present glistening scales which are soft and apparently micaceous. It is evident that the minerals are mixtures of corundum and probably diaspore with a mica similar to the damourite found at the lesleyite locality; and that the foliated soft mineral is damourite or a hydrous mica near that species.

Pattersonite. This substance, classed temporarily under the mica group in the supplement to this mineralogy (p. 801), has been analyzed by S P. Sharples with the following results (Am. J. Sci, II. xlvii. 309).

$\ddot{\mathrm{Si}}$	$\dddot{\overline{\mathrm{Fe}}}$	$\dddot{\overline{\mathrm{Al}}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Na}}$ $\dot{\mathrm{Li}}$	$\dot{\mathrm{K}}$	$\dot{\mathrm{H}}$
30·20	14·88	20·55	1·28	tr	11·35	11·73=89.99

The potash is stated to have been determined by the difference (loss), but the analysis foots up, exclusive of the potash, only 78·64 leaving 21·36 for potash instead of 11·35. This large error runs through the calculated oxygen ratios, and hence is not typographical. In view of it, the analysis leads to no satisfactory conclusion. The percentages of silica, iron, alumina and water are very near those of prochlorite.

463. *Schwynite.* Ulrich now regards this species as belonging to the *pinite* group (Contrib. Min. Victoria, p. 24).

98. *Sylvanite.* Schrauf's recent crystallographic researches makes this species orthorhombic in crystallization. He says that he has observed the twins described by Kokscharof; and that the angles and planes are given rightly by Miller; and that he has observed 17 new planes. (Jahrb. Min., 1871, 394.)

Tridymite. This new variety of silicic acid, discovered by v. Rath (p. 805, this Min.) in Mexican porphyry, has been found in many localities in Europe; it is especially well characterized in the trachyte of Drachenfels and in the orthoclase-porphyry of Waldböckelheim.

610. *Wolframite.* Des Cloizeaux has shown that this species is monoclinic in crystallization. C. R. lxix. 868.

SECOND APPENDIX

TO THE

FIFTH EDITION

OF

DANA'S MINERALOGY,

BY

EDWARD S. DANA,

CURATOR OF THE MINERALOGICAL DEPARTMENT OF THE PEABODY MUSEUM, YALE COLLEGE.

COMPLETING THE WORK TO 1875.

NEW YORK:
JOHN WILEY & SONS,
15 ASTOR PLACE.
1877.

Entered according to Act of Congress, in the year 187[illegible],

By J. D. DANA,

In the Office of the Librarian of Congress, at Washington.

PREFATORY NOTE.

THIS Second Appendix to Dana's Mineralogy, prepared with the co-operation of the author, is designed to make the work complete up to January, 1875.

It includes descriptions of all species announced as new within the past seven years, with the exception of those contained in Appendix I., prepared by Prof. Brush. The names of the latter are, however, also included, with such new facts in regard to them as have been brought out since 1872.

In addition, references are given under the name of each species to all important articles relating to it that have appeared since the publication of the Mineralogy early in 1868. On account of the limited space and time at command, the work, in this latter respect, is, however, little more than an index, yet the attempt has been made to indicate so far as possible the character of each article—*i. e.*, whether it contains a description of crystals (*cryst.*), or an analysis (*anal.*), or a discussion of the chemical composition (*comp.*). Whenever new facts of special importance have been made known in regard to any species, this is noted at somewhat greater length.

An alphabetical arrangement has been adopted for convenience of reference. A list of the more important of recent mineralogical works is added, and also the titles of some memoirs which, owing to their general character, seemed to require a special mention.

For the explanation of *abbreviations*, see Dana's Min., pp. xxxv.-xlv. The black-faced figures, prefixed to names of new species, are intended to indicate their position as arranged in the classification adopted in the Mineralogy: it is not to be understood that these species are necessarily varieties of those near which they are thus made to stand.

NEW HAVEN, March, 1875.

LIST OF MINERALOGICAL WORKS.

CRYSTALLOGRAPHY.

Frankenheim. Zur Krystallkunde, vol. i., 212 pp. 8vo, Leipzig, 1869.

Müller. Grundzüge der Krystallographie, 2d Ed., 64 pp. 8vo, Brunswick, 1868.

Quenstedt. Grundriss der bestimmenden und rechnenden Krystallographie, 443 pp. 8vo, Tübingen, 1873.

Sadebeck. Gustav Rose's Elemente der Krystallographie, 3d Ed., 181 pp. 8vo, Berlin, 1873.

Schrauf. Lehrbuch der physikalischen Mineralogie, vol. i., 253 pp. 8vo, 1866. Vol. ii., 426 pp. 8vo, Vienna, 1868.

DETERMINATIVE MINERALOGY.

Brush. Manual of Determinative Mineralogy, with an introduction on Blowpipe Analysis, 176 pp. 8vo, New York, 1875.

Elderhorst's Manual of Qualitative Blowpipe Analysis, edited by *H. B. Nason* and *C. F. Chandler*, 6th Ed., 312 pp. 8vo, Philadelphia, 1874.

Frazer. Tables for the Determination of Minerals, translated from the German of Weisbach, 117 pp. 8vo, Philadelphia, 1875.

Fuchs, C. W. C. Anleitung zum Bestimmen der Mineralien, 144 pp. 8vo, Heidelberg, 1868.

Helmhacker. Tafeln zur Bestimmung häufig vorkommender Mineralien mittelst der einfachsten Versuche, 66 pp. 8vo, Vienna, 1873.

Von Kobell. Tafeln zur Bestimmung der Mineralien, 10th Ed., 108 pp. 8vo, Munich, 1873.

Laube. Hülfstafeln zur Bestimmung der Mineralien, 53 pp. 12mo, Prague, 1872.

Plympton. The Blowpipe. A guide to its use in the determination of salts and minerals, 167 pp. 8vo, New York, 1874.

Senft. Analytische Tabellen zur Bestimmung der Mineralien und Gebirgsarten, 102 pp. 8vo, Hannover, 1874.

DESCRIPTIVE MINERALOGY.

1868.

Senft. Die krystallinischen Felsgemengtheile, nach ihren mineralischen Eigenschaften, etc., 752 pp. 8vo, Berlin.

Websky. Die Mineral-Species nach den für das specifische Gewicht derselben angenommenen und gefundenen Werthen, 170 pp. 4to, Breslau.

1869.

Adam. Tableau Mineralogique, 102 pp. 4to, Paris.

Grimm. Die Lagerstätten der nutzbaren Mineralien, 233 pp. 8vo, Prague.

Senft. Lehrbuch der Mineralien und Felsartenkunde, 656 pp. 8vo, Jena.

Schrauf. Handbuch der Edelsteinkunde, 252 pp. 8vo, Vienna.

1870.

HÖFER. Die Mineralien Kärnthens, 84 pp. 8vo, Klagenfurt.

KOKSCHAROW. Materialien zur Mineralogie Russlands, vol. v., 397 pp. 8vo, St. Petersburg, 1869. Vol. vi., 208 pp., 1870.

LANDGREBE. Mineralogie der Vulkane, 396 pp. 8vo, Cassel and Leipzig.

SMITH, J. A. Catalogue of the Principal Minerals of Colorado, 16 pp. 8vo, Central City.

ULRICH. Contributions to the Mineralogy of Victoria, 32 pp. 8vo, Melbourne.

1871.

CHAPMAN. The Minerals and Geology of Central Canada, 205 pp. 8vo, Toronto.

COLLINS, J. H. Handbook to the Mineralogy of Cornwall and Devon, 182 pp. 8vo, London.

KENNGOTT. Lehrbuch der Mineralogie, 208 pp. 8vo, Darmstadt.

VON KOBELL. Die Mineralogie, leichtfasslich dargestellt, 4th Ed., 272 pp., Leipzig.

1872.

BRUSH, G. J. Appendix I. to Dana's Mineralogy, 5th Ed., 19 pp. 8vo, New York.

EGLESTON. Lectures on Mineralogy delivered at the School of Mines, Columbia College, 80 pp. 8vo, New York.

FUCHS. Die künstlich dargestellten Mineralien nach G. Rose's krystallo-chemischem Mine alsysteme geordnet, 174 pp. 4to, Haarlem.

1873.

D'ACHIARDI. Mineralogia della Toscana, vol. i, 276 pp., 1872. Vol. ii., 402 pp. 8vo, Pisa.

VON DECHEN. Die nutzbaren Mineralien und Gebirgsarten im Deutschen Reiche, 806 pp. vo, Berlin.

FISCHER. Kritische mikroskopisch-mineralogische Studien, 64 pp. 8vo, Freiburg, i. Br., 69. Erste Fortsetzung, 64 pp., 1871. Zweite Fortsetzung, 96 pp., 1873.

HESSENBERG. Mineralogische Notizen, No. viii., 46 pp. 4to, Frankfort, 1868, No. ix., 68 ., 1870, No. x., 44 pp, 1871, No. xi., 35 pp., 1873.

PAYOT. Geologie et Mineralogie des environs du Mont Blanc.

ROSENBUSCH. Mikroscopische Physiographie der petrographisch wichtigen Mineralien, 8 pp. 8vo, Stuttgart.

SCHRAUF. Atlas der Krystall-Formen des Mineralreiches, II. Lief., Tf. xi.–xx., Vienna, 71 ; III. Lief., Tf. xxi.–xxx., 1872 ; IV. Lief., Tf. xxxi.–xl., 1873.

VON ZEPHAROWICH. Mineralogisches Lexikon für das Kaiserthum Oesterreich, vol. ii., 6 pp. 8vo, Vienna.

ZIRKEL. Die mikroscopische Beschaffenheit der Mineralion und Gesteine, 502 pp. 8vo, ipzig.

1874.

BEHRENS. Die Krystalliten. Mikroskopische Studien über verzögerte Krystall-Bildung, 5 pp. 8vo, Kiel.

BLUM. Lehrbuch der Mineralogie (Oryktognosie), I., Abth., 4th Ed., 256 pp. 8vo, Stutt-rt, 1873 ; II. Abth., 257–642 pp.

DES CLOIZEAUX. Manuel de Minéralogie, Tome Second, 1er Fasc., 208 pp. 8vo, Paris.

DOMEYKO. Mineralojia de Chile, Segundo Apéndice, 52 pp. 8vo, 1867. Tercéro Apéndice,* 73. Cuarto Apéndice, 57 pp., Santiago, 1874.

FRENZEL. Mineralogisches Lexicon für das Königreich Sachsen, 380 pp. 12mo, Leipzig.

GROTH. Tabellarische Uebersicht der einfachen Mineralien nach ihren krystallograph-en-chemischen Beziehungen geordnet, 120 pp. 8vo, Brunswick.

---

[*] Through the kindness of Dr. Hunt I have had the benefit of a translation of the 3d Appendix, with notes im.

Jentzsch. Die geologische und mineralogische Literatur des Königreiches Sachsen u der angrenzenden Ländertheile, von 1835 bis 1873, systematisch zusammengestellt, 132 p 8vo, Leipzig.

Naumann. Elemente der Mineralogie, 7th Ed., 1868. 8th Ed., 1871. 9th Ed., 654 pp 8vo, Leipzig, 1874.

1875.

Vogelsang. Die Krystalliten von Hermann Vogelsang, nach dem Tode des Verfasser herausgegeben von Ferdinand Zirkel, 175 pp. 8vo, Bonn.

Genth. Report on the Mineralogy of Pennsylvania, about 150 pp., now in press.

Tschermak's mineralogische Mittheilungen (referred to as Tsch. Min. Mitth.) deserves to b mentioned as an important addition to the list of mineralogical journals. It is published quarterly at Vienna in connection with the *Jahrbuch der k. k. geol. Reichsanstalt*, though issued also independently. The first number appeared in the middle of 1871.

LIST OF MINERALOGICAL MEMOIRS.

CRYSTALLOGRAPHY.

BREZINA. Entwickelung der tetartosymmetrische Abtheilung des hexagonalen Krystallsystem, Ber. Ak. Wien, 1869.

BREZINA. Entwickelung der Haupsätze der Krystallographie und Krystallphysik, Tsch. Min. Mitth., 1872, 125.

HIRSCHWALD. Grundzüge einer mechanischen Theorie der Krystallisationgesetze, Tsch. Min. Mitth., 1873, 171.

KLEIN. Ueber Zwillings-Verbindungen und Verzerrungen und ihre Beziehungen zu den Symmetrie-Verhältnissen der Krystall-Systeme, 50 pp. 8vo, Heidelberg, 1868.

MILLER. On the crystallographic method of Grassmann, and on its employment in the investigation of the general geometric properties of the crystals, Cambridge, Phil. Soc., Pt. v., 1868.

MINERAL CHEMISTRY.

VON KOBELL. Ueber das Wasser der Hydrosilicate. Ber. Ak. München, March 6, 1870. Ueber Krystallwasser, ibid., June 11, 1870.

LEFFLER. Ueber die Einwirkung der kohlensauren Alkalien auf Silicate. Inaug. Dissert., 18 pp. 8vo, Breslau, 1873.

RAMMELSBERG. Ueber die chemische Constitution der Silicate, ZS G. Ges., xxi., 106, 1869 (ibid., 1870, 830).

RAMMELSBERG. Ueber die gegenseitigen Beziehungen und die chemische Natur der Arsen- und Schwefelarsenmetalle im Mineralreich, ZS. G. Ges. xxv., 266, 282, 1873.

TSCHERMAK. Die Aufgaben der Mineralchemie Tsch. Min. Mitth., 1871, p. 93.

PHYSICAL MINERALOGY.

BAUER. Untersuchung über den Glimmer und verwandte Minerale, Pogg. Ann., cxxxviii., 137, 1869.

BAUMHAUER. Ueber Aetzfiguren und die Erscheinungen des Asterismus an Krystallen, Pogg. Ann., cxxxviii., 563; cxxxix., 349; cxl., 271; cliii., 621.

COOKE. The Vermiculites: their crystallographic and chemical relations to the Micas, Am. Acc. Sci., Boston, 1874, 85.

EXNER. Untersuchungen über die Härte der Krystallflächen, 166 pp. 8vo, Vienna, 1873.

EXNER. An Lösungsfiguren in Krystallen, Ber. Ak. Wien, lxix., 6, 1874.

FRIEDEL. Sur les propriétés pyro-électrique des Cristaux bons Conducteurs de l'electricité, Ann. Ch. Phys., IV., xvii., p. 79, 1869.

GROTH. Ueber Apparate und Beobachtungsmethoden für krystallographisch-optische Untersuchungen, Pogg. Ann., cxliv., 34, 1871.

HAHN. Ueber die Phosphorescenz der Mineralien, Zeitsch. Ges. Nat. Wiss., Berlin (Giebel), I., ix., 1, 131, 1874.

HANKEL. Elektrische Untersuchungen. Ueber die thermo-elektrische Eigenschaften des Topases, 8vo, Leipzig, 1870.

VON LANG. Orientirung der Wärmeleitungsfähigkeit einaxiger Krystalle, Pogg. Ann., xxxv., 29, 1868.

REUSCH. Ueber die Körnerprobe am zwei-axigen Glimmer, Pogg., cxxxvi., 130, 632, 1869. —— am krystallirten Gyps, ibid., p. 135. Untersuchung über Glimmercombinationen, ibid, pp. 626, 637, 1869.

ROSE. Ueber den Zusammenhang zwischen hemiëdrischer Krystallform und thermo-elektrischem Verhalten beim Eisenkies und Kobaltglanz, Pogg. Ann., cxlii., 1, 1871.

ROSE. Ueber die im Kalkspath verkommenden hohlen Canäle, 22 pp. 4to, Abhandl. Ak. Berlin, 1868.

SCHRAUF & DANA. Ueber die thermo-elektrischen Eigenschaften von Mineralvarietäten Ber. Ak. Wien, lxix., 1874 (Am. J. Sci., III., viii., 255).

SCHRÖDER. Die Volumconstitution einiger Mineralien, Jahrb. Min., 1873, 561, 932; 1874, 399, 506, 600, 711, 806, 943.

SCHARFF. Ueber die Bauweise des Feldspaths, II. Der schiefspaltende Feldspath, 39 pp. 4to, Frankfort a. M., 1869.

SCHARFF. Ueber den Quarz. Die Uebergangsflächen, 42 pp. 4to, Frankfort a. M., 1874.

NOTE.—For a complete and valuable list of memoirs on all subjects connected with the microscopic examination of minerals, including the nature of inclosed fluids, etc., see Rosenbusch, Physiographie d. Min., pp. 30-895, 1873.

DESCRIPTIVE MINERALOGY.

D'ACHIARDI. Sopra alcuni minerali e rocce del Peru; Lettera a Carlo Regnoli, 23 pp. 8vo, Pisa, 1870.

BORICKY. Zur Entwickelungsgeschichte der in dem Schichtencomplex der silurischen Eisensteinlager Böhmens vorkommenden Minerale, Ber. Ak. Wien, lix, April, 1869.

DANA, J. D. On Serpentine Pseudomorphs and other kinds, from the Tilly Foster Iron Mine, Putnam Co., New York, Am. J. Sci., viii., 371, 1874.

GENTH. Corundum: its alterations and associated minerals, Am. Phil. Soc., Philad., xiii., 361, 1873.

LEMBERG. Ueber die Contactbildungen bei Predazzo, ZS. G. Ges., xxiv., 187, 1872.

MOESTA. Ueber das Vorkommen der Chlor-, Brom-, und Jodverbindungen des Silbers in der Natur. Ein Beitrag zur Kenntniss der geologischen und bergbaulichen Verhältnisse von Nordchile, 47 pp. 8vo Marburg, 1870.

PUMPELLY. The Pargenesis and derivation of copper and its associates on Lake Superior, Am. J. Sci III., ii., pp. 188, 243, 347, 1871.

POSEPNY. Ueber concentrisch-schalige Mineralbildungen, Ber. Ak. Wien, 1868.

POSEPNY. Die Blei- und Galmei-erzlagerstätten von Raibl in Kärnten, Jahrb. G. Reichs., xxiii., 319, 1873.

PETERSEN. Ueber die Mineralien der barytischen Erzgänge von Wittichen in Baden, Pogg. Ann., cxxxiv., p. 64, 1868.

VOM RATH. Geognostisch-mineralogische Fragmente aus Italien, II. Theil, ZS. G. Ges., xx., 265, 1868 III. Theil, Die Insel Elba, ibid., xxii., 1870. IV. Theil, ibid., xxv., p. 117, 1873.

SANDBERGER. Ueber den Wenzel-gang bei Wolfach im Schwarzwald, Jahrb. Min., 1869, 290.

STELZNER. Mineralogische Beobachtungen im Gebiete der argentinischen Republik, Tsch. Min. Mitth., 1873, 213.

TSCHERMAK. Ueber Pyroxen und Amphibol, Tsch. Min. Mitth., 1871, p. 17.

WHITNEY. On the minerals of the Pacific Coast of North America, Proc. Ac. Cal., iii., 372, 375, 1869 (ZS. G. Ges., xxi., 741).

WILLCOX. Canadian localities of various minerals, Proc. Ac. Philad., 1873, p. 276.

WUNDER. Beobachtungen über die Bildung von Krystallen in Glasflüssen bei Behandlung derselben vor dem Löthrohre, 22 pp. 46, Chemnitz, 1870.

LIST OF NEW SPECIES.

1. *Native Elements.*

Kongsbergite	32

2. *Sulphids, Arsenids, etc.*

Arite	4	Horbachite	28
Arsenotellurite	5	Livingstonite	35
Chalcopyrrhotite	11	Luzonite (Enargite)	35
Famatinite	20	Oldhamite	42
Frenzelite	22	Schirmerite	50
Guadalcazarite	25	Spathiopyrite	52
Henryite	27	Valleriite	58

3. *Chlorids, etc.*

Bordosite	8	Erythrosiderite	19
Chlorocalcite	11	Tocornalite	56

4. *Oxyds.*

Asmanite	5	Hydrocuprite	28
Delafossite (Melaconite)	16	Magnochromite (Chromite)	36
Heterogenite	27	Meymacite	38
Hydrargyrite	8		

5. *Anhydrous Silicates.*

Agricolite	1	Microsommite	39
Ardennite (Dewalquite)	4	Trautwinite	56
Manganophyllite	37	Tschermakite	57
Maskelynite	37	Victorite (Enstatite)	18

6. *Hydrous Silicates.*

Allophite	2	Limbachite	34
Chalcomorphite	11	Maconite	36
Cossaite (Paragonite)	63	Nefidieffite	41
Culsageeite (near Jefferisite)	30	Rauite	47
Dudleyite	17	Resanite	48
Foresite	22	Seebachite (Herschelite)	50
Garnierite	23	Sterlingite (Damourite)	15
Grochauite	25	Strigovite	53
Hallite	26	Vaalite	58
Hygrophilite	29	Willcoxite	61
Kerrite	31	Zöblitzite	34

7. *Tantalates, Columbates.*

Koppite	32	Nohlite (near Samarskite)	41

8. *Phosphates, Arsenates, etc.*

Hebronite	27	Stibioferrite	53
Kjerulfine	31	Uranospinite	58
Korarfveite (near Monazite)	32	Veszelyite	59
Miriquidite	40	**Wapplerite**	60
Rhagite	48	**Winklerite**	61
Rivotite	48	**Zeunerite**	62

9. *Borates.*

Ludwigite	35	**Priceite**	45

10. *Tungstates, Vanadates, etc.*

Cuprotungstite	14	**Uranosphærite**	57

11. *Sulphates, etc.*

Bartholomite	6	**Hydrocyanite**	29
Cupromagnesite	14	**Maxite (Leadhillite)**	38
Dolerophanite	17	**Nitroglauberite**	41
Ettringite	19	**Syngenite (Kaluszite)**	54
Guanovulite	64		

12. *Carbonates.*

Dawsonite	16	**Schröckeringite**	50

13. *Carbo-hydrogen Compounds.*

Aragotite	4	Siegburgite	51
Bombiccite	8	Wheelerite	60
Byerite	9		

The following list includes additional names recently introduced into the science. They belong in part to previously described species, and in part to species which, in consequence of imperfect descriptions, cannot be definitely classified.

Aerugite, Arsenstibite, Bieirosite, Cacheutaite, Campbellite, Carbonyttrine, Cerbolite, Chalcomiclite, Chalypite, Clarite, Corkite, Cryoconite, Cuproapatite, Cuprovanadite, Dauberite, Dernbachite, Ferrotungsten, Glancespar, Glasbachite, Köhlerite, Mariposite, Milanite, Meerschaluminite, Pealite, Plumbocuprite, Plumbiodite, Pyrichrolite, Pyritolamprite, Rhodite, Scacchite, Simlaite, Tapalpite, Wachenrodite, Xanthiosite, Zirlite, Zonochlorite.

For some other new names not belonging to definite mineral species, see *crystallites*, p. 14, *microlites*, p. 39.

APPENDIX II.

AARITE. See **ARITE.**

ACANTHITE, Min. p. 51.—Localities in Saxony, Frenzel, Min. Lex. Sachsen, p. 2.

ACHTARAGDITE, Min. p. 478.—Description of crystals and analysis, *Hermann*, J. pr. Ch. iv., 104, 182, 1868. Description, Kokscharow, Min. Russl., v., 324.

ACMITE and **AEGIRITE**, Min. p. 223, 224.—Relation to pyroxene, *Tschermak*, Tsch. Min. litth., 1871, 33.

ACTINOLITE, Min. p. 232.—Brewster, N. Y., analysis, *Breidenbaugh*, Am. J. Sci., III., i., 211, 1873.

ADAMITE, Min. p. 565.—Cap Garonne, analysis and description, *Damour*, C. R., lxvii., 124; Pisani, C. R. l. 1001, 1870.

AERUGITE. Adam, Tableau Min., 1869, p. 43. A doubtful arsenate of nickel ($\dot{\text{Ni}}^5\,\overset{\cdot\cdot\cdot}{\overline{\text{As}}}$) om Johanngeorgenstadt, analyzed by Bergemann (Dana Min. p. 548).

AESCHYNITE, Min. p. 522,—anal.: *Marignac*, Ann. Ch. Phys., IV., xiii., 5, 1868; *Herann*, J. pr. Ch. cv., 105, 321; *Rammelsberg*, Pogg., cl., 214, 1873.

AGALMATOLITE, Min. p. 480.—China, Kenngott, Jahrb. Min. 1870, 782.

336 A. Agricolite. *Frenzel*, Jahrb. Min., 1873, 791, 947; 1874, 686; *Breithaupt* (refer-ces in Dana's Min., p. 391).
Monoclinic (Groth). C = 110°. In globular or semi-globular forms, with radiated or rous structure. Also in indistinct groups of crystals. Soft, heavy, brittle. Color hair-own (Schneeberg); colorless to wine-yellow (Johanngeorgenstadt). Lustre adamantine, easy.

Composition same as for eulytite (q. v.) 2 $\ddot{\overline{\text{Bi}}}$, 3 $\ddot{\text{Si}}$. Analysis, Frenzel, l. c.

$\ddot{\text{Si}}$	$\ddot{\overline{\text{Bi}}}$	$\overline{\text{Fe}}$		
16·67	81·82	0·90	=	99·39

ccurs at Johanngeorgenstadt on quarz, associated with bismuth, cloanthite, bismite; also the mine Neuglück, Schneeberg.
he *arsenwismuth* of Breithaupt has until now been included with eulytite, but the inves-ations of Frenzel and Groth show that, though having the same composition, it is different crystalline form, and hence is a distinct species.

LBERTITE, Min. p. 753.—Probable origin, *S. F. Peckham*, Am. J. Sci. II., xlviii., 362, 9.

LBITE, Min. p. 348.—Saas, cryst., *F. Scharff*. Jahrb. Min., 1869, 342.
t. Gotthard, cryst., *Hessenberg*, Min. Not. ix., 40, 1870.
edia, Penn., anal., *Leeds*, Am. J. Sci., III., vi., 25, 1873.
rystallographic memoir, with full list of planes, *Brezina*, Tsch. Min. Mitth., 1873, 19.
rystallographic memoir, twinning laws, etc., *v. Rath*, Pogg. Ann. Erg., Bd. v., 425, 1870.
rystals implanted in orthoclase, *Scacchi*, Atti Accad. Napoli, March 12, 1870.
chneeberg, description of simple crystals, *J. Rumpf*; anal., *Ludwig*, Tsch. Min. Mitth., 1874, 97, 176.
ee also Feldspar.

ALLANITE, Min. p. 285.—Schmiedefeld, Thüringer Wald (Schwarze Krux), cryst., memoir, new forms, *Bauer*, Würtemberg. Nat. Jahresheft, 1872, 246.
Vesuvius (orthite), cryst., *v. Rath*, Pogg., cxxxviii., 492.
Finland (Erbo and Kyokslätt), Wiik, Œfv. Finsk. Vet. Soc., Helsingfors, xiii., 75, 1870–71.
Composition discussed, *Rammelsberg*, ZS. G. Ges., xxiv., 60, 1872.
Greenland, Fredrickshaab, anal., *Rammelsberg*, ZS. G. Ges., xxiv., 60, 1872.
Found in the Böhmer Wald, near Husinec, Krejci, Ber. Böhm. Ges., 1873, p. 360.
Amherst Co., Va., anal., *J. A. Cabell*, Ch. News, 1874, p. 141.

ALLOPHANE, Min. p. 419.—Dehrn (near Limburg), Nassau, anal., *v. Rath*, Pogg., cxliv., 393, 1871.
Northampton, England, *Hermann*, Q. J. G. Soc., xxvii., 234, 1871.

448 A. Allophite, *Websky*, ZS. G. Ges., xxv., 399, 1873.
In dense, micro-crystalline masses, on fracture dull, and easily polished to a greasy lustre by the hand. H. less than calcite. G. = 2·641 (Leffler). Color, pale grayish-green. In appearance very similar to pseudophite; distinguished from serpentine by its inferior hardness.

Analysis Leffler (l. c.).

$\ddot{\mathrm{Si}}$	$\dddot{\overline{\mathrm{Al}}}$	$\overline{\mathrm{Fe}}$	$\overline{\mathrm{Cr}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{H}}$	
36·23	21·92	2·18	0·85	35·53	2·97	= 99·68

Neglecting the water Leffler gives the formula $2(\dddot{\overline{\mathrm{Al}}}\,\ddot{\mathrm{Si}}) + 3(3\dot{\mathrm{Mg}}\,\ddot{\mathrm{Si}})$. If the water be reckoned in the oxygen ration for $\dot{\mathrm{R}} : \overline{\mathrm{R}} : \ddot{\mathrm{Si}} : \dot{\mathrm{H}} = 5 : 4 : 6\frac{2}{3} : 1$; or for all bases (including $\dot{\mathrm{H}}$) to silica = 3 : 2. The water goes off only at a high temperature.
Occurs at Langenbielau, Silesia; also at Reichenstein. From a quarry of limestone occurring in the gneiss.

ALTAITE, Min. p. 44.—Red Cloud Mine, Colorado, anal., *Genth*, Am. Phil. Soc., Philad., xiv., 225, 1874.

ALUMINITE, Min. p. 658.—Brighton, *J. Howell*, Rep. Brit. Assoc., 1872; 108.
Kuchelbad, anal., *Stolba*, Ber. Böhm. Ges., Prag, 1873, 335.

ALUNOGEN, Min. p. 649.—Iquique, Peru, anal., *Field*, J. Ch. Soc., vii., 259, 1869.

AMALGAM, Min. p. 13.—Chili, anal., Domeyko, 2d App., Min. Chili, p. 33, 1867.

AMBLYGONITE, Min. p. 545.—See Montebrasite, hebronite.

AMBLYSTEGITE, *v. Rath*, Pogg., cxxxviii., 531, 1869. Appendix I., p. 1.

AMBROSINE, *C. U. Shepard.* Appendix I., p. 1.

AMPHIBOLE, Min. p. 232.—Crystal of unusual habit, Härtlingen, Nassau, *Nies*., Jahrb. Min., 1868, 53.
Peru, in dioryte, anal., *Achiardi*, Lettera a Carlo Regnoli, p. 11, Pisa, 1870.
Group of minerals, microscopically distinguished, *Tschermak*, Ber. Ak. Wien, lx., p. 5, 1869; relations to minerals of the pyroxene family. Tsch. Min. Mitth., 1871, 38.
With augite, at Vesuvius, anal., *v. Rath*, Pogg. Erg., vi., 229, 1873. Formed by sublimation at Vesuvius, Scacchi., Atti Accad. Sci. Napoli, Sept. 14, 1872.
Greenland, anal., *Janorsky*, Ber. Chem. Ges., Berlin, 1873, 1232.
South Sherbrooke, Canada, anal., *Harrington*, Geol. Survey, Canada, 1874, 201.
Altered to serpentine, Brewster, N. Y., *J. D. Dana*, Am. J. Sci. III., viii., 375, 1874.

ANALCITE, Min. p. 432.—Renfrewshire, analyses, *Young*, Ch. News, xxvii., 55, 1872.

ANATASE, Min. p. 161.—See octahedrite.

ANDALUSITE, Min. p. 371.—Ramsberg, Sweden, anal., *Igelström*, Jahrb. Min., 1871, 360.
Composition, etc., *Rammelsberg*, ZS. G. Ges., xxiv., 87, 1872.
Anal. and description, *Kokscharow*, Min. Russl., v., 164, 170 (chiastolite).
Crystal from Delaware Co., Penn., *E. S. Dana*, Am. J. Sci., III., iv., p. 473, 1872.

ANDREWSITE, *Maskelyne*, Ch. News, xxiv., 99. Appendix I., p. 1.

ANGLESITE, Min. p 622.—Arizona, anal. of a compact form (*Tyson*) *Brush*, Am. J. Sci., III., v., 421.
Cerro Gordo, Cal., a compact variety, *Silliman*, Am. J. Sci., III., vi., 131, 1873.

ANHYDRITE, Min. p. 621.—Formation of, *G. Rose*, Ber. Ak. Berlin, July, 1871, 368.
Cryst. monograph, *Hessenberg*, Min. Not., x., 1, 1871.

ANKERITE, Min. p. 685. Erzberg, crystallized, anal., *Reibenschuh*, Ber. Ak. Wien, lv., 648, 1867.
Vordernberg, Steiermark, cryst. (R ∧ R = 106° 7′), anal., *Zepharovich*, Jahrb. Min., 1868, 204.
Bohemia, anal., *Boricky*, Ber. Ak. Wien, lix., 613, 1869.
Call, in the Eifel, anal., *Schmidt*, Jahrb. Min., 1875, 89.

ANORTHITE, Min. p. 337.—From meteorite of Juvenas (France), cryst., *v. Lang*, Ber. Ak. Wien, lvi., 839, 1867.
Vesuvius, cryst., monograph, *v. Rath*, Pogg., cxxxviii., 449; ibid., cxlvii., 22.
Santorin, cryst., *Hessenberg*, Min. Not., viii., 31, 1868.
New law for twining, *Strüver*, Atti Accad. Sci., Torino, iv., 38, 1868; from Monte Somma, ib., vi., 358, 1871.
Pesmeda Alp, cryst., anal., *v. Rath*, Ber. Ak. Berlin, 1874, 749.
See also *Feldspar*.

ANTHOLITE, Min. p. 234.—Delaware Co., Penn., *Leeds*, Am. J. Sci., III., vi., 25, 1873.

ANTHOPHYLLITE, Min. p. 231.—Hermannschlag, anal., *Brezina*, Tsch. Min. Mitth., 1874, 247.

ANTIGORITE, Min. p. 465.—Zermatt, anal., *v. Kobell*, Ber. Ak. München, 1874, 165.

ANTILLITE. *Shepard*. Appendix I., p 1.

ANTIMONARSENNICKEL. *Petersen*, see arite.

APATITE, Min. p. 530.—Bolivia, anal., Domeyko, 2d App. Min. Chili, p. 44, 1867.
Offheim, anal., *Kosmann*, ZS. G. Ges., xxi., 795, 1869.
In large beds near Perth, Canada West, *Jackson*, Proc. N. Hist. Bost., xii, 88, 1868.
As a constituent of crystalline rocks, *Petersen*, J. pr. Ch., cvi., 145, 1869; as a secondary product in basalts, Jahrb. Min., 1873, 852.
Jumilla and Poloma, cryst. new forms, *Schrauf*, Ber. Ak. Wien, lxii., 745 et seq., 1870.
Schlaggenwald, crystallized holohedrally, *Schrauf*, Tsch. Min. Mitth, 1871, 105.
Tyrol and Switzerland, cryst., note, *Klein*, Jahrb. Min., 1871, 485.
Var *francolite*, Cornwall, anal., *Mashelyne & Flight*, J. Ch. Soc., ix., 1, 1871.
Alathal, cryst. $\left(\frac{\frac{3}{2}\cdot\frac{3}{2}}{2}\text{ new}\right)$, *Strüver*, Atti Accad. Sci. Torino, iii., 125, 1867–8. Corbassera, Botino, Baveno, cryst., *Strüver*, ibid., vi., 363, et seq., 1871.
Untersulzbach, cryst. description, new forms, *Klein*, Jahrb. Min., 1872, 121.
Murcia, Spain, anal., *A. H. Church*, J. Ch. Soc., II., xi., p. 101, 1873.
See also Phosphorite.

APHROSIDERITE, Min. p. 502.—Saxeby, Sweden, anal., *Igelström*, B. & H. Zeit., 1868, xxvii., 187.
Note, *Nies*, Jahrb. Min., 1873, 320.

APHTHITALITE, Min. p. 615.—Vesuvius, character discussed, *Scacchi*, Atti Accad., Napoli (read), March, 1870.
Girgenti, cryst., *v. Rath*, Pogg., Erg. Bd. vi., 359, 1873.

APOPHYLLITE, Min. p. 415.—India, cryst. note, *Haughton*, Journ. R. Geol. Soc., Dublin, II., ii., 113, 1868.
Greenland, twin crystals, *Schrauf*, Ber. Ak. Wien, lxii., 699, 1870.
Maderanerthal, *Kenngott*, Jahrb. Min., 1873, 725.
From the basalt, cryst., and partial analysis, *Streng*, Jahrb. Min., 1874, 573.

AQUACREPITITE, *Shepard*. Am. J. Sci., II., xlvi., 256. Appendix I., p. 2.

ARAGONITE, Min. p. 694.—Cryst., twins, *Schrauf*, Ber. Ak. Wien, lxii., 734, 1870; from Sasbach, cryst., new forms, ibid., lxv., 250, 1873.

Waltsch, Bohemia, altered to hyalite, *Boricky*, Ber. Böhm. Ges., 1873, 65.

795 A. Aragotite.—*Durand*, Proc. Acad., Cal., iv., p. 218, 1872, (Am. J. Sci., III., vol. vi., 67).

A volatile hydrocarbon related to idrialite. It occurs at the New Almaden Mine, Cal. in bright yellow scales, impregnating a crystalline siliceous dolomite; also on cinnabar at the Redington Mine.

It contains no arsenic, nor sulphur, nor any metal. Insoluble in oil of turpentine, alcohol, and ether.

ARCANITE, Min. p. 615.—See **APHTHITALITE**.

284 A. Ardennite.—*Lasaulx* and *Bettendorf*, Ber. Nied. Ges. Bonn, xxix., p. 189, Nov. 24, 1872; Pogg. cxlix., 241, 1873. DEWALQUITE, Pisani, C. R., lxxv., 1542, Dec. 2, 1872; lxxvii., 329, 1873.

Orthorhombic. a (vert.)$=0{\cdot}3135$, $b=1$, c (brach.) $0{\cdot}4663$. Observed planes $i\text{-}\bar{i}$, $i\text{-}\breve{i}$, I, $i\text{-}\bar{\tfrac{3}{2}}$. $i\text{-}\breve{2}$, $1\text{-}\bar{i}$. 1 . $1\text{-}\tfrac{3}{2}$. $I \wedge I$ (over $i\ \bar{i}$)$=130°\ 0'$, $i\text{-}\bar{\tfrac{3}{2}} \wedge i\text{-}\bar{\tfrac{3}{2}}=145°\ 28'$, $i\text{-}\breve{2} \wedge i\text{-}\breve{2}=94°\ 0'$. $1 \wedge 1=150°\ 50'$ and $114°\ 40'$. $1\text{-}\breve{i} \wedge 1\text{-}\breve{i}=112°\ 12'$ (Pisani 112° 24 $a' \wedge a'$). Above determinations by v. Rath.

Good crystals very rare, mostly in fragments without terminations. Habit much like ilvaite; $1\text{-}\bar{i} \wedge 1\text{-}\bar{i}=112°\ 40'$ for ilvaite, $=112°\ 12'$ for ardennite. Prismatic planes strongly striated. Cleavage, $i\text{-}\breve{i}$ perfect, I very distinct.

Pisani gives the following optical determinations. Acute bisectrix, positive, normal to the cleavage plane $i\text{-}\breve{i}$ (in which the optic axes are observed). Angle of axes in air: red rays$=68°$ 58′, yellow = 66° 37′, green, 62° 18′ (mean). Des Cloizeaux found: red = 76° 7′–79° 9′, yellow 72° 55′, 74° 26′, green 68° 36′–70° 59′.

H. 6–7. G. = 3·620. Color yellow to yellowish-brown; in thin splinters translucent, red. Dichroic. Brittle and fragile.

Analyses 1, 2, 3, 4, Lasaulx and Bettendorf, Pogg., cxlix., 243, 245. 5. Pisani, C. R., lxxv., 1542. 6. same, ib., lxxvii., 329.

	$\ddot{\text{Si}}$	$\dddot{\overline{\text{Al}}}$	$\dddot{\overline{\text{Mn}}}$	$\dot{\text{Mn}}$	$\dot{\text{Fe}}$	$\dot{\text{Ca}}$	$\dot{\text{Mg}}$	$\dddot{\text{V}}$	$\dddot{\overline{\text{As}}}$	Cu	ign.
1.	29·65	22·91	30·12	——	1·91	1·66	3·82	7·50	——	——	——
2.	29·69	26·68	28·69	——	1·88	2·00	——	4·84	——	——	——
3.	29·60	23·50	——	25·88	1·68	1·81	3·38	9·20	——	tr(PO_5)	4·04 = 99 09
4.	29·89	——	——	26·03	2·21	2·28	3·47	9·09	——	tr "	3·10
5.	28·70	28·36	——	26·40	2·94	4·30	4·32	1·80	——	1·30	0·98 = 99·10
6.	28·40	24·80	——	25·70	1·31	2·98	4·07	3·12	6.35	0·22	5·20 = 102·15

In analyses 1 and 2, L. & B. found 2 p. c. Pt., Pd., etc., which, as they afterward showed, came from platinum dishes used in the analysis, the water was overlooked. Analyses 3 and 4 were made subsequently, and by an improved method. The manganese is present in the form $\dot{\text{Mn}}$, as is shown by Pisani (not $\dddot{\overline{\text{Mn}}}$ as in analyses 1 and 2 of L. & B.).

B. B.—Easily fusible to a black glass. With borax gives a manganese bead. The water can only be driven off at a strong red heat.

According to Pisani the arsenic is readily recognized on heating the mineral in a matrass, mixed with carbonate of soda and cyanid of potassium, a ring of metallic arsenic being obtained. He explains the high percentage of vanadic acid obtained by Lasaulx on the ground that he has overlooked the arsenic.

Found near Ottrez (Salm Chateau) in the Ardennes, Belgium, with quartz (containing particles of pyrolusite) and albite.

Lasaulx first noticed this mineral under the name of *mangandisthen*, in consequence of a supposed resemblance to cyanite. This, as Pisani urges, is on several accounts an objectionable name, and is naturally superseded by the name *ardennite*, which too has the right of priority over *dewalquite*.

ARGENTITE, Min. p. 678.—Cryst., new forms, *Schrauf*, Ber. Ak. Wien, lxiii., 165, 1871.

ARGENTOPYRITE, Min. p. 39.—Cryst. memoir, *Schrauf*, Ber. Ak. Wien, lxiv., 192, 1871.

72 A. Arite. The arsenid of nickel, containing 27·8 p. c. antimony, described by Berthier from the Basses-Pyrénées (Dana, Min. p. 60), has been called aarite (more properly *arite*, Pisani) by Adam, Tableau Min., 1869, p. 40.

The same mineral has been subsequently investigated by Pisani (C. R., lxxvi., 239, 1873), and he concludes that it is merely a variety of breithauptite. An analysis gave him: As 11·5. Sb 48·6, Ni 37·3, Zn 2·4 = 101·5, corresponding to an arseniferous breithauptite. G. = 7·19. It is similar to the mineral from Allemont also described by Berthier (Dana Min. p. 60, anal. 4), which is an antimoniferous niccolite.

The name arite, however, may still be well retained for the antimonarsennickel of Petersen (Pogg., cxxxvii., 396, 1869), the analysis of which agrees very closely with that of Berthier for the Pyrenees mineral. The mineral described by Petersen occurs massive at the Wenzel mine, Wolfach, Baden, in a coarse granular limestone. It is sometimes accompanied by wolfachite. An analysis afforded: As 30·06, Sb 28·22, Ni 39·81, Co tr, Fe 0·96, S 1.77 = 100·82. H. = 5·5, G. = 7·50. B.B. fuses with a strong reaction for arsenic and antimony. With soda gives a magnetic globule.

ARSENIC (native), Min. p. 17.—Found in the argentiferous mines of San Augustin, State of Hildago, Mexico (H = 2, G. = 7·24), La Naturaleza, xl., p. 313, 1873.

Marienberg, Saxony (arsenglanz), *Frenzel*, Jahrb. Min., 1873, 25; 1874, 677.

ARSENICAL cobalt. Appendix I., p. 1.

ARSENIOSIDERITE, Min. p. 76.—Anal., *Church*, J. Ch. Soc., II., xi., p. 102, 1873.

ARSENOPYRITE, Min. p. 78.—Schneeberg, anal., *Frenzel*, Jahrb. Min., 1872, 517.
Patosi, containing 4 p. c. Bi, anal., Domeyko 3d Appendix, Min. Chili, 1871.
Meymac, Corrèze (containing bismuth), anal., *Carnot*, C. R., lxxix., 479, 1874.
Schladming, anal., *Rumpf*, Tsch. Min. Mitth., 1874, 178, cryst. description, ibid., p. 231.
See also Danaite.

33 A. Arsenotellurite, a name proposed by *Hannay* for a supposed new tellurid. It occurs in small brownish scales upon arsenical iron-pyrites. An analysis gave him (on ·6347 gr.) Te = 40·71, As = 23·61, S = 35·81, corresponding to the formula 2 TeS_2, As_2S_3. *No locality mentioned.* J. Ch. Soc., II., xi., p. 989, 1873.

ARSENSTIBITE. Adam, Tableau Min., 1869, p. 42.—A hydrous arsenate of antimony, for which Pisani gives the formulas $\ddot{S}b^3 \overset{...}{A}s + 15\dot{H}$ and $\ddot{S}b^5 \overset{...}{A}s + 30\dot{H}$.

ASBESTUS, Min. p. 234.—Found at Pelham, Mass., *Adams*, Am. J. Sci., II., xlix., 271, 1870.

ASBOLITE, Min. p. 181.—Saalfeld, note, *v. Kobell*, Ber. Ak. München, 1870, 49.

231 B. Asmanite, *Maskelyne*, Phil. Trans., clxi., p. 361, 1871 (v. Rath, Pogg., Erg. Bd. vi, 382, 1873.

Orthorhombic. Occurring planes *O*. *I*. *i*-ī, $\frac{4}{3}$-ī, 1-ī, $\frac{2}{3}$-ī, $\frac{1}{2}$-ī, $\frac{1}{4}$-ī, $\frac{2}{3}$, $\frac{1}{2}$, $\frac{1}{5}$. *a* (vert.) : *b* : *c* = 3·31320 : 1·0000 : 1·7437. *I* ∧ *I* 120° 20′. *O* ∧ 1-ī = 117° 46′. *O* ∧ $\frac{1}{2}$: 117° 39′.

Cleavage *O* good, surface having a vitreous lustre, *I* difficult. Lustre generally resinous, resembling that of opal. Extremely brittle, especially in outer portions.

H. = 5·5. G. = 2·245. Optically bi-axial, divergence large, in air = 107°–107½° (approximately), being somewhat greater for red rays than blue. First bisectrix normal to *i*-ī (100), second normal to *O*. Double-refraction, positive.

Composition nearly pure silica, consequently the same as for quartz and tridymite. Analysis, Maskelyne, l.c. 1. On 0.3114 gr. 2. On 0·2653 gr.

	$\dddot{S}i$	$\ddot{F}e$	$\dot{C}a$	$\dot{M}g$	
1.	97·43	1·12	0·58	1·51	= 100·64
2.	(99.21)	0·79 etc.			100·00

Found in the meteoric iron of Breitenbach, in very minute grains, generally much rounded and stained with iron on the surface.

It is mixed with bronzite (after the removal of the iron, troilite and chromite), and constitutes about one-third of the mixed siliceous minerals. Maskelyne suggests that the rounded character of the mineral and of the accompanying bronzite may be due to this having undergone superficial fusion, or having been softened by the intense heat generated by the rapid course of the meteorite in the air; an idea which, he says, seems to be supported by the brittleness of the outer portions of the grains.

ASPIDOLITE, *v Kobell*. Ber. Ak. München. March, 1869. Appendix I., p. 2.
Found in gneiss near Snarum, Moravia, Tsch. Min. Mitth., 1871, 112.

ASTEROITE, *Igelström*. Appendix I., p. 2.

ASTROPHYLLITE, Min. p. 308.—Cryst., *Nordenskiöld*, Œfv. Ak. Stockh., xxvii., 561, 1870.

ATACAMITE, Min. p. 121.—New South Wales, cryst., *Klein*, Jahrb. Min., 1869, 347; 1871, 495; *v. Zepharovich*, Ber. Ak. Wien, lxiii., 6, 1871; ib., lxviii., 120, 1873.
Morphological study, *E. S. Dana*, Tsch. Min. Mitth., 1874, 103.
Anal., *J. A. Cabell*, Chem. News, xxviii., 272, 1873.
Anal., and discussion of composition, *Ludwig*, Tsch. Min. Mitth., 1873, 35 (42).
Altered to malachite, *Kokscharow*, Bull. Soc. Imp. St. Pet., xviii., 186, 1872; *Tschermak*, Tsch. Min. Mitth., 1873, 39.
A black oxy-chlorid of copper, differing somewhat from atacamite, is described by Domeyko (3d Append., Min. Chili, 1871). It was amorphous, grayish-black, without lustre. Compact to granular. Fracture even or subconchoidal. It takes a semi-metallic polish under the knife. Composition as obtained by Stuven, deducting impurities, CuCl 16·94, $\dot{\mathrm{C}}\mathrm{u}$ 68·67, $\dot{\mathrm{H}}$ 14·39.

ATELESTITE, Min. p. 392.—Schneeberg, cryst. description (monoclinic), *v. Rath*, Pogg., cxxxvi., 422.
Anal., essentially an arsenate of bismuth, *Frenzel*, Jahrb. Min., 1873, 794.

AUGITE, Min. p. 216.—In meteorites, *Rammelsberg*, Pogg., cxl., 320, 187–.
Relation to other minerals of pyroxene group, *Tschermak*, Tsch. Min. Mitth., 1871, 28.
Schönhof, Bohemia, in twins, from basalt, *Zepharovich*, Jahrb. Min., 1872, 59.
Occurring with hornblende at Vesuvius, anal., *v. Rath*, Pogg. Erg., Bd. vi., 229, 337, 1873.
See also pyroxene.

AURICHALCITE, Min. p. 712.—Found at Franklin, N. J., *Trautwine*, J. Frank. Inst., III., lxiv., 374.

AUTUNITE (Kalkuranit), Min. p. 586.—Occurrence in phosphorite, *Wibel*, Jahrb. Min., 1873, 242. Cornwall, anal., *Church*, J. Ch. Soc., II., xiii., 109, 1875.

AXINITE, Min. p. 297.—Baveno, cryst., *Strüver*, Atti Accad. Torino, iii., 131, 1867–68.
Composition, *Rammelsberg*, ZS. G. Ges., xxi., 689, 1869.
Cryst., relation to glauberite, *Schrauf*, Ber. Ak. Wien, lxv., 244, 1872; cryst., ibid., lxii., 712, 720, 729; lxiv., 191.
Striegau, Silesia, cryst., *Websky*, Tsch. Min. Mitth., 1872, 1.
Bottallock, Cornwall, cryst. memoir, *Hessenberg*, Min. Not., xi., 30, 1873.

AZORITE, Min. p. 761.—St. Miguel, cryst., *Schrauf*, Ber. Ak. Wien, lxiii., 187, 1871.

AZURITE. Min. p. 715.—Nertschinsk, occurrence described, *Schrauf*, Tsch. Min. Mitth. 1871, 13.
Exhaustive cryst. memoir (homomorphous with epidote, p. 159), *Schrauf*, Ber. Ak. Wien. lxiv., 123, 1871.
Composition and paragenesis discussed, *Wibel*, Jahrb. Min., 1873, 245.

BABINGTONITE. Min. p. 227.—Baveno, cryst. description. *v. Rath*, Pogg., cxxxv., 583.
Devonshire, analysis and description, *Forbes*, Phil. Mag., IV., xxxvii., p. 328, 1869.
Herbornseelbach, Nassau, *v. Rath*, Pogg. Erg., v., 420, 1871; C. Jehn, Pogg., cxliv., 594; Jahrb. Min., 1872, 319.

BARETTITE: Bombicci, Jahrb. Min., 1868, 750. Appendix I., p. 3.

BARITE, Min. p. 616.—Hemimorphic crystals, *Reuss*, Ber. Ak. Wien, lix., 623, 1869.
Tavetsch, Graubünden, cryst., *Kenngott*, Jahrb. Min., 1870, 354.
Przibram, cryst., new forms, *Schrauf*, Ber. Ak. Wien, lxiv., 199, 1871.
Val Alvernia, etc., cryst., *Strüver*, Atti Accad. Sci. Torino, vii., p. 368, 1871.
Bohemia, cryst. memoir, *Helmhacker* (Denkschr. Ak. Wien), Tsch. Min. Mitth., 1872, 71.

687 A. Bartholomite, *Cleve*, Ak. H. Stockholm, IX., No. 12 (Nov., 1870), (Geol. West Indian Islands, p. 31).
Occurs with mendozite in yellow nodules composed of small needles Analysis, Cleve l. c.

NaCl	$\dddot{\mathrm{S}}$	$\bar{\mathrm{F}}\mathrm{e}$	$\dot{\mathrm{N}}\mathrm{a}$	$\dot{\mathrm{H}}$	$\dot{\mathrm{M}}\mathrm{g}$	
2·88	44·75	22·71	17·08	8·08	0·63	insol. 3·56 = 99·69

Deducting NaCl (2·88), $\dot{\mathrm{M}}\mathrm{g}\dddot{\mathrm{S}}$+7Aq (3·87), and insoluble matter (3·56), we obtain $\dddot{\mathrm{S}}$ 48·66, $\overline{\mathrm{F}}\mathrm{e}$ 25·41, $\dot{\mathrm{N}}\mathrm{a}$ 19·11, $\dot{\overline{\mathrm{H}}}$ 6·82 = 100, corresponding to the formula $2\dot{\mathrm{N}}\mathrm{a}\,\dddot{\mathrm{S}}+\overline{\mathrm{F}}\mathrm{e}\dddot{\mathrm{S}}^3+2\dot{\overline{\mathrm{H}}}$. Results from the alteration of pyrite. Locality St. Bartholomew, West Indies. It is closely related to botryogen.

Barytocelestite, Min. p. 620.—Greiner, Tyrol, analyses (*Ullik*) and description, *Zepharovich*. Ber. Ak. Wien, lvii., 740, 1867.

Bastnäsite, *Huot*. Appendix I., p. 2.

Beauxite, Min. p. 174.—Wollerdorf, analysis, *Strum*, B. & H. Zeit., xxii., 283, 1868.
Found in French Guiana, *Meunier*, C. R., lxxiv., 633, 1872.
Analyses and description, *H. Coquand*, Bull. Soc. G., xxviii., 98, 1871.
Genth, Am. Phil. Soc., Philad., xiii., 372, 1873.
See also wocheinite and zirlite.
Kokorije, anal., *John*, Verh. G. Reichs, 1874, 389.

Beraunite, Min. p. 558.—St. Benigna, Bohemia, analysis, Boricky, Ber. Ak. Wien, lvi., 6, 1867.
Saxony (near Scheibenberg), *Frenzel*, Jahrb. Min., 1873, 23.

Beryl, Min. p. 245.—Chili, anal. (0·8 p. c. $\dot{\mathrm{N}}\mathrm{i}$), Domeyko, 2d App. Min. Chili, p. 48, 1867.
Elba, cryst., *v. Rath*. ZS. G. Ges., xxii., 661, 1870; Achiardi, Nuovo Cimento, II., iii., Feb., 1870; analysis, *Bechi*, Boll. Com. Geol. Ital., 1870, 82.
Siberia, cryst. description, *Schrauf*, Ber. Ak. Wien, lxv., 255, 1872.
Remarkable crystal described (new forms), *Kokscharow*, Min. Russl., vi., 94.
Emerald, investigation of cause of color, *Williams*, Proc. Roy. Soc., London, xxi., 409, 1873.
Emerald, Muso mine, New Granada, anal., *Boussingault*, Ch. News, xx., 311, 1869.

Beyrichite, Liebe, Jahrb. Min., 1871, 840.

Bieirosite—Beudantite. Adam, Tableau Min., 1869, p. 49.

Binnite, Min. p. 90.—Cryst., note, *Hessenberg*, Jahrb. Min., 1874, 842, 844.

Biotite, Min. p. 304.—Brewster, N. Y., altered to serpentine, *J. D. Dana*, Am. J. Sci., III., viii., 375, 1874.
Morawitza, analysis, *Rumpf*, Tsch. Min. Mitth., 1874, 177.
Pargas, Ceylon, etc., analyses, Tsch. Min. Mitth., 1874, 239, 242.
See also Mica.

Bismite, Min. p. 185.—Meymac, Corrèze, anal., *Carnot* thinks that bismuth ochre should e united to bismutite (Wismuthspath), and this name reserved for the true oxyd, C. R., xxix., 478, 1874.

Bismuth, Min. p. 19.—Found at Meymac, Corrèze, *Carnot*, C. R., lxxviii., 171; lxxix., 478, 874.
Victoria, *Ulrich*, contrib. Min. Vict., 1870, p. 5.

Bismuthinite, Min. p. 30.—Beaver Co., Utah, occurrence described, *Silliman*, Am. J. Sci., II., vi., 127, 1873.
Cerro Gordo, containing 5 p. c. Cu, anal., Domeyko, 3d Append., Min. Chili, 1871.
Meymac, Corrèze, anal., *Carnot*, C. R. lxxix., 304, 1874.

Bismutite, Min. p. 716.—St. José, Brazil, note, *v. Kobell*, J. pr. Ch., II., iii., 469.
Haddam, Conn., *Shepard*, Am. J. Sci., II., l., 94.
Mexico, near Guanajuato, pseudomorph after scheelite (?), anal., *Frenzel*, Jahrb. Min., 873, 801, 946; *Castillo*, Naturaleza, iii., p. 92, 1874. Oruro, Bolivia, ibid., 1874, 686.
Meymac, Corrèze, anal., *Carnot*, C. R., lxxix., 304, 1874.

Bismutoferrite, Appendix I., p. 3.—A second analysis afforded, *Frenzel*, $\ddot{\mathrm{S}}\mathrm{i}$ 24·05, $\overline{\mathrm{F}}\mathrm{e}$ 3·12, $\overline{\mathrm{B}}\mathrm{i}$ 42·83 = 100·00. He regards it as without doubt a good species. J. Min., 1872, 516.

Blende, Min. p. 48.—See **Sphalerite**.

BLOEDITE, Min. p. 643.—Stassfurt, cryst. and optical examination, *Groth* and *Hintze*, ZS G. Ges., xxiii., 670.
Stassfurt (simonyite, q. v., Appendix I., p. 14), *v. Rath*, Pogg., cxliv., 586 1871.

805 A. Bombiccite, *Bechi*, *Achiardi*, Min. Toscana, p. 358, 1873; *Bombicci*, Mem. Ac. Sc. Bologna, II., ix., 1869; *Guareschi*, Boll. Com. Geol. Ital., 1871, 70.

Triclinic. $I \wedge i\text{-}\bar{i} = 174° 50'$, $1 \wedge i\text{-}\bar{i} = 159°$.
H. = 0·5–1. G. = 1·06. Transparent. Colorless.
Analysis, Bechi (after deducting impurities) l.c.

H	O	C
10·70	14·74	74·56 = 100·00

This corresponds to the formula $H^{13}OC^7$.
Softens with heat, and fuses at 75°, and at a higher temperature it volatilizes. Insoluble in water, but extremely soluble in sulphid of carbon; also soluble in ether and in alcohol.
Found in lignite at Castelnuovo d'Avane, in the upper valley of the Arno, Tuscany.
Achiardi refers to this species a fossil resin, described by Guareschi (l.c.) as found in the upper valley of the Arno. It occurs in irregular whitish-yellow masses, soft. It fuses easily, and burns with a smoky flame. Two analyses gave:

	H	O	C
1.	9·41	17·87	72·72 = 100·00
2.	9·12	13·94	76·94 = 100·00

These analyses lead to a formula essentially identical with that given for bombiccite.

BORACITE, Min. p. 595.—Stassfurt, crystallized, *Schultze*, Jahrb. Min., 1871, 844.
Cryst. note, *Schrauf*, Tsch. Min. Mitth., 1872, 114.

BORATES.—Found in Nova Scotia, *How*, Phil. Mag., IV., xli., 274. 1871.
Peru, analyses (with wide variations probably due to admixtures of $Ca\,Cl_2$ and $Ca\,SO_4$), *Walker*, Ch. News, xviii., 203, 1868; see also *Thiercelin*, Bull. Soc. Ch., xvii., 387, 1872.

BORAX, Min. p. 597.—Sierra Nevada, *Silliman*, Am. J. Sci., III., vi., 130, 1873; see also Jahrb. Min., 1874, 716.

144 A. Bordosite.—Ann. des Mines, VII., i., p. 412, 1872. Bertrand describes a mineral substance. color yellow to red, occurring with an amalgam rich in Hg and Ag, and resulting from its decomposition. It becomes dark rapidly on exposure to the air.

Analysis.	AgCl	Hg'Cl	HgO
	31·23	45·53	22·70 = 99·46

Bertrand regards the HgO as adventitious, and proposes for it the name HYDRARGYRITE. deducting this there remain AgCl 40·69, and Hg_2Cl 59·31 = 100, or AgCl + Hg_2Cl, to which he gives the name of BORDOSITE. Both species appear very uncertain. Locality Los Bordos in Chili.

BORNITE, Min. p. 44.—From the Ardennes, anal., *Koninck*, Bull. Acad. Belg., II., xxvii., 290, 1871.

BOULANGERITE, Min. p. 99.—Silbersand, near Mayen, anal., *v. Rath*, Pogg., cxxxvi., 430. (Var. Embrithrite), composition, *Frenzel*, J. pr. Ch., II., ii., 360.

BOURNONITE, Min. p. 96.—Liskeard, Cornwall. anal., *Wait*, Ch. News, xxviii., 752, 1873

BOUSSINGAULTITE. Min. p. 635.—Bechi gave the name boussingaultite (C. R., lviii., 583, 1864) to the double salt of ammonia and magnesia occurring at the boracic acid fumaroles of Tuscany. The same mineral has since been fully described by Popp (Ann. Ch. Pharm., Suppl. Bd., viii., 1, 1870), and has received from him the name *cerbolite*. It seldom occurs quite pure in nature, but on re-crystallization it is obtained in perfect crystals of monoclinic form. An analysis of material thus obtained gave: $\frac{1}{2}$, NH^4 9·38, $\dot{M}g$ 11·05, $2\dddot{S}$ 44·39, $7\dot{H}$ 35·16 = 99·98, which affords the formula $NH_4O\dddot{S} + \dot{M}g\,\dddot{S} + 6\dot{H}$. A number of analyses of the natural salt showed that $\dot{F}e$, $\dot{M}n$ and $\dot{C}a$ may, in variable proportions, replace the $\dot{M}g$.

BRAGITE, Min. p. 525.—See FERGUSONITE.

BREITHAUPTITE.—See **ARITE.**

BREUNERITE, Min. p. 686. See **MAGNESITE.**

BROCHANTITE, Min. p. 664.—Schrauf (Ber. Ak. Wien, lxvii., 275, 1873) has thoroughly investigated this group of minerals, finding them to be isomorphous with malachite, and in crystalline form approximately monoclinic. He distinguishes four types. I Brochantite from Rezbanya (in two varieties), Redruth, Cornwall, etc., triclinic. II. Warringtonite from Cornwall. and a variety from Rezbanya, monoclinic (?). III. From Nischne, Tagilsk, monoclinic-triclinic. IV. Kōnigin from Russia, also a variety from Rezbanya, monoclinic or orthorhombic (anal. by *Ludwig* of this variety, Tsch. Min. Mitth., 1873, 36.)

BRONZITE, Min. p. 208.—In meteorites, *Rammelsberg*, Pogg., cxl., 316; from the chrysolite bombs of the Eifel, anal., same, ibid., cxli., 514, 1870.

From meteorite of Lodrau, cryst. and anal., *Tschermak*, Ber. Ak. Wien, lxi., 469, 1870.

Relation to other minerals of the pyroxene group, *Tschermak*, Tsch. Min. Mitth., 1871, 17.

From meteorite of Ibbenbühren, anal., *v. Rath*, Ber. Ak. Berlin, 1872, 33.

From basalt hills of Bohemia, anal., *Farsky*, Ber Böhm. Chem. Ges. (Zprávy, etc.), I., 26, 1872.

From the diamond rock of So. Africa, analyses, *Maskelyne & Flight*, Q. J. G. Soc., xxx., 411, 413, 1874.

Manayunk, Penn., anal., *Leeds*, Am. J. Sci., III., ix., 229, 1875.

See also *Enstatite.*

BROOKITE, Min. p. 164.—Cryst. (monoclinic, and isomorphous with wolframite), *Schrauf* Jahrb. Min., 1871, 168; 1873, 754 (Atlas der Krystall-Formen, Lief. IV.).

Urals, cryst., new forms, *v. Leuchtenberg*, Koksch. Min. Russl., vi., 204, 1870.

Found at Pfitsch Joch, Tyrol, Tsch. Min. Mitth., 1873, 49.

BRUCITE, Min. p. 175.—Altered by exposure to the air, *Hessenberg*, Min. Not., viii., 45, 868.

Brewster, N. Y., pseudomorph after dolomite; altered to serpentine, *J. D. Dana*, Am. J ci., III., viii., 375, 1874.

BUSTAMENTITE, Adam, Tableau Min., 1869, p. 67. An iodid of lead, Liebe, Jahrb. Min., 867, 159.

830 F. Byerite.—A name given by Mallet (Am. J. Sci., III., ix., 146, 1875) to the min- ral coal of Middle Park, Colorado. It belongs to the class caking-bituminous, and gave on nalysis, 39·95 p.c. volatile matter (gas and tarry oil), 54·03 p.c. fixed residue (coke and ash), nd 6·02 p.c. water. G. = 1.323. Color jet-black. Powder brown. It resembles albertite the large amount of gas and tarry oil yielded by it, but differs in being heavier and in elding no soluble products with bisulphide of carbon, ether, etc. It also resembles tor- nite, but is heavier, does not crackle in the fire, and melts and intumesces when heated.

BYTOWNITE, Min. p. 340.—*Tschermak*, Pogg., cxxxviii., 162.

Shown to be a mixture, *Zirkel*, Tsch. Min Mitth., 1871, 61.

CABRERITE, Min. p. 561.—Anal. and description, *Frenzel*, Jahrb. Min., 1874, 682.

CACHEUTAITE. Adam, Tableau Min., 1869, p. 52. A doubtful variety of clausthalite om the Cacheuta mine, Mendoza, So. Amer., Dana, Min., p. 798.

CACHOLONG, Min. p. 199.—Analyzed by *Nordenskiöld*, Œfv. Ak. Stockholm, 1874, 3.

CACOXENITE, Min. p. 584.—St. Benigna, Bohemia, *Boricky*, Ber. Ak. Wien, lvi., 6, 1867.

ALAMINE, Min. p. 407.—Silesia, anal., *Wieser*, Verh. Geol. Reichs., 1871, 112.

Wythe Co., Virginia, anal., *Irby*, Ch. News, xxviii., 272, 1873.

ALAVERITE, Min. p. 795.—Red Cloud mine, Colorado, anal., *Genth*, Am. Phil. Soc. ilad., xiv., 229, 1874.

ALCITE, Min. p. 670.—In melaphyr on the Nahe, cryst., new forms, *v. Rath*, Pogg., xv., 572.

ryst. *Meyn*, *Rose*, ZS. G. Ges., xxiii., 456, 464.

Discussion of causes producing variety in forms, *Credner*, J. pr. Ch. II., i., 293, 1870.
Discussion of twins, *Scharff*, Jahrb. Min., 1870, 542.
Pseudomorphs in sandstone, Heidelberg, *Klocke*, Jahrb. Min., 1869, 714; at Sievring, near Vienna, *Brezina*, Jahrb. G. Reichs., xx., 1, 1870.
Pseudomorph after apophyllite, *Streng*, Jahrb. Min., 1870, 425.
An apparently hemimorphic crystal, *Bauer*, ZS. G. Ges., xxiv., 397, 1872.

Striegau, cryst. (with R^{17}, $-\frac{7}{8}R^{\frac{4}{7}}$, $-\frac{7}{8}R$), *Websky*, Tsch. Min. Mitth., 1872, 63.
Lake Superior, cryst., *Hessenberg*, Min. Not., ix., 1, 1870; Canary Is., ib., ix., 9; Bleiberg, ibid., x., 37, 1871; Iceland, ib., xi., 9, 1873; Andreasberg, xi., 17, 1873.
Stalactites from Niemschitz, from Erzberg, cryst., *Vrba*, Lotos, Déc., 1872.
Lake Superior, a remarkable twin, *v. Rath*, Pogg., clii., 17; Alston Moor, cryst. (R^4), ibid., Erg. Bd. v., 438.
Cryst., drilling (2R), *E. S. Dana*, Tsch. Min. Mitth., 1874, 180.
Brewster, N. Y., altered to serpentine, *J. D. Dana*, Am. J. Sci., III., viii., 375, 1874.
From the melaphyr at Canisdorf, cryst., new forms, *Schnorr*, Jahrb. Min., 1874, 636.
Catalogue of planes given by *Des Cloizeaux*, translated into Naumann's Symbols, *Hessenberg*, Jahrb. Min., 1874, 849.
Schneeberg, remarkable association with quartz, *v. Rath* and *Frenzel*, Ber. Ak. Berlin, 1874, 683.

CALEDONITE, Min. p. 625.—Red Gill, Cumberland, cryst., *Hessenberg*, Min. Not., ix., 48, 1870.
Leadhills, anal. by *Maskelyne* and *Flight;* they conclude that the mineral is really free from carbonic acid, and corresponds in composition to the formula $5\dot{P}b\overline{S} + 3\dot{C}u\dot{H} + 2\dot{P}b\dot{H}$. J. Ch. Soc., II., xii., 101, 1873.
Rezbana, cryst., *Schrauf*, Ber. Ak. Wien, lxiv., 173; lxv., 241. **See Appendix I., p. 18.**

Campbellite. See CHALYPITE.

CANCRINITE, Min. p. 329.—Comp., *Kenngott*, Verh. Min. Ges. St. Pet., II., vii.

CARBONYTTRINE. *Adam*, Tableau Min., 1869, p. 24. Synonym of *tengerite*, Dana Min. 1868, p. 710.

CARNALLITE, Min. p. 118.—Westeregeln, anal., *Reinwarth*, Jahrb. Min., 1874, 618.
Stassfurt, containing thallium, *Hammerbacher*, Ann. Ch. Pharm., clxxxii., 82, 1875.

CARPHOLITE, Min. p. 419.—Found at Wippra in the Harz, anal., *Lossen*, ZS. G. Ges., xxii., 455, 1870.

CASSITERITE, Min. p. 157.—Found at Winslow, Me., *Jackson*, Proc. N. Hist. Bost., xii., 267, 1869.
New South Wales, occurrence described, *Ulrich*, Q. J. G. Soc., xxix., 5, 1873.
Found in large quantities in Queensland, Am. J. Sci., III., v., 137, 1873.

CELESTITE, Min. p. 619.—Anal., and discussion of products of decomposition, *Ullik*, Ber. Ak. Wien, lvii., 929, 1868.
Found in tertiary rocks of Egypt, Phil. Mag., IV., xxxviii., 162, 1869.
Pseudomorphs, *Scacchi*, Atti Acad. Sci., Napoli, March, 1870.
Cryst. memoir (many figures), *Auerbach*, Ber. Ak. Wien, lix., 549, 1869.
Monte di Zoccolino, Italy, anal., *Achiardi*, Boll. Com. Geol. Ital., 1871, 135.
Found near Hannover Lindener Berg, *Guthe*, Jahrb Min., 1870, 480.
Rüdersdorf, etc., cryst. and analyses, with a discussion of the influence of isomorphous admixtures on the crystalline form, *Arzruni*, ZS. G. Ges., xxiv., 477, 1872.

CERARGYRITE, Min. p. 114.—Andreasberg, in crystals, *v. Groddeck*, Jahrb. Min., 1869, 445.
Domeyko has described a related mineral from the Cordillera of Dehesa. It contains beside AgCl also Ag_2Cl and Cu_2Cl, though in varying proportions, as shown by the analyses. Its color is ash-gray, and it does not alter at all on exposure to the light. Sectile like horn-silver. 3d Append. Min. Chili, 1871.

Cerbolite. See BOUSSINGAULTITE.

CERITE, Min. p. 413.—Bastnäs, cryst., shown to be orthorhombic, $I \wedge I = 90° 4'$, $i\text{-}\bar{i} \wedge 1\text{-}$ $= 129° 8'$, anal., *Nordenskiöld*, Œfv. Ak. Stockholm, xxvii., 551, 1870, xxx., 13, 1873.

CEROLITE, Min. p. 470.—Saxony, anal., *Frenzel*, Jahrb. Min., 1873, 789.

CERUSSITE, Min. p. 700.—Kurlibaba (Bukowina), cryst., *Zepharovich*, Ber. Ak. Wien, lxii., 439, 1870.
Cryst. memoir, *Kokscharow*, Min. Russl., vi., 100.
Cryst., new forms, and discussion of twins, *Schrauf*, Tsch. Min. Mitth., 1873, p. 203.

CHABAZITE, Min. p. 434.—Discussion of composition, with analyses, *Kenngott*, J. pr. Ch., II., i., 123; *Rammelsberg*, Pogg., cxlii., 476; anal., ZS. G. Ges., xxi., 84.

CHALCOLITE, Min. p. 585.—See TORBERNITE.

CHALCOMICLITE. A name used by Blomstrand for a mineral having the composition $3CuS, FeS^3$, and hence synonymous with bornite (see Rammelsberg Min. Chem., p. 115). Œfv. Ak. Stockholm, xxvii., p. 24, 1870.

370 A. Chalcomorphite, v. Rath, Pogg. Ann., Erg. Bd. vi., p. 376, 1873.
Hexagonal, *a* (vert.) = 1·8993. Occurring planes *O*, *I*, 1. *O* : 1 = 114° 24′. Cleavage, *O* distinct. H. = 5. G. = 2·54. Lustre vitreous. Pyr., gives water in a matrass, becoming white and lustreless. B.B., fuses with difficulty on the edges, curling up like skolecite. Soluble in HCl with the separation of gelatinous silica.

Analysis (l. c.) on 0·26 gr.	$\ddot{\mathrm{Si}}$	$\dddot{\bar{\mathrm{A}}}\mathrm{l}$	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\bar{\mathrm{H}}}$ (and some $\ddot{\mathrm{C}}$)
	25·4	4·0	44·7	16·4

loss, in part $\dot{\mathrm{N}}\mathrm{a}$, 9·5 = 100·00.
From the Laacher See, also from Niedermendig in the Eifel. Occurring in cavities in limestone-inclosures in the lava.

CHALCOPHYLLITE, Min. p. 571.—Cornwall, analyses, *Church*, J. Ch. Soc., II., viii., 168, 1870.

CHALCOPYRITE, Min. p. 65.—Cryst. memoir, *A. Sadebeck*, ZS. G. Ges., xx., 595, 1868; even apparently holohedral forms are really hemihedral, same, ib., xxiv., 181, 1872.
Tuscany, analyses, Boll. Com. Geol. Ital., 1873, 239.

68 A. Chalcopyrrhotite, Blomstrand, Œfv. Akad. Stockholm, xxvii., p. 23, 1870.
Massive. Color like that of pyrite with a tinge of brown. Hardness nearest that of chalcopyrite. G. = 4·28.
Analysis (l. c.)

	Fe	Cu	S	residue
$\frac{3}{2}$	48·22	12·98	38·16	0·74 = 100·09

which gives the formula Fe^4CuS^6 or $\left.\begin{matrix}2FeS\\CuS\end{matrix}\right\} Fe\,S^3$
Occurs at Nya Kopparberg, Sweden, in small imbedded portions with magnetite, spalerite, calcite, as well as chondrodite, the mineral most characteristic of the locality.

Chalypite. A name given by Shepard to a compound of iron and carbon found by Forchhammer as a leading constituent of the Niakornak iron. The carbon varied from 7·23 — 11.06 p. c., corresponding to the formula CFe^2 (Am. J. Sci., II., xlviii., 28, 1867). Meunier uses the name (Ann. Ch. Phys., IV., xvii., 36, 1869), and introduces another, **Campbellite,** for a similar compound, C. = 1·50 p. c., seemingly contained in the Campbell Co., Tenn., meteoric iron, which was analyzed by J. L. Smith (Am. J. Sci., II., xix., 159, 1855).

CHAMASITE, Min. 16.—In meteoric iron, *Meunier*, Ann. Ch. Phys., IV., xvii., 32.

CHILDRENITE, Min. p. 579.—Tavistock, anal., *Church*, J. Ch. Soc., II., xi., p. 103, 1873.

CHLORITE. See RIPIDOLITE, PROCLORITE.

CHLORITOID, Min. p. 504.—Chatham Co., No. Carolina, anal., *Genth*, Am. Phil. Soc. Philad., xiii., 399, 1873.

138 A. Chlorocalcite. Scacchi, Rend. R. Accad. Sc. Napoli, Oct., 1872 (ZS. G. Ges., xxiv., 505).

Isometric. In small crystals with cubic, octahedral and dodecahedral planes. Transparent, sometimes stained a light violet. Very soluble, deliquescing readily. Analysis gave 58·76 p. c. $CaCl_2$, the residue consisting of the chlorides of potash, soda and manganese.

Isomorphous with the chlorides of potash and soda.

Found at Vesuvius in the bombs thrown out during the eruption in April, 1872.

CHONDRODITE, Min. p. 363.—Composition discussed, *Kenngott*, Nat. Ges. Zürich, xiv., 162, 1869.

Pargas, crystals identical with humite, type II,, *Kokscharow*, Min. Russl., VI., 73 et seq.

Nya-Kopparberg, crystals belonging to humite, type II., *v. Rath*, Pogg., cxliv., 563, 1871.

Found in the Böhmerwald, near Husine, *Krejci*, Ber. Böhm. Ges. Prag, 1873, 360.

Brewster, N. Y., anal., *Breidenbaugh*, Am. J. Sci., III., vi., 212; altered to serpentine, *J. D. Dana*, ibid., viii., 375, 1874; preliminary notice of crystals, in which it is shown that while the majority belong to the second type (humite), there are also some which are of *type III*. The same planes occur, as on humite, with a large number of other new forms, the kind of hemihedrism is the same, and the angles are nearly identical. *E. S. Dana*, ibid., ix., 63, 1875.

See also Humite.

CHROMITE, Min. p. 153.—Analyses, Koksch., Min. Russl., V., 161, 1867.

Analyses, *Clouet*, Ann. Ch. Phys., IV., xvi., 90.

Monterey Co., Cal., anal., *E. Goldsmith*, Proc. Ac. Philad., 1873, 365.

Hungary, analyses, *Hoffmann*, Jahrb. Min., 1873, 873.

See Magnochromite.

CHROMPICOTITE, *J. Petersen*, J. pr. Ch., cvi., 137. Appendix I., p. 3.

CHRYSOBERYL, Min. p. 155.—Helsingfors, anal., *F. J. Wiik*, Jahrb. Min., 1868, 184. Cryst., ibid., 1869, 356.

Russia, cryst., new forms, *Klein*, Jahrb. Min., 1869, 548; 1871, 479.

Isomorphous with chrysolite, *Sadebeck*, Ber. Ges. Berlin, May 17, 1870; Jahrb. Min., 1870, 628.

CHRYSOLITE, Min. p. 256.—Laacher See, cryst., *v. Rath*, Pogg., cxxxv., 579; Vesuvius, twin, ibid., p. 581.

Bourbon Isles, red variety in lava, *Fuchs*, Jahrb. Min., 1869, 577.

As constituent of rocks, *Boué*, Ber. Ak. Wien, lvi., 254; same, with analyses, *Tschermak*, ibid., p. 261; from meteorite of Lodran, anal., *Tschermak*, ib., lxi., 467, 1870.

Cryst. memoir, *Kokscharow*, Min. Russl., VI., 1, 1870.

From the Pallas iron, anal., *v. Baumhauer*, Versl. Med. Ak. Amsterdam, v., 362, 1871; from Tjobe (India), meteorite, anal., same, ib., vi., 54, 1872.

From some basalts of Bohemia, anal., *Farsky*, Ber. Chem. Ges. Böhm. (Zprávy, etc.), 1872, 22.

In labradorite rocks of N. Hampshire, anal., *E. S. Dana*, Am. J. Sci., III., iii., 49, 1872.

Snarum, anal., Pogg., cxlviii., 329, 1873.

CHRYSOTILE, Min. p. 465.—See SERPENTINE.

CHUSITE, Min. p. 258.—Character doubtful, *Rosenbusch*, Jahrb. Min., 1872, 169.

CINNABAR, Min. p. 55.—Province of Lucca, cryst., showing that it is tetartohedral like quartz, *Achiardi*, Boll. Com. Geol. Ital., 1871, 163. Min. Tosc., II., p. 282.

Pseudomorph after barite, *Durand*, Cal. Acad. Sci., iv., 211, 1872.

Clarite. Sandberger has given this name to a supposed new mineral occurring at the Clara mine, near Schapbach, Kinzigthal. The chief constituents were found to be sulphur, antimony, arsenic and copper. Color dark steel-gray. Apparently orthorhombic, with cleavage perfect in one (macrodiagonal) direction. Occurs altered to chalcopyrite; also affords covellite as a result of decomposition. In addition to these minerals, tetrahedrite has been found at the same mine, and in larger quantities barite, fluorite, psilomelane and limonite. Jahrb. Min., 1874, 960.

CLAUSTHALITE, Min. 42, 798.—Mendoza, *Domeyko*, 2d App. Min. Chili, p. 30, 1867; 4th App., p. 21, 1874. *Stelzner*, Tsch. Min. Mitth., 1873, 254.

CLINOCHLORE, Min. p. 497.—Belonging to a "clino-hexagonal" system, *Schrauf*, Tsch. Min. Mitth., 1874, 161.

Chester Co., Penn., anal., *Neminars*, Tsch. Min. Mitth., 1874, 176.

Coal, analyses, showing the presence of sulphur in addition to that combined with the iron (as FeS_2), *Wormley*, Ohio Geol. Report, 1870, p. 412.

Cobaltite, Min. p. 17.—Thermo-electrical character, *Rose*, Pogg., cxlii., 1, 1871; *Schrauf* and *Dana*, Ber. Ak. Wien, lxix., 156, 1874.

Coeruleolactite, *Petersen*, Jahrb. Min., 1871, 353—Appendix I., p. 3.
Dr. Genth has observed a similar mineral with wavellite at General Trimble's iron mine, near White Horse Station, Chester Valley R. R., Chester Co., Penn (the locality erroneously called "Steamboat"). It is in cryptocrystalline, botryoidal, incrustations of a pale greenish blue or sky-blue color. An analysis of nearly pure material gave him: $\overset{\cdot\cdot}{\bar{P}}$ 36·31, $\overset{\cdot\cdot\cdot}{\bar{A}}l$ 38·27, Cu 4·25, $\dot{H} = 21·70$, quartz $0·54 = 101·07$. $G. = 2·696$. Neither the wavellite nor any other associated mineral contains copper, so that Dr. Genth regards it as probably belonging to the constitution of the mineral (priv. contrib.).

Columbite, Min. p. 515.—Bodenmais, composition, *Hermann*, J. pr. Ch., ciii., 127, 1868; II., ii., 2, 113.
Composition, *Rammelsberg*, ZS. G. Ges., xxi., 555, 1869.
From New England, *Shepard*, Am. J. Sci., II., l., 90, 1870.
Relation to wolframite, *Jeremejew*, Jahrb. Min., 1873, 421; also *Groth* and *Arzruni*, Pogg., xlix., 235, 1873.
San Roque, Argentine Republic, anal., Siewert, Tsch. Min. Mitth., 1873, 224.

Copiapite, Min. p. 655.—Anal., Domeyko, 4th Append. Min. Chili, p. 7, 1874.

Copper, Min. p. 14.—Wallaroo, *Schrauf*, Tsch. Min. Mitth., 1872, 55; artificial crystals, bid., 1873, 290.
Cryst. note, *Zerrenner*, Tsch. Min. Mitth., 1874, 94.
Remarkable crystal, *Kokscharow*, Verh. Min. Ges. St. Pet., II., vii. (Jahrb. Min., 1873, 421).

Coquimbite, Min. p. 650.—Atacama, anal., Domeyko, 4th Append. Min. Chili, p. 6, 1874.

Corkite. Adam, Tableau Min., 1869, p. 49. A synonym of beudantite, Levy (Dana Min., p. 589).

Cornwallite, Min. p. 569.—Analyses by *Church*, confirming it as a good species, but iving a smaller amount of $\dot{H}$ (about 8 p. c.) than in the analysis by *Lerch* (l. c.), J. Ch. Soc., II., vi., 276, 1868.

Corundophilite, Min. p. 504.—Chester, Mass., anal., *Eaton*, Am. J. Sci., II., xlvi., 56, 1868.

Corundum, Min. p. 137.—Pelham, Mass., *Adams*, Am. J. Sci., II., xlix., 271.
No. Carolina, Am. J. Sci., III., iii., 301; same, *Shepard*, ibid., iv., 109, 172, 1872; same lso Montana), occurrence described, *J. L. Smith*, ib., vi., 180.
Chester Co., Penn., Proc. Acad. Philad., 1872, 238, 260.
Ceylon (sapphire), cryst., *Klein*, Jahrb. Min., 1871, 486.
No. Carolina, complete description of occurrence, analyses, and enumerarion of various inerals as alteration products, *Genth*, Am. Phil. Soc. Philad., xiii., 361, 1873.

Cosalite, Min. p. 797.—Found at Rezbanya, *Frenzel*, Jahrb. Min., 1874, 681.

Cotunnite, Min. p. 117.—Vesuvius, *Scacchi*, Atti Accad. Sci. Napoli, (read) March, 1870.

Crocidolite, Min. p. 243.—Altered to Faserquarz, *Wibel*, Jahrb. Min., 1873, 367.

Cronstedtite, Min. p. 503.—Cornwall, analyses, and cryst. description (an illustration hemimorphism of a very interesting kind), *Maskelyne* and *Flight*, J. Ch. Soc., II., ix., 1871.

Cryoconite. Kryokonit, *Nordenskiöld*, Œfv. Ak. Stockholm, 1871, 293; 1874, 3. (Pogg., n., cli., 161, 1874; Geol. Mag., ix., 355, 1872.)
Nordenskiöld has given the name cryoconite to the powder found by him in Greenland vering the surface of land ice, as also at a distance of 30 miles from the coast. It formed ayer of gray powder, sometimes several millimetres in thickness, and often agglomerated o small round balls of loose consistency. Under the microscope it was seen to consist fo

the most part of colorless, crystalline, angular grains; there were also some organic particles, some transparent fragments showing cleavage surfaces (feldspar?), green crystalline fragments (augite?), and black, opaque magnetic particles. An analysis gave *G. Lindström* (l. c.)

$\ddot{\mathrm{Si}}$	$\overset{\cdot\cdot}{\overline{\mathrm{Al}}}$	$\overline{\mathrm{Fe}}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Mn}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{K}}$	$\dot{\mathrm{Na}}$	$\overset{\cdot\cdot}{\overline{\mathrm{P}}}$	$\ddot{\mathrm{C}}$
62·25	14·93	0·74	4·64	0·07	5·09	3·00	2·02	4·01	0·11	0·06

water, organic matter (ignited at 100°) = 2·86, hygroscopic water 0·34 = 100·12.

Nordenskiöld states that the amount of foreign constituents (named above) is very small, so that *if the transparent grains all belong to the same mineral*, its composition can be deduced from the analysis, the oxygen ratio for $\dot{\mathrm{R}} : \ddot{\mathrm{R}} : \ddot{\mathrm{Si}} = 2 : 3 : 14$, and the formula as given by him is $2\dot{\mathrm{R}}\,\ddot{\mathrm{Si}}^2 + \overset{\cdot\cdot}{\overline{\mathrm{Al}}}\ddot{\mathrm{Si}}^3 + \dot{\mathrm{H}}$. Its specific gravity was 2·63 (21° C.), hardness inconsiderable, and crystalline form monoclinic. The magnetic particles contain metallic iron, with cobalt and probably nickel. In regard to the source of the powder, the conclusion arrived at is that it must either have come from Jan Mayen, or from some unknown volcanic region in the interior of Greenland, or else it must be of *cosmical origin*.

The oxygen ratio given is a very unlikely one, and there seems to be no sufficient ground for considering the material essentially homogeneous, as claimed by Nordenskiöld. The composition is very closely that of an oligoclase-trachyte, so that the cryoconite may be properly, as he calls it, a "trachytic dust."

CRYOLITE, Min. p. 126.—Manufacture of soda from, *J. L. Smith*, Chem. News, xxiii., 270, 1871.

CRYPTOMORPHITE, Min. p. 599.—Extensive deposits in Nevada, Am. J. Sci., III., iv., 146. —See Priceite.

Crystallites. A name given by Vogelsang to the forms, often observed especially in igneous rocks, which show a regular arrangement or grouping, but have not the properties of crystals, particularly not their regular exterior form. They seem to form an intermediate step between amorphous matter and true crystals. See Vogelsang,—DIE KRYSTALLITEN, Bonn, 1875, this App. p. vi. To the crystallites, Vogelsang has given a variety of names according to their form or appearance: *Globulites* (Vogelsang, p. 13), *margarites* (p. 19), *longulites* (p. 21, 112), *sphärolites* (p. 131), *cumulites* (p. 134), *globosphärites* (p. 134), *belonosphärites* (p. 135), *felsosphärites* (p. 135), *granosphärites* (p. 135). See also *Ferrite*, *Opacite*, *Viridite*.

CUBANITE, Min. p. 65.—Found at Tunaberg, Kafveltorp, Sweden, analyses, *Cleve*, Geol. För. Förh. Stockholm, I., 105, 1873.

Culsageeite. See JEFFERISITE.

CUPRITE, Min. p. 133.—Liskeard, Cornwall, cryst. ($\frac{3}{2}$-$\frac{3}{2}$ new), *Schrauf*, Tsch. Min. Mitth., 1871, 106.

CUPROAPATITE. Adam, Tableau, Min., 1869, p. 45. An apatite from Chili, containing 20·93 p. c. $\dot{\mathrm{C}}\mathrm{u}$; analyzed by Field (Dana Min., p. 532.)

669 A. Cupromagnesite. *Scacchi*, Rend. R. Accad. Sc. Napoli, Oct., 1872 (ZS. G. Ges., xxiv., 506). Found at Vesuvius as a product of the eruption of April, 1872, in bluish-green crusts, consisting of copper vitriol and sulphate of magnesia. From the solution crystals are obtained having the composition $(\dot{\mathrm{C}}\mathrm{u}\ \dot{\mathrm{M}}\mathrm{g})\ \dddot{\mathrm{S}} + 7\ \dot{\mathrm{H}}$, and isomorphous with iron vitriol.

CYANITE, Min. p. 375.—No. Carolina, with corundum, *Genth*, Proc. Am. Phil. Soc. Philad., xiii., 381, 1873.

CYANOCHALCITE, *Hermann*, J. pr. Ch., cvi., 65.—Appendix I., p. 4.

CYANOTRICHITE, Min. p. 666.—Cap Garonne, note by Pisani, C. R., lxx., 1004, 1870.

CYMATOLITE, Min. p. 455.—Optical characters, *Bauer*, ZS. G. Ges., xxvi., 186, 1874.

CUPROSCHEELITE, Min. p. 606.—Chili, analyses, Domeyko, 2d Append. Min. Chili, p. 3, 1867.

615 A. Cuprotungstite. Tungstate de cuivre, *Domeyko*, Ann. des Mines, VI., xvi., p. 537, 1869. Cuprotungstite, *Adam*, Tableau Min., 1869, p. 32.

Amorphous, forming crusts of one or two mm. thickness, enveloping small, hard, glittering kernels of cupreous scheelite (the latter green in color).

Color yellowish-green. Streak bright greenish-yellow. Analyses of fragments taken with a knife from different crusts.

	$\dddot{\mathrm{W}}$	$\dot{\mathrm{C}}\mathrm{u}$	$\dddot{\mathrm{F}}\mathrm{e}$	$\dot{\mathrm{C}}\mathrm{a}$	residue ($\ddot{\mathrm{S}}\mathrm{i}$)	$\dot{\mathrm{H}}$
1.	55·7	——	4·2	2·1	2·4	4·5
2.	56·48	30·63	2·53	2·00	3·87	4·62=100·13
3.	55·54	28·15	3·62	1·00	6·00	4·62= 99·03

Analysis (2) was made on what was regarded as the purest material. Part of the iron probably belongs with the residue ($\ddot{\mathrm{S}}\mathrm{i}$). The composition is expressed by the formula $\dddot{\mathrm{W}}^3\dot{\mathrm{C}}\mathrm{u}$, there being also some $\dddot{\mathrm{W}}^3\dot{\mathrm{C}}\mathrm{a}$ present.

On charcoal blackens, and fuses easily to a black globule, slightly porous, and with an uneven surface. In the closed tube gives water. at a red heat loses 4½ p. c. Easily decomposed by nitric acid, even in the cold, giving a yellow residue soluble in ammonia, and a solution strongly colored by copper.

Found near the copper mines of Llannico in the environs of Santiago, Chili. The cuproscheelite (Dana Min. p. 606) associated with the cuprotungstite had sometimes a rich dark green color, also a clear green color with a tint of yellow; lustre vitreous or resinous, with an imperfect lamellar structure. H.=4. An analysis gave:

$\dddot{\mathrm{W}}$	$\dddot{\mathrm{F}}\mathrm{e}$	$\dot{\mathrm{C}}\mathrm{u}$	$\dot{\mathrm{C}}\mathrm{a}$	ign	insol.
(76·00)	1·55	5·10	15·25	1·70	0·40=100

The ordinary scheelite also occurs at the same locality, but is easily distinguished by its superior hardness.

CUPROVANADITE. Adam, Tableau Min., 1869, p. 33. Syn. of chileite, 1853, Dana Min., p. 612.

DAMOURITE, Min. p. 487.—Horrsjöberget, anal., *Igelström*, Œfv. Ak. Stockh., xxv., 37, 1868.

As a result of decomposition, anal., *Tschermak*, Ber. Ak. Wien, lviii., 16, 1868.

Salm Chateau, anal., *Koninck* and *Davreux*, Bull. Acad. Roy. Belg., II., xxxiii., 324, 1872.

Optical character, *Bauer*, ZS. G. Ges., xxvi., 183.

No. Carolina, associated with corundum, analyses, *Genth*, Am. Phil. Soc. Philad., xiii., 384, 1873.

A variety of damourite has been called STERLINGITE by *J. P. Cooke* (Mem. Am. Ac. Boston, 1874, p. 39).

It agrees with *damourite* in physical properties, but differs in the value of the optic-axial angle. Biaxial divergence about 70° (damourite 10°-12°), plane of axes parallel to the shorter diagonal. Dispersion small. Analysis by C. E. Munroe. (l. c.)

$\ddot{\mathrm{S}}\mathrm{i}$	$\dddot{\mathrm{A}}\mathrm{l}$	$\dddot{\mathrm{F}}\mathrm{e}$	$\dot{\mathrm{K}}$	$\dot{\mathrm{H}}$
43·87	36·45	3·36	10·86	5·19

Regarding the water as basic with the protoxides, the atomic ratio becomes $\ddot{\mathrm{S}}\mathrm{i} : \dddot{\mathrm{R}} : \dot{\mathrm{R}} =$ 4 : 3 : 1 (as in damourite).

Found at Sterling, Mass., associated with spodumene in the vein of a large bowlder rock. (This same name was given by Alger to the zincite of New Jersey.)

DANAITE (arsenopyrite), Min. p. 78.—Relation to glaucodot, *Tschermak*, Ber. Ak. Wien, lv., 447, 1867.

San Jose, anal., Domeyko 2d App. Min. Chili, p. 13, 1867.

Shown to possess positive and negative thermo-electrical varieties, *Schrauf* and *Dana*, Ber. Ak. Wien, lxix, 152, 1874.

DATOLITE, Min. p. 380.—Isomorphous with euclase and gadolinite, *Rammelsberg*, ZS. G. Ges., xxi., 807. See Euclase.

Andreasberg, anal., *Lemberg*, ZS. G. Ges., xxiv., p. 250, 1872.

Bergen Hill, cryst. monograph, new forms, *E. S. Dana*, Am. J. Sci., III., iv., 16, 1872.

Arendal, Toggiana, etc., cryst., enumeration of all known planes, with the addition of some new ones, *E S. Dana*, Tsch. Min. Mitth., 1874, 1.

Santa Clara, Cal., associated with garnet and idocrase, *J. L. Smith*, Am. J. Sci., III., viii., 434, 1874.

DAUBERITE. Adam, Tableau Min., 1869, p. 64. Synonym of zippeite, Haidinger, Handb., 1845. Dana Min., p. 667.

Dawsonite, *B. J. Harrington*, Can. Nat., vol. vii., p. 305, 1874.
Monoclinic with $C = 105°$? In thin bladed crystals, sometimes somewhat fibrous. Double-refracting. H. = 3. G. = 2·40. Lustre vitreous. Color white. Transparent to translucent.
Analysis (l. c.) Harrington.

	$\dddot{\overline{\text{Al}}}$	$\dot{\text{Mg}}$	$\dot{\text{Ca}}$	$\dot{\text{Na}}$	$\dot{\text{K}}$	$\dot{\text{H}}$	$\ddot{\text{C}}$	$\ddot{\text{Si}}$	
1.	32·84	tr	5·95	20·20	0·38	11·91	29·88	0·40	= 101·56.
2.	32·68 ($\dddot{\overline{\text{Fe}}}$ tr)	0·45	5·65	20·17		[10·32]	30·72		= 100·00

The two analyses, made at different times, show considerable constancy of composition, and seem to point to "a hydrous carbonate of alumina, lime and soda, or perhaps a compound consisting of a hydrate of alumina combined with carbonates of lime and soda."

There is approximately the quantity of water required to form a di-hydrate of alumina, and nearly enough carbonic acid to form a neutral carbonate of lime and bicarbonate of soda. If it be a carbonate of alumina, it gives the mineral peculiar interest as being a compound, not surely identified hitherto either in nature (see hovite, Dana Min., p. 709), nor in the laboratory.

DECHENITE, Min. p. 609.—Cryst., *Schrauf*, Ber. Ak. Wien, lxiii., 167, 1871.

178 A. Delafossite, *C. Friedel*, C. R., lxxvii., p. 211, 1873.
In small crystalline plates, cleavable into thin opaque lamellæ. H. = 2·5, G. = 5·07. Color dark gray like graphite, with a more decided metallic lustre. Streak blackish-gray.
An analysis gave Friedel (l. c.)

$\dot{\overline{\text{Cu}}}$	$\dddot{\overline{\text{Fe}}}$	$\dddot{\overline{\text{Al}}}$
47·45	47·99	3·52 = 98.96

This corresponds to $\dddot{\overline{\text{Fe}}}$,$\dot{\overline{\text{Cu}}}$, (but is it not a mixture ?)
B.B. Fusible with difficulty, coloring the flame green. Easily soluble in HCl, even in the cold.
Found on yellowish-white lithomarge from the region of Katharinenburg, Siberia, perhaps also from Bohemia. Named for the mineralogist Delafosse.

DELESSITE, Min. p. 497.—Filling cavities in an amygdaloid, Nova Scotia, anal., *How*, Phil. Mag., IV., xxxvii., 269.

DERNBACHITE. Adam, Tableau Min., 1869, p. 49. A synonym of beudantite, *Lévy*, (Dana Min., p. 589).

DESCLOIZITE, Min. p. 609.—Wheatly mine, Penn., *J. L. Smith*, Am. J. Sci., II., xlviii., 137, 1869.
Note by *Kenngott*, Jahrb. Nat. Ges. Zürich, xvi., 137, 1871.
Cryst., *Schrauf*, Ber. Ak. Wien, lxiii., 167, 1871.

Dewalquite. See ARDENNITE.

DEWEYLITE, Min. p. 469.—Probably derived from the decomposition of albite, anal., *Leeds*, Am. Chemist, iv., 64, 1873.

DIABANTACHRONNYN, *Liebe*, Jahrb. Min., 1870, 1.—Appendix I., p. 4. See also *Kenngott*, Jahrb. Min., 1871, 51.

DIALLAGE, Min. p. 215.—Relation to minerals of the pyroxene group, *Tschermak*, Min. Mitth., 1871, 25; Streng, ibid., 1872, 274.

DIAMOND, Min. p. 21.—Occurrence described, *Kokscharow*, Min. Russl., V., 373; VI., 190 et seq.
Found at Dlaschkovitz, Bohemia, *Schafarik*, Pogg., cxxxix., 188, 1870; ibid., cxl., 336; *Zepharovich* throws doubt upon the matter, ibid., cxl., 652.

Views on the origin of, W. B. Clarke, Ch. News, xxiv., 16, 40. 64. 78.
Probably exists with the platinum of Oregon, *Wœhler*, Am. J. Sci., II., xlviii., 441.
Probable existence in the gold washings of California, with zircons and topaz, *Silliman*, Am. J. Sci., III., v, 384; found at Cherokee, Butte Co., Cal., same, ib., vi., 133, 1873.
Behavior on heating, Rose, Pogg., cxlviii., 497; v. Schrötter, Ber. Ak. Wien, lxiii., 462, 1871; Baumhauer. Vers. Need. Ak. Amsterdam, II., vii., 200, 1873.
A uniaxial crystal, Schrauf, Tsch. Min. Mitth., 1873, 289.
Knop has shown that the supposed diamonds of Jeremejew do not exist in the xantophyllite (Jahrb. Min., 1871, 275; Appendix I., p. 19). On the contrary, the appearances are due, not to inclosed crystals, but to cavities which, says Knop, owe their existence to the corroding influence of acids either in nature or in the laboratory (Jahrb. Min., 1872, 785).

DIAPHORITE, *Zepharovich*, Ber. Ak. Wien, lxiii., 130; Appendix I., p. 4.

DIASPORE, Min. p. 168.—Chester Co., Penn., anal., *Sharples*, Am. J. Sci., II., xlvii., 319, 1868.
Urals, near Mramorsk, anal., containing P_2O_5, *Hermann*, J. pr. Ch., cvi., 70, 1869.
Chester, Mass., containing phosphoric acid, *Shepard*, Am. J. Sci., II., l., 96, 1870.
No. Carolina, occurrence described, *Genth*, Am. Phil. Soc. Philad., xiii., 372, 1873.

DIMORPHITE (Scacchi), Min. p. 28.—*Kenngott* suggests that both types of this species are o be referred to orpiment (auripigment), Jahrb. Min., 1870, 537.

DIOPSIDE, Min. p. 214.—From the chrysolite bombs of the Eifel, *Rammelsberg*, Pogg., xli., 516.
Relation to minerals of the pyroxene group, *Tschermak*, Tsch. Min. Mitth., 1871, 21.

DIOPTASE, Min. p. 248.—Composition, *Rammelsberg*, ZS. G. Ges., xx., 536, 1868.

DOLOMITE, Min. p. 681.—Brewster, N. Y., altered to serpentine; to brucite; pseudoorph after chondrodite, *J. D. Dana*, Am. J. Sci., III., viii., 375, 1874.
Pseudomorph after garnet, *Laube*, Lotos, xxii., 209, 1872.
Analyses, *Lemberg*, ZS. G. Ges., xxiv., 218 et seq., 1872.

DOMEYKITE, Min. p. 36.—Analyses, *Frenzel*, Jahrb. Min., 1873, 26.
Zwickau, Weisbach, Jahrb. Min., 1873, 64.

634 B. Dolerophanite, *Scacchi*, Note Mineralogiche, p. 22, Napoli, 1873. **Extract from** tti Acad. Sci. Napoli, v. (read 1870).
Monoclinic. Observed planes, *i-i*, *i-ĭ*, *O*; $-\tfrac{1}{3}$-*i*, $\tfrac{1}{3}$-*i*, $\tfrac{2}{3}$-*i*, 1-*i*, $\tfrac{3}{2}$-*i*; 1, -3; $\tfrac{3}{2}$-$\tfrac{3}{2}$; $-\tfrac{5}{3}$-$\tfrac{5}{3}$, -5-$\tfrac{5}{3}$, $\tfrac{1}{3}$-3̆, 3̆; $-\tfrac{7}{3}$-$\tfrac{7}{3}$. C = 113° 52′. *a* (vert.) : *b* : *c* = 0·9962 : 1 : 0·6753. *i-i* ∧ 1 = 70° 3′, *i-ĭ* ∧ 1 = 1° 5′, *O* ∧ 1 = 110° 9′. Crystals small, rarely having a diameter of more than two millietres. Well polished. Opaque. Color brown. Powder brownish-yellow.
Composition Cu_2S. Analyses:

	$\dot{\mathrm{C}}\mathrm{u}$	$\overset{\equiv}{\mathrm{S}}$	insoluble	loss	
1.	62·27	36·07	1·22	0·44	= 100.
2.	65·20	33·49	1·31		= 100.

A little $\dot{\mathrm{C}}\mathrm{u}\overset{\equiv}{\mathrm{S}}$ accompanying the dolerophanite is probably the occasion of the excess of $\overset{\equiv}{\mathrm{S}}$.
Kept for some time in water, the crystals dissolve in part, giving a blue solution; they serve their form, however, though the color changes from brown to bluish. Dissolves ily in nitric acid. B.B., fuses, leaving a black scoriaceous residue. Unaltered at a temature of 260°. With the fluxes gives reaction for copper.
Found by Scacchi at Vesuvius, having been produced by sublimation during the eruption October, 1868. The name is derived δολερός, fallacious, φαίνω, to appear.
See also Hydrocyanite.

159 A. Dudleyite, Genth, Am. Phil. Soc. Philad., xiii., p. 404, 1873.
Ias the form of margarite, from the alteration of which it has been made. Color soft nze, or brownish-yellow; lustre, pearly.
nalysis (l. c.)

$\ddot{\mathrm{S}}\mathrm{i}$	$\ddot{\overline{\mathrm{A}}}\mathrm{l}$	$\ddot{\overline{\mathrm{F}}}\mathrm{e}$	$\dot{\mathrm{F}}\mathrm{e}$	$\dot{\mathrm{M}}\mathrm{g}$	$\dot{\mathrm{L}}\mathrm{i}$	$\dot{\mathrm{N}}\mathrm{a}$	$\dot{\mathrm{K}}$	ign	
32·42	28·42	4·99	1·72	16·87	0·19	1·52	0·56.	13·43	= 100·12.

Oxygen ratio $\dot{R} : \bar{\bar{R}} : \ddot{Si} : \dot{H} = 6 : 12 : 14 : 10$ nearly, or $2(3\dot{R}, 2\ddot{Si}) + 4(\bar{\bar{R}}, 3\ddot{Si}) + 10\dot{H}$.
Exfoliates slightly on heating, and fuses with difficulty to a brownish-yellow blebby mass. Easily decomposed by hydrochloric acid with separation of silica in scales. Found at the Cullakenee Mine, Clay Co., N. Carolina, and in larger quantity with margarite at Dudleyville, Alabama.

Dufrenite, Min. p. 583.—St. Benigna, Bohemia, anal., *Boricky*, Ber. Ak. Wien, lvi., 6, 1867.

Dufrenoysite, Min. p. 92.—Switzerland, anal., Chem. News, xxx., 103, 1874.

Durangite, Brush, Am. J. Sci., II., xlviii., 179. Appendix I., p. 4.—Note on composition, *Kenngott*. Jahrb. Min., 1870, 783. Cryst. description, *Des Cloizeaux*, Ann. Ch. Phys., iv., 1875.

Dyscrasite, Min. p. 35.—Appendix I., p. 5.

Embolite, Min. p. 117.—Chili, several analyses by Mœsta (Marburg, 1869) quoted by Domeyko, 3d Append., Min. Chili, 1871.

Elæolite, Min. p. 327.—Investigated microscopically, *Zirkel*, Jahrb. Min., 1870, 810.

Embrithrite, Min. 99.—See *Boulangerite*.

Emerald, Min. 245.—See *Beryl*.

Emplectite, Min. p. 86.—Christophsan, near Freudenstadt, anal., *Petersen*, Jahrb. Min., 1869, 847.

Enargite, Min. p. 107.—Morning Star Mine, Cal., anal., *Root*, Am. J. Sci., II., xlvi., 201, 1868.
Peru, anal., *Achiardi*, Lettera a Carlo Regnoli sopra alcuni Min. del Peru, p. 19, Pisa, 1870. See also Domeyko, 2d App. Min. Chili, p. 20, 1867.
Occurrence in southern Utah described, Silliman, Am. J. Sci., III., vi., 126, 1873.
Famatina Mts., Argentine Republic, analyses and description of occurrence, *Stelzner*, Tsch. Min. Mitth., 1873, 241, 249; Catamarca, anal., Domeyko, 3d App., Min. Chili. See *Famatinite*, *Luzonite*.

Enstatite, Min. p. 208.—In meteoric iron of Breitenbach, cryst. form described. *v. Lang*, Ber. Ak. Wien, lix., 848, 1869 (Pogg., cxxxix., 315, 1870): analysis by *Maskelyne*, Proc. Roy. Soc., xvii., 370, 1869 (Phil. Trans., clxi., 360, 1871).
In Shalka meteorite, anal., *Maskelyne*, Phil. Trans. clxi., 366, 1871; in Busti (Inda) meteorite, same, Proc. Roy. Soc., xvii., 151, 1869–70.
From some basalts of Bohemia, anal., *Farsky*, Ber. Böhm. Chem. Ges., i., 27, 1873 (Zpravy, etc.).
In meteorites, *Rammelsberg*, Pogg., cxl., 315; *J. L. Smith*, Am. J. Sci., III., v., 108, 1873.
Brewster, N. Y., analysis, Breidenbaugh, Am. J. Sci., III., vi., 211, 1873; altered to serpentine, *J. D. Dana*, ibid., viii., 375, 1874.
See also *Bronzite*.

234 A. Victorite, *Meunier*, Ber. Ak. Wien, lxi., p. 26, 1870.
Occurs in needle-like crystals in cavities in the meteoric iron from Cordillere, Deesa, Chili. Crystals 0·3 mm. in length and 0·07 in width, appearing under the microscope as six-sided prisms with four-sided pyramids; they are grouped together in a rosette. Examined crystallographically by Des Cloizeaux, as follows:
I ∧ *i-ĭ* (*g m*)=134° 3′-20′; *i-ī* ∧ *i-ĭ* (*gh*)=90° 40′; (*g′m*)=46°; *I* ∧ *i-ī* (*mh′*)=137° 20′; *I* ∧ *I* (*mm′*)=93°-93° 40; *I* ∧ *i-ī* (*h′m*)=136° 25′-135° 40′; *I* ∧ *i-ĭ* (*g′m*)=134°, 134° 40; *I* ∧ *I* (over *i-ĭ*) (*mm*)=88° 40′. In polarized light shows bright colors. Fracture conchoidal, no cleavage observed. Colorless (showing absence of iron). B.B. infusible, not attacked by acids. Meunier considers the victorite as a variety of enstatite entirely free from iron.

Eosite, *Schrauf*, Ber. Ak. Wien.—Appendix I., p. 5.

Epiboulangerite, *Websky*, ZS. G. Ges., 1869, 747.—Appendix I., p. 5.

Epidote, Min. p. 281.—Cryst. memoir, homomorphous with azurite, *Schrauf*, Ber. Ak Wien, lxiv., 159, 1871.
Striegau, cryst. description (new forms), *E. Becker*, Koskch. Min. Russl.; V., 366.

Composition discussed, Kenngott, Jahrb. Min., 1871, 449.

Untersulzbach, cryst. description, *Brezina*, Tsch. Min. Mitth., 1871, 49; *C. Klein*, Jahrb. Min., 1872, 113. 132; optical properties determined with great precision, *Klein*, ibid., 1874, 1; analyses, *Rammelsberg*, ZS. G. Ges., xxiv., 69; xxiv., 649; *Ludwig*, ibid., xxiv., 465 (Tsch. Min. Mitth., 1872, 187); *v. Drasche*, Jahrb. Min., 1872, 120; *v. Kottal*, Ber. Ak. Wien, lxvi., 200, 1872: see also Jahrb. Min., 1873, 422.

The analyses of Ludwig (l. c.) show the presence of about 2 p. c. of water as an essential constituent of epidote. In this Rammelsberg finally coincides (l. c.). According to the former the composition is expressed by the formula $Si_6 Al_6 Ca_4 H_2 O_{26}$ (earlier obtained by Tschermak, and Kenngott); this gives the oxgyen ratio for $\dot{H}$, $\dot{R}$, $\overset{\dots}{R}$, $\ddot{Si}=1:4:9:12$.

Epigenite.—Appendix I., p. 5.

Epiphanite, Igelström, Œfv. Ak. Stockh., 1868, 29.—Appendix I., 6.

Epistilbite, Min. p. 443.—Glatz, Silesia, cryst. *Rammelsberg*, ZS. G. Ges., xxi., 95; *Websky*, ibid., xxi., 100, 1869.

Lünddsdörrsfjall, Sweden, anal. (result somewhat doubtful, possibly a new mineral), *Igelström*, Jahrb. Min., 1871, 361.

Ersbyite, Min. p. 361.—Pargas, analyses, *v. Rath* concludes that this mineral should be placed in the scapolite group, Pogg., cxliv., 384; Wiik, Œfv. Finsk. Vet. Soc., xiii., 79, 1870–71. See also *Wiik*, Œfv. Finsk. Vet. Soc., xiv., 26, 1871–72.

Erythrite, Min. p. 558.—Wittichen, Baden, anal., *Petersen*, Pogg., cxxxiv., 86.

148 A. Erythrosiderite, *Scacchi*, Rend. R. Acc. Sci. Napoli, Oct., 1872 (ZS. G. Ges., xxiv., 505). Orthorhombic, with two zones affording angles 110° and 92°. Color red. Very soluble. Composition expressed by the formula $2KaCl+Fe_2 Cl_3+2\dot{H}$. Found at Vesuvius imbedded in the lava of April, 1872, and undoubtedly formed by sublimation at that time.

Related to Kremersite.

Esmarkite, Des Cloizeaux has shown that there are two minerals, from the same locality, which have borne this name. One is a true praseolite (fahlunite, Dana, Min., p. 485), the other in crystalline form, and in composition, approaches very near to anorthite, Ann. Ch. Phys., IV., xix., 176, 1870.

688 A. Ettringite, *Lehmann*, Jahrb. Min., 1874, 273.

Hexagonal. *a* (vert.)$=0\cdot9434$. Occurring planes *O*, *I*, 1, ½. $I \wedge 1=137° 27'$, $1 \wedge \frac{1}{2}=162° 14'$. In minute needle-like prismatic crystals, seldom more than 3 mm. in length, thickness $\frac{1}{10}$ to ½ mm. Cleavage prismatic perfect. H.=about 2. G.=1·7504. In appearance very similar to chalcomorphite.

Analysis, Lehmann, l. c. (on 0·3623 gr.).

$\overset{\dots}{Al}$	$\dot{Ca}$	$\overset{\dots}{S}$	$\dot{H}$	loss (probably $\overset{\dots}{S}$)		
7·76	27·27	16·64	45·82	2·51	=	100·00

Lehmann gives the formula $\overset{\dots}{Al}, 3\overset{\dots}{S}+6(\dot{Ca}\,\dot{H})+26$ aq.

Occurs in cavities in the limestone-inclosures in lava of the Bellenberg at Ettringen and Mayen, in the district of Laach.

Euclase, Min. p. 379.—Isomorphous with datolite and gadolinite, Rammelsberg, ZS. G. Ges., xxi., 807, 1869.

The isomorphism of datolite and euclase was proved by J. D. Dana in 1854 (Am. J. Sci., II., xvii., 215): moreover the similarity in chemical composition (exhibited by Rammelsberg) was brought out in Dana's Mineralogy, 1868, pp. 362, 363 (Am. J. Sci., II., xlix., 400, 1870). The statement in Groth, Tabellar. Uebersicht der Min., 1874, 91, is consequently to be corrected.

Eudialyte, Min. p. 248.—(=eucolite), cryst. *Nordenskiöld*, Œfv. Ak. Stockholm, 1870, xxvii., 559.

Eulytite, Min. p. 391.—Description, with correction of chemical formula, *v. Rath*, Pogg., cxxxvi., 416.

From Johanngeorgenstadt (*not* from Braunsdorf, Saxony, Min. p. 392), anal., *Frenzel*, Jahrb. Min., 1873, 791.

EUPHYLLITE, Min. p. 488.—Associated with corundum, *Genth*, Am. Phil. Soc. Philad., xiii., 391, 1873.

EURALITE, *Wiik*, Jahrb. Min., 1869, 357.—Appendix I., p. 6.

EUXENITE, Min. p. 521.—Eydland, near Lindernäs, anal., *Rammelsberg*, ZS. G. Ges., xxi., 561; anal., same, Pogg., cl., 207, 1873.
Hitteroë, anal., *Jehn*, Jahrb. Min., 1872, 319; Pogg. Ann., cxliv., 595, 1871.

FAHLERZ, Min. p. 100.—See *Tetrahedrite*.

FAHLUNITE, Min. p. 484—(or a related mineral) in the Eozoon, and in paleozoic crinoids, Am. J. Sci., III., i., 378, 379, 1871.
Nova Scotia, *How*, Phil. Mag., IV., xxxvii., 270.

132 B. Famatinite, *Stelzner*, Tsch. Min. Mitth., 1873, p. 242.
Massive, sometimes reniform. Fracture uneven, somewhat brittle. H. = 3·5. G. = 4·57. Color mixture of copper-red and gray. Streak black.
Composition $4(3Cu_2S, Sb_2S_5) + 3(Cu_2S, As_2S_5)$, or an antimonial enargite (see luzonite). Analyses 1, 2, Siewert, l. c.; 1, from the Mejicana Upulunzos mine; 2, from the Mejicana Verdiona mine.

		S	Sb	As	Cu	Fe	Zn	Gangue
1.	$\frac{2}{2}$	29·17	21·23	4·07	44·12	0·82	0·59	—— = 100·00
2.	$\frac{1}{2}$	29·63	20·54	3·63	45·34	0·51	0·59	0·63 = 100·87

Pyr. In the closed tube decrepitates, giving off sulphur readily, and on stronger heating also some sulphid of antimony. On charcoal gives off white fumes of antimony, leaving a black, brittle metallic globule. Occurs with enargite, chalcopyrite, pyrite, etc., in the Famatina Mts., Argentine Republic.
It has also been found by Hübner at Cerro de Pasca, Peru (Frenzel, Jahrb. Min., 1874, 685; Tsch. Min. Mitth., 1874, 279).

FASSAITE, Min. p. 216.—Pseudomorph after vesuvianite, *Döll*, Tsch. Min. Mitth., 1874, 85.
Pseudomorph after monticellite, Tyrol, *v. Rath*, Ber. Ak. Berlin, 1874, 747.

FAUJASITE, Min. p. 433.—Annerod, pseudomorph after palagonite, *Streng*, Jahrb. Min., 1874, 576.

FELDSPAR GROUP, Min. p. 352.—In diorytes (Schriesheim, labradorite), ZS. G. Ges., xx. 365.
Discussion of composition, *Tschermak*, Ber. Ak. Wien (lx., 145, 1869); Pogg., cxxxviii., 162; cxli., 174; cxlii., 464; *Rammelsberg*, ZS. G. Ges., xxiv., 138; *v. Rath*, Pogg., cxliv., 219, 375: cxlvii., 274; clii., 39; Erg. Bd. vi., 378.
Cryst. relation of the different species, *v. Rath*. Pogg., cxxxv., 454; compound crystals from Sangerhausen, same, Pogg., cxxxviii., 537, 1869; crystals from Elba, same, and analysis, ZS. G. Ges., xxii., 652, 1870.
Relations of the species, cryst. and chem., *Streng*, Jahrb. Min., 1871, 598, 715.
Decomposition of, *J. Lemberg*, ZS. G. Ges., xxii., 335, 1870. Analyses, ibid., xxiv., 188, 1872; *Beyer*, Arch. Pharm., II., cl., 193.
From granites, Scotland, analyses, *Haughton*, Phil. Mag., IV., xl., 59, 1870.
India, from granite, *Ormsby*, Journ. R. Geol. Soc. Ireland, II., iii., 26, 1871.
Analyses, *Cleve*, Ak. H. Stockholm, ix., No. 12, Nov., 1870 (Geol. West India Is., p. 29).
In dolerytes, anal., *Sandberger*, Ber. Ak. München, 1873, 143.
Tuscany, cryst. memoir, *Achiardi*, Boll. Com. Geol. d'Italia, 1871, 208, 261.
Finland, *Wiik*, Œfv. Finsk. Vet. Soc., xiv., 26. 1871–72.
Altered to penninite (pseudophite), *Zepharovich*, Tsch. Min. Mitth., 1874, 7.
Trachytic rocks of Transylvania, analyses, *Doelter*, Tsch. Min. Mitth., 1874, 13 et seq.
Verespatak, anal., *Sipocz*, Tsch. Min. Mitth., 1874, 175.
With corundum, No. Carolina, *Genth*, Am. Phil. Soc. Philad., xiii., 375; *J. L. Smith*, Am. J. Sci., III., vi., 185.
Manhattan Is., New York, analyses, Schweitzer, Amer. Chem., iv., 443, 1874.
Analyses, *Petersen*, Jahrb. Min., 1874, 269.
Fournier mine, Canada, anal., *Harrington*, Geol. Surv., 1874, 198.
See also *Albite*, *Andesite*. *Anorthite*, *Oligoclase*, *Orthoclase*, *Tschermakite*.

Des Cloizeaux has recently investigated the optical properties of the triclinic feldspars (C. R., lxxx., Feb. 8, 1875). The principal results obtained by him are contained in the following table, in which *Bx* stands for *bisectrix:*

	ALBITE.	OLIGOCLASE.	LABRADORITE	ANORTHITE
Acute bisectrix	always +	generally — sometimes +	always +	always —
Angle made by the + Bx. with a normal to *i-ī* (*g*)	15°	18° 10′	30° 40′	Position of the Bx. has no simple relation to the planes observed on the crystals.
Same, with a normal to *O* (*p*)	78° 35′	68°	56°	
Angle made by the line in which the plane of the optic-axes cuts *i-ī*, with edge *i-ī* / *O*(*g′* / *p*)	20°	Line parallel to the edge *O* / *i-ī*.	27°–28°	
Same, with edge *i-ī* / *I*(*g′* / *m*)	96° 28′ (front)	" "	37° 23′–36° 25′	
Ordinary dispersion	$\rho < v$(+ Bx.)	$\rho < v$(+ Bx.)	$\rho > v$(+ Bx.)	$\rho < v$(— Bx.)
Dispersion parallel or perpendicular to plane of polarization	*Inclined;* probably also slight *horizontal.*	*Crossed;* also slight *inclined.*	*Crossed;* also slight *inclined.*	*Inclined.*
Appar'nt optic-axial angle (in air)				
—— for red rays	80° 39′	89° 35′	88° 15′	84° 58′
—— for blue rays	81° 59′	88° 31′	87° 48′	85° 59′
	(Roc tourné)	(Sunstone. Tvedestrand)	(Labrador)	(Somma)

The axial divergence is quite constant for albite, labradorite and anorthite, but varies for oligoclase even in different sections taken from the same specimen. Des Cloizeaux concludes from his observations that labradorite and oligoclase have an equal right with albite and anorthite to be considered independent species, contrary to the views presented by Tschermak. Andesite he concludes to be altered oligoclase, while tschermakite (q. v.) is identical with albite.

FERGUSONITE, Min. p. 524.—Composition discussed, *Hermann*, J. pr. Ch., cvii., 129, 1869. *Tyrite*, *bragite*, anal., *Rammelsberg*, Pogg., cl., 203, 1873.

FERRITE. A name proposed by *Vogelsang* (ZS. G. Ges., xxiv., p. 529, 1872) for the amorphous oxide of iron (hydrous), which in red or yellow particles plays an important part in many rocks, and whose composition is as yet undetermined.

FERROILMENITE (columbite), *Hermann*, J. pr. Ch., II., ii., 118.

Ferrotungsten. See TAMMITE.

FIBROFERRITE, Min. p. 656.—Atacama, anal., Domeyko, 4th Append. Min. Chili, p. 7, 1874.

FIBROLITE, Min. p. 373.—Delaware Co., Penn., analyses, associated with corundum, *Genth*, Am. Phil. Soc. Philad., xiii., 380, 1873.

FICHTELITE, Min. p. 735.—Found in peat near Sobeslau, *Krejci*, Ber. Böhm. Ges., 1873, 344.
Discovered in a log of Pinus Australis, Alabama, *Mallet*, Am. J. Sci., III., iv., 419.

FIORITE, Min. p. 199.—Anal., Chem. News, xxviii., 272.

FLUOCERITE, Min. p. 126.—Broddbo, cryst., *Nordenskiöld*, Œfv. Ak. Stockholm, xxvii., 550, 1870.

FLUORITE, Min. p. 123.—Coloring matter microscopically investigated, Bull. Soc. Imp. Mosc., xl., 228.
Urals, cryst. description, *Kokscharow*, Min. Russl., v., 197.
Artificial, *Scheerer*, J. pr. Ch., II., vii., 63.
Münsterthal, cryst., *Klocke*, Jahrb. Min., 1874, 731.
Saxon localities, *Frenzel*, Min. Lex. für Sachsen, p. 109.

392 A. Foresite, *v. Rath*, Pogg., clii., p. 31, 1874. Cookeite, *Achiardi*, **Min. Toscana**, II., p. 236; Boll. Com. Geol. d'Italia, 1874, 306.

Orthorhombic. In crystalline crusts on tourmaline, or lining cavities. Crystals very minute, prismatic in habit, with planes *i-ī*, *i-ĭ*, *O* and 1. Angles obtained (approximate) $O \wedge 1 = 132°$, $i\text{-}\bar{i} \wedge 1 = 121°$. Form resembling stilbite, with which it seems to be isomorphous. Cleavage parallel to *i-ĭ*, distinct; lustre on this face, pearly. G. = 2·405. Color white.

Analysis 1. v. Rath, l. c. 2. Bechi, Min. Tosc., II., 236. 3. Pullè and Capacci, Boll. Com. Geol. Ital., 1874, 311.

		$\ddot{Si}$	$\dddot{Al}$	$\dot{Mn}$.	$\dot{Ca}$	$\dot{Mg}$	$\dot{Na}$	$\dot{Ka}$	$\bar{Be}$	$\dot{H}$
1.	½	49·96	27·40	——	5.47	0·40	1·38	0.77	——	15.07 = 100.45
2.		44·60	36·00	1·02	5·50	0·02	2·33	0·72	0·71	9·18 = 100·08
3.		44·60	38·00	1·02	5·50	0·20	3·33	0·72	0·71	6.00 = 100·08

For his analysis v. Rath deduces the formula $\dot{Na}_2$, $3\dot{Ca}$ $8\dddot{Al}$ $24\ddot{Si}$ $24\dot{H}$. Oxygen ratio for $\dot{R} : \bar{R} : \ddot{Si} : \dot{H} = 1 : 6 : 12 : 6$ (stilbite = 1 : 3 : 12 : 6).

B. B. Expands and melts. With difficulty decomposed by HCl, even after ignition. The water goes off in part at 100°–110° C., after continued heating at 200° the mineral loses 5–5¼ p. c., and to drive off the whole amount present (15·06 p. c. and 15.09 in two trials) a strong red heat was required.

Found at San Piero in Campo, Island of Elba, in cavities in the granite, with tourmaline, lepidolite, quartz, feldspar. It occurs, as a secondary product, along with heulandite and stilbite, covering these minerals.

A mineral from the same locality, with the foresite of v. Rath, associated in the same way, and similar in physical properties (anal. 2), was referred provisionally by Achiardi (l. c.) to cookeite (cuccheite), although with a question as to the propriety of so doing. It is like cookeite (*Brush*, Dana's Min., 1868, p. 489) in manner of occurrence, but, as mentioned by Achiardi, has a very different chemical composition. (Could a confounding of the relative amounts of $\ddot{Si}$ and $\dddot{Al}$ have suggested the identity of the Elba mineral with cookeite, viz.: $\ddot{Si}$ 35, $\dddot{Al}$ 45 (cookeite), $\ddot{Si}$ 45, $\dddot{Al}$ 36 (foresite). Pullè and Capacci first suggested that the species was new in an article entitled 'Un Viaggio nell' Arcipelago Toscano,' published in a Florence newspaper (1874).

FRANKLINITE, Min p. 152.—Found at Centerville, near Paterson, N. J., Am. J. Sci., II., xlviii., 138, 1869. [This observation was erroneous, Brush.]

Pseudomorph after calcite, *Leeds*, Am. Chemist, iv., 4, Oct., 1873.

FREIESLEBENITE. See DIAPHORITE.

30 A. Frenzelite.—Selenwismuthglanz, *Castillo*, Naturaleza II., 174, 1873, Jahrb. Min., 1874, 225; *Frenzel*, Jahrb. Min., 1874, p. 679. Frenzelite, *Dana*.

Massive, structure fine-granular, foliated to fibrous. Orthorhombic? In minute, needle-like crystals, irregular, strongly striated vertically. Crystals sometimes single imbedded in galapektite, sometimes grown together, forming semi-compact masses. Cleavage distinct, parallel to *i-ĭ*.

H. = 2 (Castillo), 2·5–3 (Frenzel). G. = 5·15 (Castillo), 6·25 (Frenzel). Color bluish-gray. Streak, gray, grayish black shining. Lustre metallic. Soft, malleable.

Analysis, Frenzel l. c.

Se	Bi	S		
24·13	67·38	6·60	=	98·11

This corresponds to the formula Bi_2 Se_3, where some of the Se is replaced by S, or more strictly $2Bi_2$ $Se_3 + Bi_2S_3$. A partial examination on a very small quantity gave Rammelsberg Bi = 65·4, Se = 16·7. He suggests the presence of Zn, which is not confirmed by Frenzel. B. B. fuses on charcoal with a blue flame, giving a strong odor of selenium. With iodid of potassium gives a fine red coating, even without the addition of sulphur, thus proving that it is already present. Decomposed by aqua regia on slow heating.

Found at Guanajuato, Mexico.

Frenzel has given the first complete description of this species, in fact he speaks of having been aware of its existence for some years, so that it may well receive his name.

GADOLINITE, Min. p. 293.—*Rammelsberg*, ZS. G. Ges., xxi., 807, 1867. See Euclase.

Crystalline form (= monoclinic), optical properties and chem. composition, Des Cloizeaux, Ann. Ch. Phys., IV., xviii., 305, 1869.

Radauthal Harz, cryst. description, *v. Rath*, Pogg., cxliv., 576, 1871.

GAHNITE, Min. p. 149.—Franklin, N. J., description and analysis, (*Adam*) *G. J. Brush*, Am. J. Sci., III., i., 28.

GALENITE, Min. p. 40.—Tiefen glacier, anal., *v. Fellenberg*, Jahrb. Min., 1869, 373.
Province of Lucca, Italy, cryst., *Achiardi*, Boll. Com. Geol. Ital., ii., 160, 1871.
Localities in Saxony, *Frenzel*, Min. Lex. Sachsen, Jahrb. Min., 1874, 425.
Positive and negative varieties, thermo-electrically, *Stefan*, Ber. Ak. Wien, li., 260, 1865; *Schrauf* and *Dana*, ibid., lxix., 155, 1874.
Cryst. monograph, *Sadebeck*, ZS. G. Ges., xxvi., 617, 1874.

GARNET, Min. p. 265.—Spessartite, crystallized, Aschaffenburg; massive, Pfitsch, Tyrol, analyses, *v. Kobell*, Ber. Ak. München, 1868, 292; almandite, No. Carolina, anal., *same*, ibid., p. 295, 1868.
Cantoira, valley of Lanzo, *Strüver*, Atti Accad. Sci. Torino, iii., 129, 1867–8.
From lava of the Herchenberg, Burgbrohl, *Wolff*, Jahrb. Min., 1868, 605.
Granatfilz, Zermatt, anal., *v. Fellenberg*, Jahrb. Min., 1868, 745.
Jordansmühl, Silesia, colorless variety, cryst. $(\frac{8}{6}\frac{4}{3}\text{-}i)$, anal., *Websky*, ZS. G. Ges., xxi., 753, 1869.
Frugard, white variety, resembling quartz, anal., Nordenskiöld, Œfv. Ak. Stockholm, xxvii., 565, 1870.
Elba, cryst., anal., *v. Rath*, ZS. G. Ges., xxii., 638, 660, 1870.
Mexico, anal., *Damour*, Ann. Ch. Phys., IV., xxiii., 159, 1871.
Tuscany, occurrence described, analyses, *Achiardi*, Boll. Com. Geol. Ital., 1871, 168.
Altered to chlorite, *Niedzwiedzki*, Tsch. Min. Mitth., 1872, 162.
Grossular, Monzoni, anal., *Lemberg*, ZS. G. Ges., xxiv., 249, 1872.
From eklogyte, Eppenreuth, etc., *v. Gerichten*, Jahrb. Min., 1874, 434.
Cryst., enumeration of all occurring planes with the localities, *Bauer*, ZS. G. Ges., xxvi., 119, 1874.

416 A. Garnierite, *Garnier*, Bull. Soc. G., II., xxiv., p. 448 (1867), *A. Liversidge*, J. Chem. Soc., II., xii., 613, July, 1874.

Amorphous, enclosed between thin plates of silica, which has filled fissures in the original material. H.=2·5. G.=2·27.

Color bright apple-green. Streak pale green. Touch not unctuous. Adheres to the tongue.

Analysis (l. c.) Liversidge.

	$\ddot{\text{Si}}$	$\ddot{\bar{\text{Al}}}\ddot{\bar{\text{Fe}}}$	$\dot{\text{Ni}}$	$\dot{\text{Mg}}$	$\dot{\text{Ca}}$	$\dot{\text{H}}$		
$\frac{3}{2}$	47·24	1·67	24·01	21·66	tr	5·27	=	99·85

Liversidge suggests the formula $(\dot{\text{Mg}}\dot{\text{Ni}})_{10}\ \ddot{\text{Si}}_8 + 3\dot{\text{H}}$.

In the closed tube gives off water, becoming gray; with borax gives a nickel bead. On immersion in water breaks to pieces with a sharp crackling sound, the fragments having a conchoidal fracture.

Occurs in veins traversing a serpentine rock near Noumea, capital of New Caledonia; associated with chromic iron and steatite.

Liversidge calls attention to the relation of this species to alipite, and suggests at the same time that it is probably a result of decomposition and consequently hardly deserves a new name, proposing, however, in case it prove to exist in large quantities, the name from the locality (*i.e.*, *noumeaite*). A private contribution from Mr. W. B. Clarke (from whom Mr. Liversidge obtained his specimen) states that the mineral was discovered by Garnier in 1865, and should properly receive the name *garnierite*, especially as it was found at Mont d'Or, before the town of Noumea existed. In the Bull. Soc. G., II., xxiv., 448 (1867), Garnier in an article on New Caledonia mentions the occurrence of a hydrous magnesian silicate (=gymnite) in the veins of the serpentine, and adds that it is sometimes colored green through the presence of a silicate of nickel (*i. e.*, the so-called garnierite?). It is hence probably a mixture. If an analysis of the similar material by Leibius (Sydney Herald, Sept. 23, 1874) is correct ($\ddot{\text{Si}}$ 48·90, $\dot{\text{Mg}}$ 10·93, $\dot{\text{Ni}}$ 6·46, $\dot{\text{S}}$ 0·83, $\ddot{\bar{\text{Fe}}}+\ddot{\bar{\text{Al}}}=15{\cdot}13$, $\dot{\text{H}}=17{\cdot}75$), it would imply an entire want of constancy of composition.

GEHLENITE, Min. p. 370.—Orawitza, anal., *Janovsky*, Ber. Chem. Ges., Berlin, 1873, 1455; *v. Zepharovich*, Ber. Ak. Wien, lxix., 26, 1874.
Monzoni, anal., *Lemberg*, ZS. G. Ges., xxiv., p. 248, 1872.

GEIERITE, Min. p. 77.—(=löllingite), Wolfach, Baden, anal., *Petersen*, Pogg., cxxxvii., 391, 1869. See also Jahrb. Min., 1869, 315.

GENTHITE, Min. p. 471.—Webster, No. Carolina, anal., *Dunnington*, Ch. News, xxv., 270, 1872.

GEYSERITE. **PEALITE** is a name given by Dr. Endlich to a variety of geyserite (opal) from the silicious deposits of the Upper Geyser basin of Firehole river. An analysis gave him $\ddot{\mathrm{Si}} = 95{\cdot}84$, $\ddot{\bar{\mathrm{Al}}}$ tr, $\ddot{\bar{\mathrm{Fe}}}$ 2·68, $\dot{\mathrm{Mg}}$, $\dot{\mathrm{Ca}}$, $\dot{\mathrm{Na}}$, $\dot{\mathrm{Li}}$, tr., ign $1{\cdot}50 = 100{\cdot}02$. The specimen had a milk-white color, crypto-crystalline structure, semi-vitreous aspect. G. = 2·49. Another kind was greenish-brown to greenish-white in color; amorphous; lustre vitreous. G. = 2·0816 It contained 6·3 p. c. water. (Hayden's U. S. Geol. Survey, 6th Ann. Rep.) Am. J. Sci. III., vi., 66.

GERSDORFFITE, Min. p. 72.—Lempälä, Finland, *Wiik*, Oefv. Finsk. Vet. Soc., xiii., 75, 1870–71.

GIESECKITE, Min. p. 479.—Occurrence, with other minerals, in Brittany, *de Limur*, Bull. Soc. G., III., i., 166, 1874.

429 A. **GILBERTITE**, Min. p. 798.—Frenzel has investigated the hitherto doubtful gilbertite, and concludes that it is really a good species belonging to mica group. It occurs at the various tin mines of the Erzgebirge (Saxony and Bohemia), Zinnwald, Ehrenfriedensdorf, etc.

Frenzel mentions two varieties: The first (*a*) is of a greenish to yellowish-white color; translucent. H. = 1. G. = 2·65–2·72. It occurs massive, with a dense to crystalline structure, filling all the cavities between the cassiterite and wolframite. The second variety (*b*) occurs in spherical or stellate forms, and also in groups of six-sided tabular crystals. It is, moreover, found pseudomorph after scheelite and apatite. H. = 3. G. = 2·82. According to Fischer the mineral shows itself under the microscope to be homogeneous. Analyses 1. and 2. of variety *a*; 1. from Ehrenfriedensdorf, 2. from Pobersbau. 3. variety *b*, from Ehrenfriedensdorf.

	$\ddot{\mathrm{Si}}$	$\ddot{\bar{\mathrm{Al}}}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ka}}$	$\dot{\mathrm{Na}}$	Fl	$\dot{\mathrm{H}}$
1.	48·96	30·96	2·24	0·26	1·97	8·47	1·65	1·04	3·83 = 99·38*
2.	48·10	32·30	3·30	0·40	1·12	10·02	——	0·81	4·09 = 100·14*
3.	48·10	31·55	3·10	1·30	1·33	8·62	2·14	0·88	3·52 = 100·54

* Contains also traces of manganese.

The water is given off only at an elevated temperature. B. B., fuses in fine splinters, coloring the flame slightly red. (Compare analyses of margarodite, Min. p. 310.)

GISMONDITE, Min. p. 418.—Found near Baumgarten, east of Giessen, *Streng*, Jahrb. Min., 1870, 430; cryst. description, same, ibid., 1874, 578.

GLASBACHITE, Adam, Tableau Min., 1869, p. 52.—A doubtful selenid of lead from Glasbach, analyzed by Kersten. See *Zorgite*, Dana Min., p. 43.

Glancespar, Pogg. Ann., cxlvii., p. 272.—Vom Rath has investigated this mineral, first mentioned by v. Dechen in his Geognost. Führer in das Siebengebirge, p. 154, Bonn, 1861. Occurs in small prismatic fragments in the basalt of the Siebengebirge. Form a rhombic prism having an acute angle of 88½°; cleavage distinct with pearly lustre, angle on prismatic face = 134° 7′ H. between quartz and feldspar. G. = 3·150.

Analysis v. Rath (l. c.) on 0·7 gr.

$\ddot{\mathrm{Si}}$	$\ddot{\bar{\mathrm{Al}}}$	$\ddot{\bar{\mathrm{Fe}}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$
36·7	57·9	4·4	0·7	0·8 = 100·5.

Part of the CaO, MgO, and Fe_2O_3 are due to impurities (augite, magnetite), and deducting these we obtain the formula $\ddot{\bar{\mathrm{Al}}}\ddot{\mathrm{Si}}$, or that of cyanite, from which it differs in prismatic angle and specific gravity. B.B., infusible.

The form given is exactly that of andalusite ($I \wedge I = 88° \; 12'$ andalusite, $= 88° \; 15'$ glancespar), and the specific gravity is identical, as is the composition also. In cleavage it seems to be somewhat different.

GLAUBERITE, Min. p. 627.—Relation to axinite, Schrauf. See Axinite.

Westeregeln, near Stassfurt, cryst., new forms, Zepharovich, Ber. Ak. Wien, lxix., 16, 1874.

GLAUCODOT, Min. p. 80.—Anal., relation to arsenopyrite, *Tschermak*, Ber. Ak. Wien, lv., 447, 1867.
Hakansbö, anal., *v. Kobell*, Ber. Ak. München, 1867, 276.
Thermo-electrical properties, crystals shown to be positive internally, but having an oute portion (2 mm. thick) which is negative. These two portions also show considerable variation in specific gravity. G. 5·905 and 6·011. *Schrauf* and *Dana*, Ber. Ak. Wien, lxix., 153, 1874.

GLAUCONITE, Min. p. 462.—Russia, analyses, Kupffer, Jahresb. Chem., 1871, 1307.
Anvers, anal., *Dewalque*, Soc. Geol. Belg., Dec., 1874, p. 3.

GLAUCOPYRITE, Sandberger, J. pr. Ch., II., i., 230. Appendix I., p. 6.

GMELINITE, Min. p. 436.—Andreasberg, cryst., *H. Guthe* (Jahrb. Nat. Ges. Hannover, 1871, p. 520), Jahrb. Min., 1871, 752.

GOLD, Min. p. 3.—Scotland, occurrence described, *Lindsay*, Trans. Edinburgh G. Soc., i., 105, 1868.
In Great Britain, *D. Forbes*, Phil. Mag., IV., xxxvii., 321, 1869.
Vancouver's Is., and west Africa, analyses, *Wibel*, Jahrb. Min., 1873, 244.

GÖTHITE, Min. p. 169.—"Silicious nodular brown hematite," from the carboniferous imestone beds, near Cookstown, Co. Tyrone, Ireland, *Hardman*, R. Geol. Soc. Dublin, II., ii., 150, 1873.

GRAMMATITE, see nephrite.

GRAPHITE, Min. p. 24.—Behavior on being heated, *Rose*, Pogg., cxlviii., 497, 1872.
In meteoric irons, *Meunier*, Ann. Ch. Phys., IV., xvii., 46, 1869.
Wythe Co., Va., anal., *Goldsmith*, Amer. Ac. Philad., 1874, p. 73.

GREENOCKITE, Min. p. 59.—Cryst., *Kokscharow* (Bull. Ac. Imp. Russ., xv., 219, 1871), ahrb. Min., 1871, 894.

458 B. Grochauite, Websky, ZS. G. Ges., xxv., p. 395, 1873. See also Bock, Inaug.)issert., Breslau, 1868.
Monoclinic? In small, six-sided, tabular crystals, rough and allowing no measurements, he edges being rounded off by irregular planes. Optically biaxial, angle of axes about 20° o 30°. Double refraction weak, probably positive. Cleavage basal easy, forming thin soft lates.
Analysis, Bock (l. c.).

$\ddot{\mathrm{Si}}$	$\dddot{\mathrm{Al}}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{H}}$
28·20	24·56	5·27	30·94	12·15 = 101·12.

Oxygen ratio for $\dot{\mathrm{R}} : \dddot{\mathrm{R}} : \ddot{\mathrm{Si}} : \dot{\mathrm{H}} = 4 : 3 : 4 : 3$.
Occurs mixed with a chromic spinel (magnochromite, q. v.), also in cavities crystallized, ι serpentine at Grochau, south of Frankenstein, in Silesia.

65 B. Guadalcazarite. Schwefelselenquecksilber, *Castillo* and *Burkhart*, Jahrb. Min., 366, 411. Guadalcazite, *Adam*, Tableau Min., p. 59. Guadalcazarite, *Petersen*, Tscherak's Min. Mitth., 1872, p. 60; *Burkhart*, ibid., 243.
Massive, cryptocrystalline. H. = 2. G. = 7·15. Lustre greasy-metallic. Color deep ack. Streak bluish-black to black.
Composition 6HgS + ZnS, with some of the sulphur replaced by selenium and the zinc by dmium.
Analysis, Petersen (l. c.)

S	Se	Hg	Zn	Cd	Fe
14·58	1·08	79·73	4·23	tr	tr = 99·62

Pyr. On charcoal first decrepitates, giving off mercurial fumes, and a selenium odor; on ntinued blowing the white deposit of oxyd of zinc and also a distinct cadmium reaction. the open tube deposits a sublimate, gray to black, of Hg, S, and Se, giving off sulurous acid, while the yellowish oxyd of zinc remains behind. Soluble in aqua regia, with e separation of some sulphur. In composition it is not very unlike cinnabar, but quite fferent in physical properties.

Occurs at Guadalcazar, Mexico, with cinnabar, quartz and barite. This mineral was first mentioned by Castillo and Burkhart (l. c.), but no complete description was given. (Dana Min. p. 109.) According to Castillo it crystallizes in rhombohedrons, also occurs imbedded. Lustre metallic. Color lead-gray, granular. H. = 3. G. = 6·69–7·165. The qualitative examination gave Castillo essentially the same results as those since obtained by Petersen.

GUANO, and guano minerals. See Appendix I., p. 6.

GUARINITE, Min. p. 383.—Shown to be orthorhombic, not tetragonal in cryst. form, *v. Lang*, Tsch. Min. Mitth., 1871, p. 81. The same result was obtained earlier by Guiscardi, see Brezina in Tsch. Min. Mitth., 1874, 285.

GÜMBELITE, *v. Kobell*, Ber. Ak München, March 5th, 1870.—Appendix I., p. 6.

GYPSUM, Min. p. 637.—Loss of water on heating, *How*, Phil. Mag., IV., xxxix., 279, 1870.
Cryst. memoir, *Hessenberg*, Min. Not., x., 30, 1871; Jahrb. Min., 1874, 831.
Cryst., *Scharff* (Senckenberg, Ges., viii., 39), Jahrb. Min., 1871, 881.
Cryst., twins, *Schrauf*, Ber. Ak. Wien, lxiii., 157, 1871.
Cryst., new forms ($\frac{1}{3}$-ì, $\frac{3}{2}$-ì), *Brezina*, Tsch. Min. Mitth., 1872, 17.

445 C. Hallite, *Leeds*, Journ. Frank. Inst., III., lxii., 70. *J. P. Cooke*, Mem. Am. Ac. Boston, 1874, p. 59.

Hexagonal? Occurs in large rough six-sided prisms with easy micaceous cleavage. Color in some varieties green, in others yellow.

G. (yellow) = 2·402, (green) = 2·398.

Analyses (l. c.) Munroe, 1. green var., 2. yellow.

		$\ddot{\text{Si}}$	$\overline{\dddot{\text{Al}}}$	$\overline{\dddot{\text{Fe}}}$	$\dot{\text{Fe}}$	$\dot{\text{Mg}}$	$\dot{\text{K}}$	$\dot{\text{H}}$
1.	$\frac{3}{2}$	35·89	7·45	8·78	1·13	31·45	0·46	14·33 = 99·49
2.	$\frac{3}{2}$	35·26	7·58	9·68	0·32	31·51	0·61	14·78 = 99·74 (Mn tr)

Oxygen ratio for $\dot{\text{R}} : \overline{\dddot{\text{R}}} : \ddot{\text{Si}} : \dot{\text{H}} = 2 : 1 : 3 : 2$—the two varieties are identical.

Exfoliates somewhat on heating; decomposed by hydrochloric acid after ignition.

A foreign mineral is interspersed between the leaves of the hallite, in spear-shaped, very narrow forms, and lying in parallel lines, crossing at angles of 60° and 120°, like the magnetite in the Pennsbury mica. The mass of this interspersed mineral was too small to affect the analysis essentially.

Found at East Nottingham, 3 miles south of Oxford, Chester Co., Penn., in nests or pockets in the serpentine formation. Named from Mr. John Hall, of Philadelphia.

This name has been previously used as a synonym of aluminite, Dana Min., p. 658.

HALLOYSITE, Min. p. 475.—Elba, anal., Achiardi, Nuovo Cimento, II., iii., Feb., 1870.
Tüffer, anal., *Rumpf*, Tsch. Min. Mitth., 1874, 282.

A variety of halloysite from Maidanpek, Serbia, has been called milanite by Tietze (Jahrb. G. Reichs, 1870, 588). An analysis gave $\ddot{\text{Si}}$ 44·96, $\overline{\dddot{\text{Al}}}$ ($\overline{\dddot{\text{Fe}}}$) 25·20, $\dot{\text{H}}$ 29·50 = 99·66. The amount of water is a little large.

HAMARTITE, see *Bastnäsite*, Appendix I., p. 7, p. 2.

HARMOTOME, Min. p. 439.—Cryst. memoir, shown to be monoclinic, *Des Cloizeaux*, Ann. Ch. Phys., IV., xiii., 417, 1868.
Cryst., *Rammelsberg*, ZS. S. Ges., xx., 589, 1868.
Strontian, Argyllshire, of unusual form, anal. (*Reynolds*), *Scott*, Q. J. G. Soc., xxvii., 374, 1871.

HARTITE, Min. p. 736.—Cryst. (triclinic) and anal., *Rumpf*, Ber. Ak. Wien, lx., 91.

HATCHETTITE, Min. p. 731.—In Silurian of Bohemia, *Boricky*, Ber. Ges. Böhm., 1873, Jan. 10th.

HAUYNITE, Min. p. 332.—Marino, near Rome, cryst., *Hessenberg*, Min. Not., viii., 43, 1868.
Composition, *Kenngott*, J. pr. Ch., cvi., 368, 1869.
In basalts, *Möhl* Jahrb. Min., 1872, 77.
Relation to nosite (nosean) and lapis lazuli, *Vogelsang*, Vers. Med. Ak. Amsterdam, II., vii., 161, 1873.

503 B. Hebronite, *v. Kobell*, Ber. Ak. München, 1872, 284.

The *montebrasite* of Des Cloizeaux (C. R., lxxiii., 306, 1247) was announced in Appendix I., p. 11, to be identical with amblygonite, the statement being founded upon the results of analyses by Pisani (C. R., lxxiii., 1479) and v. Kobell (Ber. Ak. München, Feb. 3, 1872); it is moreover confirmed by a subsequent analysis by Rammelsberg (Ber. Chem Ges. Berlin, 1872). Des Cloizeaux, however, has investigated the matter further (C. R., lxxv., 114; lxxvi., 319, 1873). He has found that, while the original montebrasite is identical with amblygonite, the mineral from Hebron, Me., differs from the latter in optical character (amblygonite, Saxony, $\rho > \upsilon$; hebronite, Maine. $\upsilon > \rho$), and in having a third cleavage surface inclined upon the other two (making 105 together as in amblygonite) at an angle of 135°–136° and 89°. They differ somewhat moreover in chemical composition (see below). Des Cloizeaux has also identified a mineral agreeing with that from Hebron at Montebras, and upon this ground he proposes to *transfer* the name montebrasite to this. V. Kobell (l. c.), on the other hand, considers such a course as likely to lead to great confusion, and proposes, wisely as it seems, to let the name montebrasite drop entirely, and to call the Hebron mineral, if it be a distinct species, *hebronite*. In this proposal he is supported by Rammelsberg, ZS. G. Ges., xxv., 59, 1873.

Analyses of hebronite: 1. G. = 3·01; 2. G. = 3·029, Pisani, C. R., lxxv., 79, 1872; 3. von Kobell (l. c.), G. = 3·06; 4. amblygonite, Rammelsberg, Ber. Chem. Ges. Berlin, 1872, 78.

	F	$\dot{\text{P}}$	$\dddot{\text{Al}}$	$\dot{\text{Li}}$	$\dot{\text{Na}}$	$\dot{\text{H}}$		
1. Hebron,	5·22	46·65	36·00	9·75	——	4·20	= 101·82	Pisani.
2. Montebras,	3·80	47·15	36·90	9·84	——	4·75	= 102·44	Pisani.
3. Auburn, Me.,	5·50	49·00	37·00	7·37	1·06	4·50	= 103·43	v. Kobell.
4. Penig,	9·44	48·00	36·26	6·68	3·29	$\dot{\text{K}}$ 0·43	= 104·10	Ramm.

As will be seen by comparison with analysis 4. of normal amblygonite, the hebronite differs in containing less fluorine and soda, while it has about 4 p. c. of water. The true nature of the mineral, even if it be a good species, cannot be regarded as satisfactorily settled, as Rammelsberg remarks.

HELVETAN, Min. p. 801.—Simmlar has obtained for helvetan the following analysis: $\ddot{\text{Si}}$ 67·07, $\dddot{\text{Al}}$ 13·05, $\dot{\text{Fe}}$ 4·43, $\dot{\text{Ca}}$ 2·38, $\dot{\text{Mg}}$ 2·18, $\dot{\text{K}}$ 7·37, $\dot{\text{Na}}$ 1·69, $\dot{\text{H}}$ 1·85 = 100·02. He calls it feldspar with the habit of a mica, Jahrb. Min., 1868, 348.

HELVITE, Min. p. 264.—Cryst. and description, *Kokscharow*, Min. Russl., v., 320.

HEMATITE, Min. p. 140.—In the Pennsbury mica (= magnetite, q. v.), *Rose*, Pogg., xxxviii., 190.

Keswick, Cumberland, Elba, cryst. description, *Hessenberg*, Min. Not., viii., 33, 41; ix., 2, 1870.

Traversella, cryst. memoir, *Strüver*, Atti Accad. Sci. Torino, vii., 377, 1872.

Peculiar striation, due to twining, *Bauer*, ZS. G. Ges., xxvi., 186, 1874.

Henryite, Endlich, Engineering and Mining Journal, Aug. 29, 1874.

Tetragonal (?). In octahedrons, also massive. Cleavage lateral perfect, basal less so. . = 2–2·5. Color brass-yellow. Lustre bright. Composition (no analysis published) PbTe + FeTe. Locality, Red Cloud mine, Colorado.

Dr. Genth asserts that Henryite "is undoubtedly nothing but an altaite with an admix- ure of pyrite." See Schirmerite.

HESSITE, Min. p. 50.—California, anal., *Genth*, Am. J. Sci., II., xlv., 311.

Colorado, *Silliman*, Am. J. Sci., III., viii., 27, 1874; anal., *Genth*, Am. Phil. Soc. Philad., v., 226, 1874.

HERCYNITE, Min. p. 148.—Analysis of a magnesia-iron spinel, *Wolle*, Am. J. Sci., II., viii., 350, 1868.

HERSCHELITE, Min. p. 437.—Victoria, anal. and description of crystals, *Ulrich*, Contrib. in. Victoria, p. 26, 1870. See Seebachite.

218. Heterogenite, *Frenzel*, Journ. für prakt. Ch., II., v., p. 404, 1872.

Amorphous, massive in globular, reniform masses, with little lustre. H. 3. G. 3·44 lor black, blackish to reddish-brown; streak dark-brown.

Analysis (after deduction of foreign constituents, Cu, Bi, etc.).

	Co	O	$\dot{\text{H}}$		
⅔	72	5·98	21·33	=	99·31

Composition $\dot{\text{Co}}\ 2\ddot{\text{Co}}+6\dot{\text{H}}$, it being a product of the decomposition of smaltite (Speiskobalt).

Pyr. In matrass gives water. B. B. fuses with difficulty on the edges, coloring the flame green; after ignition it is weak magnetic. Gives a cobalt reaction with the fluxes. Soluble in dilute hydrochloric acid, with evolution of chlorine, leaving a residue.

Occurs sparsely with calcite and pharmacolite in cobalt and nickel veins at Schneeberg.

HEULANDITE, Min. p. 444.—Composition discussed, *Rammelsberg*, ZS. G. Ges., xxi., 93, 1868.

Lunddörrsfjäll, Sweden, anal., *Igelström*, Jahrb. Min., 1871, 361.

HISINGERITE, Min. p. 489.—Gap Mine, Penn., anal., *T. D. Rand*, Proc. Ac. Philad., 1872, 304.

Cornwall, analyses (differing somewhat from previous results), *Church*, J. Ch. Soc., II., viii., 3.

81 A. Horbachite, *Knop*, Jahrb. Min., 1873, 523. In crystalline masses, showing an imperfect cleavage direction with a brighter metallic lustre than on the ordinary fracture surfaces. H. 4·5. G. 4·43. Color resembling pyrrhotite but darker, pinchbeck-brown to steel-gray. Streak black.

Analysis on pure material (as proved by the microscope), 1. Wagner (l. c.), 2. Rammelsberg (G.=4·7), Pogg., cxxi., p. 361.

		S	Fe	Ni		
1.	¼	45·87	41·96	11·98	=	99·81
2.		40·03	55·96	3·86	=	99·85

Analysis 1. gives $Fe_8Ni_2S_{15}$ or $4FeS_3+NiS_3$. It is claimed by Knop to be the first discovery of a sesquisulphid in nature, though the analysis by Rammelsberg shows that there is a very considerable variation in composition.

Decomposed rather easily under the influence of air and water, forming iron and nickel vitriol. Occurs with chalcopyrite in irregular masses in the serpentinized gneiss at Horbach in the Black Forest.

HORNBLENDE. See AMPHIBOLE.

HORTONOLITE, *Brush*, Am. J. Sci., II., xlviii., 17. Appendix I., p. 7.

HOWLITE, Min. p. 598.—From Nova Scotia, *How*, Phil. Mag., IV., xxxvii., 270, 1869; xxxix., 278, 1870.

HÜBNERITE, Min. p. 603.—Relation to wolframite, *Des Cloizeaux*, Ann. Ch. Phys., IV., xix., 175, 1870; *Groth* and *Arzruni*, Pogg., cxlix., 235, 1873.

HUMITE, Min. p. 363.—Vesuvius, complete cryst. memoir, showing the relation of the three types, with many figures, *v. Rath*, Pogg., Erg. Bd. v., 321, 1871; chemical investigation with several analyses, *v. Rath*, ibid., Erg. Bd. vi., 385, 1873; cxlvii., 246. See also chondrodite.

HYALITE, Min. p. 199.—Associated with corundum, No. Carolina, *Genth*, Am. Phil. Soc., Philad., xiii., 373, 1873.

Pseudomorph after apatite, aragonite at Waltsch, *Boricky*, Ber. Böhm. Ges., 1873, 64. 65.

HYALOPHANE, Min. p. 346.—Composition, *Kenngott*, Jahrb. Nat. Ges. Zürich, 1869, 373.

HYALOSIDERITE, Min. p. 256.—Sasbach, Kaiserstuhlgebirge, *Rosenbusch*, Jahrb. Min., 1872, 49, et seq.

HYDRARGYLLITE, Min. p. 177.—Chester Co., Penn., anal., *Hermann*, J. pr. Ch., cvi., 68, 72, 1869.

HYDRARGYRITE. See BORDOSITE.

Hydrocuprite. Genth has given the name hydrocuprite to a new mineral found at Cornwall, Lebanon Co., Penn. He gives the following description (priv. contrib.):

Amorphous, orange-yellow to orange-red; forms very thin coatings, sometimes rag-like, upon magnetite; soft.

On heating loses water and becomes black; contains water and cuprous oxide. A sufficient ıantity for analysis could not be obtained, but its composition is probably Ȼu$\dot{\mathrm{H}}$. Besides ıe amorphous coatings, the cuprite variety, *chalcotrichite*, from Cornwall, sometimes ssumes an orange-yellow color, so that on the same piece acicular crystals of a fine crimson ılor can be seen gradually changing to an orange-yellow. It is therefore very probable ıat the orange crystals are pseudomorphs of hydrocuprite after cuprite.

634 A. **Hydrocyanite.** Idrociano, *Scacchi*, Note Mineralogiche, I., p. 26, 1873; extract om Atti Accad. Sci. Napoli, v., 1870.

Orthorhombic. Observed planes, *i*-*ĭ*, *i*-2̆, *I*, 2-*ĭ*, 1-*ĭ*, 1-*ī*, 1, ½; *a* (vert.) : *b* : *c* = 0·7968 : 5650 : 1 or 1·7691 : 1 : 1·4104. Fundamental angles, $I \wedge I = 121° 4'$; $i\text{-}\breve{\imath} \wedge 1\text{-}\breve{\imath} = 128° 33'$; $\wedge\ 1 = 114° 25'$; $i\text{-}\breve{\imath} \wedge \frac{1}{2} = 108° 2'$.

Color pale green, brownish or yellowish, also sky-blue. Translucent.

An analysis (l. c.) gave $\dot{\mathrm{C}}\mathrm{u}$ 49·47, $\dddot{\mathrm{S}}$ 50·30, loss 0·40 = 100·00, which corresponds to the rmula $\mathrm{Cu\dddot{S}}$.

Completely soluble in water. Effloresces very readily in contact with the air. When preserved in the matrix untouched the crystals will remain two or three days without sensible eration, but upon being detached, or even touched, they change color almost immediately. the alteration the crystals first show a blue color, then split to pieces slowly, and separate o minute granules, which seem to be crystals, though too small to allow of their form ing determined. The cause of the efflorescence in this case is the absorption of the water om the atmosphere, not the loss of water, as is generally true. The change when complete sults in the production of chalcanthite ($\mathrm{\dot{C}u\dddot{S}} + 7\dot{\mathrm{H}}$).

In the prismatic zone the crystals show no immediate relation to allied sulphates; the angles the brachydomes, however, agree quite closely, $1\text{-}\breve{\imath} \wedge 1\text{-}\breve{\imath} = 77° 6'$, hydrocyanite; 75° 52', estite; 75° 35', anglesite; 74° 34', barite.

Found by Scacchi at Vesuvius, having been produced by sublimation at the time of the uption of October, 1868. The name is derived from the ὕδωρ, *water*, κύανος, *azure blue*; unfortunate name, suggesting a *hydrous* mineral and one relating to cyanite. See also lerophanite.

HYDROHALITE. Adam, Tableau Min., 1869, p. 69. A hydrous chlorid of sodium, described Mitscherlich, Hausmann Min., p. 1459, 1847.

HYDROMAGNESITE, Min. p. 707.—Kraubat, Steiermark, cryst. and anal., *Tschermak*, h. Min. Mitth., 1871, 113.

IYDROPHILITE. Adam, Tableau Min., 1869, p. 69. Chlorid of calcium. Hausmann ı., p. 1460, 1847.

IYDROZINCITE, Min. p. 711.—Auronza, Lombardy, anal., *Cossa*, Atti Accad. Sci. Torino, 189, 1870–71.

42 B. **Hygrophilite,** *Laspeyres*, Tsch. Min. Mitth., 1873, p. 147.

ryptocrystalline. Occurring in scales; double-refracting. H. 2–2·5. G. 2·670. Color enish-gray to yellowish-gray, in consequence of the presence of minute pores, properly ısparent. Often contains minute cubes of pyrite. Lustre and feel greasy. Streak enish-white.

nalysis, Laspeyres (l. c.)

	$\ddot{\mathrm{S}}\mathrm{i}$	$\dddot{\mathrm{A}}\mathrm{l}$	$\dot{\mathrm{F}}\mathrm{e}$	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\mathrm{M}}\mathrm{g}$	$\dot{\mathrm{K}}$	$\dot{\mathrm{N}}\mathrm{a}$	$\dot{\mathrm{H}}$
$\frac{3}{2}$	48·42	38·06	3·26	1·15	1·72	5·67	1·36	9·02 = 102·67

; belongs to the pinite group. Oxygen ratio for $\dot{\mathrm{R}} : \dddot{\mathrm{R}} : \ddot{\mathrm{S}}\mathrm{i} : \dot{\mathrm{H}}$ = (approximately) 1 : 5 :

. B. Fuses rather easily to a white enamel, which, with cobalt solution, takes a blue r. Very hygroscopic. In water falls to pieces gradually like clay. Soluble in hydroric acid.

ccurs in large irregular masses distributed in a sandstone, or silicious conglomerate in neighborhood of Halle an der Saale.

YPERSTHENE, Min. p. 209.—Cryst. form, *v. Lang*, Pogg., cxxxix., 319, 1870. idescence and dichroism, *Kosmann*, Jahrb. Min., 1869, 368, 532; 1871, 501. t. Dore, Auvergne, cryst., Des Cloizeaux, ZS. G. Ges., xxv., 566; *v. Rath*, Pogg., clii.,

e also *Amblystegite*, Appendix I., p. 1.

Hypochlorite, Min. p. 392.—*Frenzel*, Jahrb. Min., 1872, 515.

Hypotyphite (Breithaupt, arsenglanz), Min. p. 18.—Analysis by Frenzel, Jahrb. Min., 1874, 677.

Idocrase, Min. p. 276.—See **Vesuvianite**.

Ilmenite, Min. p. 143.—See **Menaccanite**.

Ilsemannite, *Höfer*, Jahrb. Min., 1871, 566.—Appendix I., p. 7.

Ilvaite, Min. p. 296.—Elba, cryst., *v. Rath*, ZS. G. Ges., xxii., 710, 1870; Achiardi, Nuovo Cimento, II., iii., Feb., 1870.
(Lievrite), composition, *Rammelsberg*, ZS. G. Ges., xxii., 897, 1870.
Nassau, cryst., *v. Rath*, Pogg., Erg., v., 424, 1871.

Iolite, Min. p. 299.—(cordierite), Ramsberg, Sweden, anal., *Igelström*, Jahrb. Min., 1871, 360.
Laacher See, cryst., *v. Rath*, Pogg., clii., 40, 1870.

Iron, Min. p. 15.—Native iron has been found at Camp Creek, Montana, in small angular fragments (largest ½ inch in length) slightly covered with rust. It showed on etching no Widmannstädtean figures, but developed a finely granular structure. Occurs in the bed rock of the gold placers, covered by six feet of gravel; associated with native lead, (q. v.), *Genth*, Am. Phil. Soc. Philad., xi., 443, 1873.
Crystalline structure of meteoric iron, *Tschermak*, Ber. Ak. Wien, lxx., Nov., 1874.

Isoclasite, *Sandberger*, J. pr. Ch., II., ii., 125.—Appendix I., p. 7.

Isopyre, Min. p. 392.—A mixture, containing more or less opal, *Maskelyne* and *Flight*, J. Ch. Soc., II., x., 1049, 1872.

Itacolumite, Min. p. 195.—Ch. News. xxii., 111, 266, 1870.

Ivigtite, *Rand*, Proc. Acad. Philad., 1868, 142.—Appendix I., p. 7.

Jacobsite, *Damour*, C. R., lxix., 168. Appendix I., p. 8.

Jalpaite, Min. p. 39.—Tres Puntas, anal., *Bertrand*, Ann. d. Mines, VII., i., 413, 1872.

Jamesonite, Min. p. 90.—Sierra de Famatina, Argentine Republic, anal., *Siewert*, Tsch. Min. Mitth., 1873, 247.

Jefferisite, Min. p. 494.—No. Carolina, with corundum, analyses, *Genth*, Am. Phil. Soc. Philad., xiii., 392, 1873.
West Chester, Penn., study of optical character, *Cooke*, Mem. Am. Ac. Boston, 1874, 44.
Culsageeite is a variety of jefferisite described by J. P. Cooke (Mem. Am. Ac. Boston, 1874, p. 48). It very closely resembles the jefferisite from West Chester, Pa., though the color is much lighter, and it is somewhat more friable; the optical properties are the same.
Three analyses gave the following results:

$\ddot{\mathrm{Si}}$	$\dddot{\bar{\mathrm{Al}}}$	$\dddot{\bar{\mathrm{Fe}}}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{H}}$
37·58	19·73	5·95	0·58	25·13	11·09=100·06
37·43	19·75	5·95	0·58	25·58	11·09=100·38
37·10	20·22	5·95	0·58	25·07	11·09=100·01

Oxygen ratio for $\dot{R} : \dddot{\bar{R}} : \ddot{Si} : \dot{H} = 2 : 1 : 1 : 1$. G. = 2·225. These results agree closely with analyses by Genth (l. c.) of the same mineral.
From the Culsagee Mine, near Franklin, Macon Co., N. Carolina.
See also Vermiculite.

Jeffersonite, Min. p. 215.—Franklin, N. J., anal., *Pisani*, C. R., lxxvi., 237, 1873.

Jeypoorite, Min. p. 47 (*Syepoorite*, bad orthogr., *Ross*).—This mineral has been investigated by W. A. Ross with the following results, previous examinations having been made, according to him, upon mixtures: Occurs in small crystalline beads, isometric (Miller), showing the cube, octahedron, and pyritohedron. Color silver-white. Streak blue-black, and semi-metallic, not magnetic. Blowpipe analysis gave 83·2 and 82·5 p. c. cobalt, with evidences of the presence of arsenic and antimony. Ross gives the following as a probable guess at the composition: cobalt 82, antimony 7, arsenic 6, sulphur 5 = 100.

Occurs in a dark gray sand, consisting of one-tenth pyrrhotite, considerable quartz, some chalcopyrite, etc. From the copper mines of Khetree, Jeypoor, province of Rajpootana, India. Proc. Roy. Soc., xxi., 292, 1873.

JORDANITE, Min. p. 88.—Cryst., new forms, *v. Rath*, Pogg., vi., 363, 1873.
Binnenthal, analyses ($As_2Pb_4S_7$), *Sipöcz*, Tsch. Min. Mitth., 1873, 29, 131.
Nagyag, cryst., description and anal., *Tschermak*, *Ludwig*, Tsch. Min. Mitth., 1873, 215.

JULIANITE, *Websky*, ZS. G. Ges., 1871, 486.—Appendix I., p. 8.

KAINITE, Min. p. 642.—See PICROMERITE.

KALKURANITE. See AUTUNITE.

Kaluszite. See SYNGENITE.

KAMACITE. See CHAMASITE.

KAOLIN, Min. p. 473.—Chili, analyses, Domeyko 2nd App. Min. Chili, p. 49, 1867.
A related mineral, anal., from the porphyry of Stein, *Ullik*, Tsch. Min. Mitth., 1873, 197.
Composition, anal., *Schloessing*, C. R., lxxix., 473, 1874.

KARSTENITE, Min. p. 621.—Lüneburg, cryst., Miller, Phil. Mag., IV., xlvii., 124, 1874.

KEROLITE. See CEROLITE.

447 A. Kerrite, *Genth*, Amer. Phil. Soc. Philad., xiii., p. 396, 1873.

In fine scales, presenting no definite shape under the microscope. Very soft. G. = 2·303 (Chatard). Color pale greenish-yellow, with tint of brown; lustre pearly.

Analysis (l. c.), Chatard (material shown by microscopic examination to be pure).

	$\ddot{\text{Si}}$	$\dddot{\text{Al}}$	$\dddot{\text{Fe}}$	$\dot{\text{Fe}}$	$\dot{\text{Ni}},\dot{\text{Co}}$	$\dot{\text{Mg}}$	ign.
$\frac{3}{2}$	38·29	11·41	1·95	0·32	0·25	26·40	21·25 = 99·87

The oxygen ratio for $\dot{\text{R}} : \dddot{\text{R}} : \ddot{\text{Si}} : \dot{\text{H}}$ = 5·4 : 3 : 10·3 : 9·5 or 6 : 3 : 10 : 10, which would ive $2(3\dot{\text{R}}.\ddot{\text{Si}}) + (\dddot{\text{R}},\ddot{\text{Si}}) + 10\,\dot{\text{H}}$.

Exfoliates upon heating, but not to such an extent as jefferisite. B.B. fuses to a white namel. Decomposed by HCl with separation of silica in pearly scales. Found as an pparent result of the alteration of chlorite at the corundum locality, Culsagee Mine, near ranklin, Macon Co., No. Carolina. Named from Prof. Kerr, State Geologist.

KIESERITE, Min. p. 641.—Hallstadt, anal., *Wieser*, Verh. Geol. Reichs, 1871, 8, p. 130; nal., and cryst. description, *Tschermak*, Ber. Ak. Wien, lxiii., 315, 1871.

495 A. Kjerulfine, v. Kobell, Journ. pr. Ch., II., vii., p 272, 1873.

Massive, cleavage imperfect in two directions, approximately 90°. H. 4–5. G. 3·15. ranslucent in fine splinters. Color pale red. Lustre greasy. Fracture uneven.

Analysis (l. c.), after deduction of SiO_2 (1·50 p. c.) and $Al_2O_3 + Fe_2O_3$ (5·40 p. c.).

$\dot{\text{Mg}}$	$\dot{\text{Ca}}$	$\dot{\text{Na}}$	Fl	$\overset{.....}{\text{P}}$
40·86	5·96	1·28	5·28	46·62 = 100

Formula, $2\,\dot{\text{Mg}}_3\overset{.....}{\text{P}} + \text{CaFl}$, where some lime is replaced by soda. Stands near wagnerite, it differs in the large percentage of Fl and almost entire absence of lime.

Occurs at Bamle, Norway.

KLAPROTHOLITE, Jahrb. Min., 1868, 415.—Appendix I., p. 8.

KNEBELITE, Min. p. 260.—Sweden, *Igelström*, B. u. H. Zeit., xxix., 91, 870; xxx., 149, 71.

KOCHELITE, *Websky*, ZS. G. Ges., xx., 250, 1868.—Appendix I., p. 8.

KÖHLERITE. Adam, Tableau Min., 1869, p. 71.—Synonym of onofrite, Dana Min., p. 56.

KOKSCHAROFFITE. Min. p. 242.—(?) No. Carolina, with corundum, anal., Genth, Am. Phil. Soc. Philad., xiii., 373, 1873.

KOLLOPHAN. Sandberger, J. pr. Ch., II., ii., 129.—Appendix I., p. 9.

10 A. **Kongsbergite** *Pisani*, C. R., lxxv., p. 1274, 1872.
An amalgam of silver and mercury occurring with arquerite (analysis l. c. Ag. 86·3, Hg 8·7) at Kongsberg, Norway. Analyses (l. c.) 1. crystalline; 2. crystals.

		Ag	Hg
1.	⅔	95 26	4·74
2.	⅔	94 94	5 06

These give the formula $Ag_{18}Hg$ (Ag 95·10, Hg 4·90). Pisani suggests the possibility that the occurrence may be accidental, but if not so, and if found at other localities, he suggests the name *Kongsbergite*.

471 A. **Koppite**, *Knop*, Jahrb. Min., 1875, 67 (ZS. G. Ges., xxiii., 656, 1871).
Occurs with apatite and magnoferrite in a granular limestone near Schelingen, Kaiserstuhlgebirge, Baden. Color brown. Transparent.
Analyses, 1. Bromeis (quoted by Knop from Handwörterb. d. Chemie, VI., 708). 2. Knop (l. c.)

	C̈b	M̈o	T̈h	Ċe	F̈e	Ṁn	Ċa	Ṁg	K̇	Ṅa	Fl	Ḣ	
1.	62·63	1·43	10·81		4·48	1·42	14·80	1·58	——	2·37	1·16	1·50	= 101 58
2.	61·90	——	Ċe 10·10 (Ḋi, L̇a)		1·80	0·40	16·00	——	4·23	7·52	——	——	

Each of the determinations of Knop was made on a separate quantity of the mineral. Rammelsberg obtained C̈b 62·46, Ċe 6·69, L̇a, Ḋi 3·00. Knop writes the formula 5Ṙ 2C̈b, neglecting a small amount of fluorine. This mineral has been hitherto called pyrochlore, but Knop separates it from that species on the ground that it contains no titanic acid and little or no fluorine. Named in honor of Prof. Kopp, of Heidelberg.

496 A. **Korarfveite**, *F. Radominski*, C. R., lxxviii., p. 764, 1874. A name proposed provisionally for a phosphate of cerium containing fluorine near monazite. It occurs in albite with gadolinite, hjelmite, and beryl at Korarfet near Fahlun, Sweden (there called monazite).
In imperfect crystals, or crystalline masses often very large; one cleavage perfect. Double refracting (Des Cloizeaux). G. 4·03. Color yellow passing into brown. Fracture vitreous, translucent. Streak grayish-yellow.
Analysis (l. c.) made upon impure material, and consequently needing confirmation.

Ċe L̇a Ḋi	Ċa	Ṁg	F̈e	Fl	P̈	Ḣ		
67·40	1·24	tr	0·32	4·35	27·38	tr	=	100·69

B. B., infusible. Partially attacked by HCl with evolution of Cl. Completely decomposed by sulphuric acid and bisulphate of potash.

KOTSCHUBEITE, Min. p. 497.—Relation to *kämmererite*, etc., *v. Leuchtenberg*, Bull. Soc. Imp. St. Pet., xiii., 34, 1869.

Kryokonite. See CRYOCONITE.

LABRADORITE, Min. p. 341.—Examination of the cause of the iridescence, *Vogelsang*, Arch. Néerland, iii., 32, 1868.
Exhaustive cryst. and microscopic investigation by *Schrauf*, in which he shows the pr- sence of inclosed crystals of augite, hematite, and magnetite (with picotite ?). He als describes two varieties of microscopic inclosures to the presence of which the color is due: the first he calls MICROPLAKITE. They form rectangular tabular crystals ($a \wedge a = 90°$, a secondary plane = 153½°–153°) and lie in a position perpendicular to that of the augite need. By transmitted light they are grayish-yellow to brownish, by reflected light reddish-green: green and blue (the colors of thin media). Schrauf says that in most of their propert they agree with magnetite, though their apparent insolubility is against that idea. T second kind of inclosures he calls MICROPHYLLITE, they form indistinct crystalline scales and lie parallel to the direction of the augite crystals; they are from ·05 to ·1 mm. in length and ·02 to ·04 in breadth; their true nature is doubtful. Ber. Ak. Wien, lx., Dec., 18

Labrador, analyses of two varieties; violet (with 11·14 p. c. $\dot{C}a$) and white (with 9·4 p. c. $\dot{C}a$), *Oudemanns*, J. pr. Ch. cvi., 56, 1869.
Narödal, analyses, *v. Rath*, Pogg., cxxxvi., 424; cxxxviii., 171; *Tschermak*, ibid., cxxxviii., 162; *Rammelsberg*, ibid., cxxxix., 178; ibid., cxli., 174.
Waterville, N. Hampshire, analyses, *E. S. Dana*, Am. J. Sci., III., iii., 48, 1872.
Greenland, anal., *Janovsky*, Ber. Chem. Ges. Berlin, 1873, 1454.
Verespatak, cryst., anal., and description of products of decomposition, *Tschermak*, Tsch. Min. Mitth., 1874, 269. See also *Feldspar*.

LAMPADITE, Min. p. 181.—(Kupfermanganerz), Chili, anal., *Frenzel*, Jahrb. Min., 1873, 801.

LANARKITE, Min. p. 628.—Analyses, *Maskelyne* and *Flight*, giving the formula $\dot{P}b\dddot{S}+\dot{P}$ with no water and no carbonic acid, J. Ch. Soc., II., xii., 103.
Pisani has analyzed l. from Scotland and finds, as above, no carbonic acid, except as due to impurity, he gives the formula $\dot{P}b^2\ddot{S}$; he adds the results of an optical examination, C. R., lxxvi., 114; *Jannettez*, ib., p. 1420, 1873.
Corrected angles given by *Schrauf*, Tsch. Min. Mitth., 1873, 137.

LANGITE, Min. p. 665.—Anal., *Maskelyne* and *Flight*, Ber. Ch. Ges. Berlin, 1870, 934.

LAPIS LAZULI, Min. p. 331.—(lasurstein), "a mixture of granular calcite, paralogite (=ekebergite) and an isometric, ultramarine mineral, which is generally blue, or violet, sometimes also colorless, and in the last case assumes a blue color on heating,"—thorough microscopic examination and discussion of relation to hauynite and nosite (nosean), *Vogelsang*, Vers. Med. K. Akad. Amsterdam, II., vii., 161, 1873. The same matter has been previously investigated by Fischer (Krit. Mikr. Stud., 1869, p. 40).

LAUMONTITE, Min. p. 399.—Cryst. description, *Kokscharow*, Min. Russl., v., 156.
Anal., *v. Fellenberg*, Jahrb. Min., 1869, 373.
St. Bartholomew, anal. (*Nordström*), Ak. H. Stockholm, IX., No 12, Nov., 1870 (Cleve, Geol. W. India Is., p. 30, 1870).
Caporciano (=caporcianite), anal., *Bechi*, *Achiardi*, Boll. Com. Geol., Ital., 1871, 139.

LAURITE, Min. p. 74.—With platinum from Oregon, *Wœhler*, Am. J. Sci., II., xlviii., 441, 1868.

LAVROFFITE, Min. p. 216.—Composition and description, a diopside colored green by 4·20 p. c. of vanadate of lime, *Hermann*, J. pr. Ch., II., i., 444; Koksch. Min. Russl., vi., 206.

LAXMANNITE, *Nordenskiöld*, Pogg., cxxxvii., 209.—Appendix I., p. 9.

LAZULITE, Min. p. 572.—Vesuvius, note, *v. Rath*, Pogg., cxxxviii., 491.
No. Carolina, with corundum, *Genth*, Am. Phil. Soc. Philad., xiii., 404, 1873.

LEAD, Min. p. 17.—Native, found with native iron (q. v.) in the bed rock of the gold placers, covered by 6 feet of gravel, at Camp Cr., Montana. Occurs in irregular and rounded flattened pieces, from the size of a pin head to ½ inch; coated with massicot, probably also by cerussite; shows crystalline structure. The solution contained gold, but no silver, *Genth*, Am. Phil. Soc. Philad., xi., 443, 1870.
Pflücker also speaks of the occurrence of native lead in rounded grains at many localities, S. W. of Huancavelica (Peru). It contains little silver, but considerable antimony, Domeyko, 3d App. Min. Chili, 1871.

LEADHILLITE, Min. p. 624.—Relation to susannite (q. v.), *Kenngott*, Jahrb. Min., 1868, 319.
Composition discussed, relation to *maxite* (q. v.), *Hintze*, Pogg., clii., 256.
Anal., *Bertrand*, Bull. Soc. Ch., xix., 67, 1873; *Laspeyres*, Jahrb. Min., 1873, 292.

LEPIDOLITE, Min. p. 314.—Eulenlohe, Fichtelgebirge, *Sandberger*, Ber. Ak. München, 871, 93.

LESLEYITE, Min. p. 800.—Appendix I., p. 18.

LETTSOMITE, Min. p. 666.—See CYANOTRICHITE.

LEUCAUGITE, Min. p. 216.—Amity, N. Y., anal., *Leeds*, Am. J Sci., III., vi., 24, 1873.

LEUCHTENBERGITE, Min. p. 500.—Chem. composition, *Kenngott*, Jahrb. Min., 1868, 203

LEUCITE, Min. p. 334.—Microscopic structure, *Zirkel*, ZS. G. Ges., xx., 97, 1868; Jahrb. Min., 1870, 809; *v. Lasaulx*, Jahrb. Min., 1872, 408.

Contains rubidium and caesium, *J. L. Smith*, Am. J. Sci., II., xlix., 335, 1870.

Vesuvius, anal., *v. Rath*, Pogg., cxlvii., 264; enveloped in sanidin, ibid., Erg. Bd., vi., 381 and 198; see also *Scacchi*, Atti Accad. Napoli, v., March, 1870; Sept. 14, 1872.

Vesuvius, shown by accurate measurements, as well as by the presence of striated faces (due to twining), to be *tetragonal*. The ordinary crystals show the planes 1, 4-2, also 2-*i* and *I*; *i* ∧ *i* (=4-2 ∧ 4-2)=133° 58′; *a* (vertical)=0·52637; composition face 2-*i*. Also anal., *v. Rath*, Pogg., Erg. Bd., vi., 198, 1873 (or Jahrb. Min., 1873, 113).

Note by *Scacchi*, Boll. Com. Geol. Ital., 1873, 183.

LEUCOPHANITE, Min. p. 260.—Cryst., *Nordenskiöld*, Œfv. Ak. Stockh., 1870, xxvii., 557. Cryst., *Bertrand*, Ann. d. Mines, VII., iii., 24. Cryst., v. Lang, Tsch. Min. Mitth., 1871, p. 82.

LEUCOPYRITE, Min. p. 77 (=löllingite, Dana)—and löllingite, anal., Przibram, *Zepharovich*, Lotos, Jan., 1870.

In Dana's Mineralogy, 1868, the names, leucopyrite and löllingite previously used as synonyms, were given, leucopyrite to the mineral with the composition $FeAs_2$, and löllingite to the compound Fe_2As_3 (supposed to include the arsenical pyrites from Lölling, not then known to have been analyzed). It appears, however, that a little earlier, Zepharovich (Verh. Min. Ges. St. Pet., II., iii., 1867) had found the Lölling mineral to have the composition $FeAs_2$, and hence proposed for it the name löllingite, reserving Shepard's name, leucopyrite, for the Fe_2As_3. The names as given by Zepharovich have the priority, and should be received. In another printing from the stereotype plates (6th sub-edition) of Dana's Min. the change will be made. It is to be added, however, that there was no "confounding of the names" (Naumann, Min., p. 611, 1874) in Dana's Mineralogy.

LEVYNITE, Min. p. 431.—Richmond, Vict., comp., *Kenngott*, Jahr. Nat. Ges. Zürich, xvi., 132, 262, 1871.

LIGNITE, Min. p. 755.—Pecton Co., N. S., anal. and description, *How*, Phil. Mag., IV., xxxvii., 264.

414 A. Limbachite, Frenzel, Jahrb. Min., 1873, 789; Min. Lex. Sachsen, p. 184.

Massive. G. = 2·395. Lustre greasy. Color grayish to greenish-white. Not hard nor brittle. Does not adhere to the tongue.

Analyses, Frenzel (l. c.)

$\ddot{\mathrm{Si}}$	$\ddot{\bar{\mathrm{Al}}}$	$\bar{\mathrm{Fe}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{H}}$
41·42	22·09	——	23·67	12·47 = 99 65
42·03	19·56	1.46	25·61	12·34 = 101·00

Frenzel gives the formula $3\dot{\mathrm{Mg}}\,2\ddot{\mathrm{Si}} + \ddot{\bar{\mathrm{Al}}}\ddot{\mathrm{Si}} + 3\dot{\mathrm{H}}$. Hence in oxygen ratio it stands very near cerolite (Kerolith), from which species Frenzel has separated it, though, as he shows, the analyses vary much. $\dot{\mathrm{R}} : \bar{\mathrm{R}} : \ddot{\mathrm{Si}} : \dot{\mathrm{H}} = 1 : 1 : 3 : 1$.

Occurs at Limbach, filling cavities or fissures in serpentine.

A similar mineral, occurring in serpentine at Zöblitz, has been called ZÖBLITZITE by Frenzel (Min. Lex. Sachsen, p. 351). Massive. Color light-yellow. An analysis gave Melling (l. c. and Jahrb. Min., 1873, 789), $\ddot{\mathrm{Si}}$ 47·13, $\ddot{\bar{\mathrm{Al}}}$ 2·57, $\dot{\mathrm{Fe}}$ 2·92, $\dot{\mathrm{Mg}}$ 36·13, $\dot{\mathrm{H}}$ 11·50 = 100·25.

LIMBILITE, Min. p. 258.—Rosenbusch thinks that the limbilite of de Saussure cannot be regarded as a result of the decomposition of chrysolite, but rather of the glassy matter of such a rock as has been called by him limburgite, Jahrb. Min., 1872, 169.

LIME-WAVELLITE, *Kosmann*, ZS. G. Ges., xxi., 795, 1869.—Appendix I., p. 9.

LIMONITE, Min. p. 172.—Pseudomorph after cerussite, *Kosmann*, ZS. G. Ges., xxi., 644, 869.

LINARITE, Min. p. 663.—Cumberland, exhaustive cryst. memoir, with many new forms, *Kokscharow*, Min. Russl., v., 206.

Chili, Domeyko 2d App. Min. Chili, p. 32, 1867; *Bertrand*, Ann. d. Mines, VII., i., 414, 1872.

Rezbanya, cryst. memoir, *Schrauf*, Ber. Ak. Wien, lxiv., 172 (1871); lxv., 241, 1872.

LITHIOPHORITE, Appendix I., p. 9.—*Laspeyres*, Jahrb. Min., 173, 1869.

29 A. Livingstonite, *Mariano Barcena*, Naturaleza, iii., 35, 1874; iii., p. 172, 1875, m. J. Sci., III., viii., p. 145, 1874; ix., p. 64, 1875.

In prisms, and columnar groups much like stibnite, and apparently isomorphous with it. I. = 2 (Breithaupt's scale). G. = 4·81. Color bright lead-gray. Streak *red* (not black as vith stibnite). Analysis, Barcena (l. c.)

S	Sb	Hg	Fe
29·08	53·12	14·00	3·50 = 99·70

Whence the atomic ratio for the sulphur, antimony, mercury and iron, 18·17 : 8·7 : 1·4 · 2 = (nearly) 15 : 7 : 1 : 1, or $4SbS_3 + HgS + FeS^2$. Fuses at the first touch of the blowipe flame, giving off white fumes in abundance. Not sensibly attacked by cold nitric acid, ut dissolved in the warm acid with a white residue.

Occurs at Huitzuco, State of Guerrero, Mexico, in a matrix of carbonate and sulphate of me, together with sulphur, cinnabar, stibnite and valentinite.

LÖLLINGITE, Min. p. 76 (= leucopyrite, Dana).—Reichenstein, Silesia, anal. (containing old), Güttler, Jahrb. Min., 1871, 81.

Chañarcillo, anal., Domeyko 3d Append. Min. Chili, 1871.

Dobschau, Hungary, anal., *Niedzwiedzki*, Tsch. Min. Mitth., 1872, 161.

See also Leucopyrite.

595 A. Ludwigite, *G. Tschermak*, Tsch. Min. Mitth., 1874, p. 59.

In finely fibrous masses, the fibres generally short and in a parallel position, so that on the esh fracture it has a silky lustre. H. = 5. G. = 3·907–3·951 (lighter colored variety), 016 (dark-colored variety). Color blackish-green, and again almost perfectly black with tinge of violet. Tough. Streak dark-green, of a somewhat lighter color than the mineral self. In microscopic splinters transparent, with a greenish-brown color.

Analysis, Ludwig and Sipöcz, l. c. 1. (mean of 7 partial analyses) G. = 3·951, color darkeen. 2. G. = 4·016, black.

	$\overline{\text{B}}$	$\overline{\text{Fe}}$	$\dot{\text{Fe}}$	$\dot{\text{Mg}}$
1.	16·09	39·92	12·46	31·69 = 100·16*
2.	15·06	39·29	17·67	26 91 = 98·93*

* Traces of manganese.

For analysis 2. Tschermak gives the formula $2\dot{\text{Mg}}\overline{\text{B}} + \dot{\text{Fe}}\overline{\text{Fe}}$, which corresponds also to alysis 1, though here a little $\dot{\text{Mg}}$ takes the place of some $\dot{\text{Fe}}$.

A microscopic examination proved the absence of magnetite in the material analyzed, ough magnetite and also sometimes calcite are generally intimately associated with it.

Heated in the air the mineral becomes red; in fine splinters fusible with difficulty to a ck, strongly magnetic, slag. With the fluxes gives the reaction for iron. Dissolved wly by cold hydrochloric acid when in the state of a fine powder.

Occurs imbedded in a crystalline limestone, with irregularly situated beds of magnetite, Morawitza in the Banat.

According to F. Berwerth (Tsch. Min. Mitth., 1874, 247) ludwigite occurs altered to onite. An analysis of material, having a brownish-red color, and graduating insensibly o pure ludwigite, afforded him: $\overline{\text{Fe}}$ 75·34, $\dot{\text{Mn}}$ tr., $\dot{\text{C}}$a 0·09, $\dot{\text{Mg}}$ 5·80, $\ddot{\text{C}}$ 1·65, $\ddot{\text{Si}}$ 2·83, 14·51, $\overline{\text{B}}$ 0 08 = 101·02. G. = 3·41. Besides the limonite (88·17 p. c.), Berwerth coners that some talc, brucite, magnesite, and calcite are also here present as mechanically ced impurities.

UNEBURGITE, Nöllner, Ber. Ak. München, 1870, 291.—Appendix I., p. 10.

32. Luzonite, *Weisbach*, Tsch. Min. Mitth., 1874, p. 257.

Massive, with uneven fracture, with but little tendency to cleavage. In cavities there were observed some minute crystals, whose form could not to be distinguished. H. = 3·5 = 4·42. Color dark reddish-steel gray, turning violet with time. Lustre black and tallic. Streak black. Brittle.

nalysis, Winkler, l. c.

S	Sb	As	Cu	Fe
33·14	2·15	16·52	47·51	0.93 = 100·55

his gives substantially $Cu_3AsS_4 = 3\,\overline{\text{Cu}}S + As_2S_5$, or similar to enargite

It is closely related to famatinite (q. v.) and Weisbach says, though without suffici reason, that the two are probably isomorphous, while it forms a dimorphous group wi enargite. The sole reason for separating the mineral from enargite seems to be its structure less character, nearly destitute of cleavage, but, unsupported by observations on the crysta line form, this cannot be regarded as conclusive.

Occurs in the copper veins of Mancayan, district of Lepanto, Island Luzon (Mani Associated with the following minerals, named in the order of their deposition: Quartz, pyrite (luzonite), enargite, quartz, tetrahedrite, barite.

447 B. Maconite, *Genth*, Amer. Phil. Soc., Philad., xiii., 396, 1873.

In irregular scales, resembling a variety of jefferisite. Soft, but slightly harder th kerrite. G. = 2·827 (Chatard). Color dark brown; lustre pearly, inclining to sub-meta Analysis, l. c., Chatard and Genth.

	$\ddot{\mathrm{Si}}$	$\bar{\mathrm{Al}}$	$\bar{\mathrm{Fe}}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Ni}},\dot{\mathrm{Co}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Li}}$	$\dot{\mathrm{Na}}$	$\dot{\mathrm{K}}$	ign.
⅔	34·22	21·53	12·41	0·32	0·12	14·46	tr	0·51	5·70	11·85 = 101·1

Oxygen ratio, $\dot{\mathrm{R}} : \bar{\mathrm{R}} : \ddot{\mathrm{Si}} : \dot{\mathrm{H}} = 3 : 6 : 8 : 5$ nearly, or $3\dot{\mathrm{R}}, 2\ddot{\mathrm{Si}} + 2(\bar{\mathrm{R}}, \ddot{\mathrm{Si}}) + 5\dot{\mathrm{H}}$.

Exfoliates largely on heating, and fuses with difficulty to a brown glass; easily decomposed by hydrochloric acid, with separation of silica in scales.

Contains numerous fragments of corundum, and some microscopic reddish-brown cryst which may be sphene. Found, as an apparent result of the alteration of chlorite, at th corundum locality, Culsagee Mine, near Franklin, Macon Co., No. Carolina.

MAGNESITE, Min. p. 685.—Traversella, cryst., *Strüver*, Atti Accad. Sci. Torino, vi., 37 1871.

Greiner, Tyrol, note, *Zepharovich*, Ber. Ak. Wien, lxvii., 750, 1868.

From the Alps, crystals with *O*, *I*, *i*-2, also anal., *Rumpf*, Tsch. Min. Mitth., 1873 26.

Var. breunnerite, anal., *Leeds*, J. Frank. Inst., III., lx., 63, 1870.

MAGNETITE, Min. p. 149.—Crystals from Achmatowsk, with planes, *O*, 1, *i*, 3-3, 5-$\frac{5}{3}$, $\frac{1}{2}$-$\frac{1}{2}$. ZS. G. Ges., xxi., 489, 1869.

Auerbach, anal., containing nickel, *Petersen*, J. pr. Ch., cvi., 441, 1869.

Wolfach, anal., *Petersen*. Pogg., cxxxvi., 506, 1869.

Traversella, cryst., *Strüver*, Atti Accad. Sci. Torino, vi., 374, 1871.

Brewster, N. Y., pseudomorph after dolomite and chondrodite, *J. D. Dana*, Am. J. S III., viii., 375, 1874.

In mica from Pennsbury, reply of *J. D. Dana* and *G. J. Brush* to a note by Rose (see he tite), Am. J. Sci., II., xlviii., 360, 1869 (Jahrb. Min., 1874, 611).

Both Zirkel (Microscop. Beschaff. der Min., 1873, p. 247) and Rosenbusch (Phys. d. M 1873, p. 213) speak of the mineral in the mica of Pennsbury as being hematite. It is di cult, however, to see how this view can be reconciled with the investigations of Brush He found that the mineral was blackish to smoky-brown in color, and strongly magneti had moreover a black streak. Upon being heated to redness out of contact of the air tained its color, but heated with access to the air it became red. It was sometimes, in con quence of alteration, changed to a bright red or yellow mineral. The red substance ha red streak, the yellow substance an ochre-yellow streak; the last became red when hea Prof. Brush concludes that the black mineral is in all probability magnetite, the red min is hematite (arising from the oxidation of the original magnetite), and the yellow-ochre m eral is hydrated sesquioxyd of iron, due to hydration as well as oxidation.

189. Magnochromite, *Bock*, Inaug. Dissert. Breslau, 1869. *Websky*, ZS. G. Ges., xx 394, 1873.

A variety of chromite from Grochau, Silesia, containing a large amount of magnesia has been previously described by Breithaupt (1832, III., p. 234; 1847, III., 777), and other authors. In physical characters it agrees with chromite, except in its want of me lustre and low specific gravity. According to Breithaupt G. = 4·031–4·110 (this, W suggests, is in part accounted for by the presence of impurities). It occurs in grains embedded in a green gangue from which it cannot be entirely separated. This mineral is considered by Websky as a new species, and using an analysis of it (v groc he deducts it from an analysis of a mixture of the two, made by Bock, and obtain following as the composition of the magnochromite: $\bar{\mathrm{Al}} = 29·92$, $\bar{\mathrm{Cr}} = 40·78$, $\dot{\mathrm{Fe}} = 15$ $\dot{\mathrm{Mg}} = 14·00 = 100·00$. This result agrees with the general formula $\dot{\mathrm{R}}, \bar{\mathrm{R}}$ of the spinel gr giving in this case $4(\bar{\mathrm{Al}}, \bar{\mathrm{Cr}}), (3\dot{\mathrm{Fe}}, 5\dot{\mathrm{Mg}})$.

MALACHITE, Min. p. 715.—Pseudomorph after atacamite, *Kokscharow*, Bull. Soc. Imp. St Pet., xviii., 186, 1872; *Tschermak*, Min. Mitth., 1873, 39.

MALDONITE, *Ulrich*.—Appendix I., p. 10.

MANGANDISTHEN. See ARDENNITE.

290 A. Manganophyllite, *Igelström*, Jahrb. Min., 1872, 296, (Kenngott, 1873, 56).
Hexagonal? In thin plates, like other micas.
Color bronze to copper-red. Streak pale red. In thin scales translucent with a rose-red color.
Analysis, Igelström (l. c.)

$\ddot{\mathrm{Si}}$	$\ddot{\bar{\mathrm{Al}}}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Mn}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{K}}$, $\dot{\mathrm{Na}}$	ign.		
38·50	11·00	3·78	21·40	3·20	15·01	5·51	1·60	=	100

Kenngott observes (l. c.) that, if we call the loss $\dot{\mathrm{H}}$ and reckon it with the bases, the oxygen ratio for bases to silica becomes 11·72 : 12 or $\dot{\mathrm{R}} : \ddot{\bar{\mathrm{R}}} : \ddot{\mathrm{Si}} = 1 : 3 : 4$ nearly (the ratio of lepidomelane). The alkalies appear to be for the most part potash.
B. B gives no coating on charcoal; with borax or soda affords a strong manganese reaction. Soluble in HCl with the separation of silica in the form of the original scales.
Occurs with tephroite, hydrotephroite, hamartite, magnetite, calcite, garnet, etc., at the manganese mine Pajsberg, near Filipstadt, Sweden.
Igelström calls attention to the fact that his manganophyll is in many respects similar to the imperfectly described (no analysis) alurgite of Breithaupt (Dana's Min. p. 764).

MARCASITE, Min. p. 75.—Pseudomorph after bournonite, chalcopyrite, magnetite, *Döll*, Tsch. Min. Mitth., 1874, 87, 88.
(Weisskupfererz) Halsbrüche, near Freiberg, an analysis by *Frenzel* gave results agreeing with the formula R_2S_3 (Cu=10·75 p. c., Fe=40·47), it is a compound between marcasite and chalcopyrite, and, if constant in composition, Frenzel suggests that it should have a distinctive name, Jahrb. Min., 1873, 785.

MARCELINE, Min. p. 163.—Examined by *v. Kobell*, J. pr. Ch., II., iii., 467.

MARGARITE, Min. p. 506.—No. Carolina, anal., *J. L. Smith*, Am. J. Sci., III., vi., 184; analyses, *Genth*, Am. Phil. Soc., Philad., xiii., 399, 1873.
Optical character investigated, *Bauer*, ZS. G. Ges., xxvi., 180, 1874.

Mariposite, a name proposed provisionally by Prof. Silliman for an anhydrous silicate con-aining as bases, according to the blowpipe, iron (protoxide), alumina, chromium, lime, nagnesia and potash, with traces of manganese and sulphuric acid. It had a light apple-green color, occurs in scales and associated with pyrite in a gangue of dolomite (ankerite) ningled with quartz; from the Mariposa estate, California. (Cal. Acad. Sci., III., 380, 1868). t has since been referred provisionally to fuchsite (Min p. 311, anal., 16), though its iden-ity with that species has not been finally determined. It is the constant associate of the ore hrough the Mariposa region, and in consequence of its paragenetical relations deserves urther investigation.

MARMOLITE, Min. p. 465. See SERPENTINE.

MARTITE, Min. p. 142.—Brazil, *Rosenbusch*, Jahrb. Min., 1871, 78.

309 A. Maskelynite, Tschermak, Ber. Ak. Wien, lxv., p. 122, 1872.
Isometric; form a distorted cube. In grains transparent, colorless, with milky portions rising from alteration. In the microscopic section seen to have a rectangular outline, and hown by optical properties to be isometric. H. = about 6·5. B. B., fusible with difficulty o a transparent glass. Analysis, mean of two closely agreeing analyses made by different nethods:

$\ddot{\mathrm{Si}}$	$\ddot{\bar{\mathrm{Al}}}$	$\ddot{\bar{\mathrm{Fe}}}\dot{\mathrm{Fe}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Na}}$	$\dot{\mathrm{K}}$		
54·3	24·8	4·7	11·1	tr	4·9	1·2	=	101·0

The iron comes from a little magnetite present, and deducting this, we obtain: $\ddot{\mathrm{Si}}$ 56·3, $\ddot{\bar{\mathrm{Al}}}$ 25·7, $\dot{\mathrm{Ca}}$ 11·6, $\dot{\mathrm{Na}}$ 5·1, $\dot{\mathrm{K}}$ 1·3 = 100·00.
The oxygen ratio is nearly $\dot{\mathrm{R}} : \ddot{\bar{\mathrm{R}}} : \ddot{\mathrm{Si}} = 1 : 3 : 6$, or that of labradorite.
Occurs in the meteorite from Shergotty, near Behar, India.

635 A. Maxite, *Laspeyres*, Jahrb. Min., 1872, 407, 508; 1873, 292.
Orthorhombic. Massive, crystalline. Cleavage tabular, perfect.

Optical characters—acute bisectrix normal to the cleavage surface. Double-refraction strong, character negative. Axial angle small. Apparent angle in air for red rays 19° 38′; for blue 22° 45′; for white 20° 51′. H. = 2·5–3. G. = 6·87 (leadhillite 6·26–6·44; 6·60, Sardinia, *Bertrand*). Colorless. Transparent to translucent. Lustre adamantine to pearly. Fracture conchoidal to splintery. Slightly brittle.

Analysis, Laspeyres and Eichhorn (l. c.)

$\dot{Pb}$	$\dddot{S}$	$\ddot{C}$	$\dot{H}$
81·91	8·14	8·08	1·87 = 100·00

Laspeyres writes the formula $5\dot{Pb}\dddot{S} + 9\dot{Pb}\ddot{C} + 4\dot{Pb} + 5\dot{H}$, making it a hydro-sulpho-carbonate of lead.

Fuses easily in the flame of a spirit lamp, forming a yellow bead, crystalline on cooling. On charcoal gives a lead coating. In the matrass decrepitates, expands and becomes white and non-transparent, giving off water. Insoluble in water. Soluble in nitric acid.

Occurs with anglesite and cerussite in galenite at the Mala-Culzetta mine near Iglesias, Sardinia.

Maxite resembles leadhillite very closely in its physical characters, especially in its optical properties, and is not far off in composition. Bertrand, on this account, has urged that the maxite is probably nothing but an altered leadhillite (Bull. Soc. Chem., xix., 17, 1873), which seems not improbable.

MEGABASITE, Min. p. 604.—Morrochoco, Peru, anal., *Pflücker*, Domeyko 3d App. to Min. Chili, 1871.

MEIONITE, Min. p. 318.—Vesuvius, cryst., *Brezina*, Tsch. Min. Mitth., 1872, 16.

MELACONITE, Min. p. 136.—Varieties from Chili containing $\ddot{Fe}$, and others with $\dot{Co}$ and $\dot{Mn}$. Domeyko 2d App. Min. Chili, p. 14 et seq., 1867; 4th App., p. 11, 1874.

MELANGLANZ. See Stephanite.

Meerschaluminite, *Ross*, = pholerite, which see.

MELIPHANITE, Min. p. 263.—(Melinophane)—Cryst., *Nordenskiöld*, Œfv. Ak. Stockholm, 1870, xxvii., 556.

MELOPSITE, Min. p. 478.—Shown by *Goppelsröder* to be a magnesia-silicate, J. pr. Ch., cv., 126.

MENACCANITE, Min. p. 143.—Titaniferous sands from Chili, *Domeyko*, Ann. d. Mines, VI., xvi., 540. See also Min. Chili, 2d and 3d App.; Silva, C. R., lxv., 207.
From doleryte, anal., *Sandberger*, Ber. Ak. München, 1873, 146.
Norway, analysis, *v. Gerichten*, Ann. Ch. Pharm., clxxi., 205, 1874.
Canada, analyses, *Harrington*, Canada Geol. Surv., 1874, 227.

MENEGHINITE, Min. p. 105.—Occurs in the emery near Schwarzenberg, Saxony, analysis and description, *Frenzel*, Pogg., cxli., 443.

MESOLITE, Min. p. 430.—Iceland and Stromoë, analyses, *Schmid*, Pogg., cxlii., 118.
In dolerytes of Bergonne, analyses, *Pisani*, C. R., lxxiii., 1447, 1871.
In basalts, *Streng*, Jahrb. Min., 1874, 575.

METACINNABARITE, *Moore*, Am. J. Sci., III., iii., 36. Appendix I., p. 10.
Durand thinks, after an examination of some good crystals, though without the opportunity of making measurements, that there is a strong presumption in favor of the mineral being orthorhombic. He gives two figures, which, however, look much like a combination of the cube and octahedron, *i.e.*, isometric, as before suggested. Proc. Cal. Acad., iv., 219, 1872.

225 A. Meymacite, *Carnot*, C. R., lxxix., p. 639, 1874.
A hydrated tungstic acid, formed from the alteration of scheelite, which Carnot suggests, may have been accomplished by means of acid waters arising from the decomposition of pyrite.

Sometimes yellow or greenish-yellow, preserving the crystalline structure and cleavage of scheelite; sometimes when the alteration has been more complete, the mineral is friable between the fingers, and has a yellow or brownish color. Lustre resinous.

Analyses (l. c.) 1. and 2. on friable material, color yellow to brownish, streak sulphur yellow. G. = 3·80. 3. firm, with lamellar structure and yellowish streak. G. = 4·54.

$\dddot{\mathrm{W}}$	$\dddot{\bar{\mathrm{Ta}}}$	$\ddot{\bar{\mathrm{Fe}}}$	$\ddot{\bar{\mathrm{Mn}}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{H}}$	gangue
71·85	1·00	6·00	0·75	2·50	12·93	4·50 = 99·53
74·25	1·05	6·10	0·65	4·65	11·75	1·85 = 100·30
75·12	0·70	6·25	0·32	7·00	6·85	2·55 = 98·79

Deducting the tungstate of lime and hydrated oxyd of iron, which he regards as impurities, Carnot deduces the formula $\dddot{\mathrm{W}}$, 2$\dot{\mathrm{H}}$. In the tube gives off water. On charcoal turns black. With salt of phosphorus, gives in the O. F. a yellow bead, nearly colorless on cooling. In R. F. a bead colored violet to red (iron and tungstic acid together). With acids gives the reaction of tungstic acid when treated in the usual way.

Found with wolfram and scheelite at Meymac (Corrèze), France.

MICA, Min. p. 301 et seq.—Milben, near Petersthal, anal., *Nessler*, Jahrb. Min., 1869, 249.

In Scotch granites, analyses, *Haughton*, Phil. Mag., IV., xl., 62, 1870.

In granite from India, anal., *Ormsby*, Journ. R. Geol. Soc. Dublin, II., iii., 26, 1871.

With penninite, lepidolite, etc. (Verwachsungen), *Rose*, Pogg., cxxxviii., 177, 1869.

Brewster, N. Y., anal., *Breidenbaugh*, Am. J. Sci., III., vi., 207, 1873.

Manhattan Is., New York, analyses, *Schweitzer*, Amer. Ch., iv., 443, Jan., 1874.

Physical and optical investigations, *Reusch* (Körnerprobe), Pogg., cxxxvi., 130, 632; Ber. Ak. Berlin, July, 1869, 530; *Max Bauer*, Pogg., cxxxviii., 337, 1869; ZS. G. Ges., xxvi., 137, 1874; *Cooke*, relation to the vermiculites, Mem. Am. Ac. Boston, 1874, 35.

MICHAELSONITE, Min. p. 289.—(Erdmannite, *Blomstrand*), composition and description, *Nordenskiöld*, Œfv. Ak. Stockholm, 1870, xxvii., 365.

MICROLITE, Min. p. 513.—Shepard Am. J. Sci., II., l., 95, 1870.

MICROLITES, a name proposed by Vogelsang (Philosoph. d. Geol., 1867, p. 139) and since used by Zirkel (Mikroscop. Beschaff. d. Min., 1873, pp. 33, 88) for microscopic crystals, sometimes belonging to known species, sometimes of indeterminate nature, but often observed in igneous rocks. The method of aggregation of these microlites is sometimes very remarkable. Trichite and belonite are names given by Zirkel (l. c.) to analogous forms.

Mikroplakite, Mikrophyllite. See LABRADORITE.

305 A. Microsommite.—Scacchi, Rend. R. Accad. Napoli, Oct., 1872, ZS. G. Ges., xxiv., 505. Further investigated by v. Rath, Pogg., Ann. Erg. Bd., vi., p. 372, 1873.

Occurs in extremely minute hexagonal crystals; often grouped together. Crystals striated vertically, occasionally with edges truncated. *O* dull. *a* (vert.) = ·347. 1 ∧ *I*=111° 50′; 1 : 1 (over *I*)=43° 40′; 1 : 1 (adj.) 158° 34′ (angles only approximate).

H. 6. G. 2·60. Transparent. Colorless. Analysis (on 0·1 gr. consisting of 1500 crystals).

$\ddot{\mathrm{Si}}$	$\ddot{\bar{\mathrm{Al}}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{K}}$	$\dot{\mathrm{Na}}$	Cl	$\dddot{\mathrm{S}}$	
33·0	29·0	11·2	11·5	8·7	9·1	1·7	= 104·2

If the Na belongs to the Cl the excess is diminished 2 p. c. Oxygen ratio for $\ddot{\bar{\mathrm{R}}}$: $\ddot{\mathrm{Si}}$=3 : 4.

B. B. fusible with difficulty. No loss by violent ignition; in hydrochloric acid decomposed vith separation of gelatinous silica. Occurs at Vesuvius in ejected masses, and formed by ublimation in the leucitic lava. It is closely related to sodalite.

Milanite. See HALLOYSITE.

MILARITE, Kenngott, Jahrb. Min. 1870, 81.—Appendix I., p. 10.

Kenngott suggests that milarite may be identical with levynite (but see below), Jahr. Nat. es. Zürich, xvi., 132, 1871.

According to Frenzel the locality is Val Giuf, Graubünden, *not* Val Milar. He has made an nalysis with the following results: 1. G.=2·59. Analysis 2. is by Finkener (Eck, Jahrb. Min., 1874, 62). G.=2·5.

	$\ddot{\mathrm{Si}}$	$\ddot{\bar{\mathrm{Al}}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Na}}$	$\dot{\mathrm{Ka}}$	$\dot{\mathrm{H}}$	
1.	71·12	8·45	11·27	——	(7·61)	——	1·55 = 100·00	Frenzel.
2.	70·04	11·62	10·05	0·20	0·65	5·74	1·69 = 99·99	Finkener.

The water is driven off only at a high temperature; Frenzel regards it as basic, and suggests that the mineral belongs near petalite (Jahrb. Min., 1873, 797).

Can the excess of silica be due to impurity?

MILLERITE, Min. p. 56.—Anal., *Liebe*, Jahrb. Min., 1871, 843.

MILOSCHITE, Min. p. 510.—May be a mixture, *Kenngott*, Jahr. Nat. Ges. Zürich, xvii., 66

MIMETITE, Min. p. 537.—Nador, province Constatine, anal., *Flajolot*, ZS. G. Ges., xxiv. 49, 1872.

Miriquidite, Frenzel, Jahrb. Min., 1874, p. 673 (1873, 939).

Rhombohedral, *a* (vert)=3·363. Planes R and $-\frac{1}{2}R$, $R \wedge -\frac{1}{2}R = 123°$, $R \wedge R = 66°$ and 114°. Crystals very minute and hence measurements only approximate. Plane R often horizontally striated, and somewhat curved (cryst. descript. by vom Rath). Also massive in imbedded portions having a yellowish to reddish brown color. Color of crystals blackish-brown, on edges red by transmitted light. Streak ochre-yellow. Lustre glassy. Translucent to opaque. Brittle.

H.=4. Contains $\dot{\mathrm{P}}\mathrm{b}$, $\bar{\mathrm{F}}\mathrm{e}$, $\dddot{\mathrm{A}}\mathrm{s}$, $\dddot{\mathrm{P}}$, $\dot{\mathrm{H}}$, but the want of sufficient quantity of pure material prevented an analysis.

B. B., fusible to a globule, coloring the charcoal yellow. In matrass gives water, and with the fluxes reacts for iron. The presence of the acids is less easily proved, and Frenzel concludes that it is probably a very basic compound.

Found at Schneeberg with chalcocite, pyromorphite, cuprite, torbernite, etc.

MISPICKEL, Min. p. 78.—See ARSENOPYRITE.

MONAZITE, Min. p. 539.—(Turnerite), Laacher See, cryst. description, *v. Rath*, Pogg. Erg. Bd., v., 413, 1871.

Cryst., *Hessenberg*, Jahrb. Min., 1874, 876.

Produced artificially, *Radominski*, C. R., lxxx., 304, 1875.

See also *korarfveite*.

MONIMOLITE, Min. p. 546.—Cryst. note (Scandinavia), *Nordenskiöld*, Œfv. Ak. Stockholm, xxvii., 550, 1870.

MONTEBRASITE, Appendix I., p. 10.—See HEBRONITE.

MONTICELLITE, Min. p. 255.—Cryst. relation to chrysolite, *v. Rath*, Pogg. Erg. Bd., v., 434. Altered to serpentine and fassaite, Pesmeda Alp, Ber. Ak. Berlin, 1874, 737, 747

MONZONITE, *v. Kobell*, Ber. Ak. München, May 6, 1871.—Appendix I., p. 11.

MYARGYRITE, Min. p. 88.—Tres Puntas, analyses, Domeyko 2d App. Min. Chili, p. 40, 1867.

MYELIN, Min. p. 373.—Anal., identical with Carnat (Breithaupt), Min. p. 474; *Frenzel*, J. pr. Ch., II., v., 401, 1872.

NÆSUMITE, *Blomstrand*, Œfv. Ak. Stockholm, 1868, 197.—Appendix I., p. 11.

NADORITE, *Flajolot*, C. R., lxxi., 237, 406.—Appendix I., p. 11.

NAMAQUALITE, *Church*, J. Ch. Soc., II., viii., 1.—Appendix I., p. 11.

NANTOQUITE. Breithaupt gives the following description of this mineral (Nantokite) previously announced by him, B. and H. Ztg., xxvii., 3, see Dana's Min. Appendix I., p. 11. Isometric, as proved by the cubic cleavage, though no crystals were observed. Granular, massive. H. = 2–2·5. G. = 3·930. Color white to colorless. Lustre adamantine.

Analyses give the formula Cu Cl or $\mathrm{Cu}_2 = 64{\cdot}11$, $\mathrm{Cl} = 35{\cdot}89$.

On charcoal fuses, coloring the flame intense azure blue, leaving a coating of oxyd of silver, and a white coating farther from the assay; a ductile globule of copper remains on the coal. Easily soluble in nitric or hydrochloric acid, as also in ammonia. Rapidly decomposed on exposure to the air. Jahrb. Min., 1872, 814.

This mineral was first described by Dr. Sieveking, see Domeyko 2d Append. Min. Chili, p. 51, Feb., 1873. A more recent analysis (3d Append., 1871) gave $\mathrm{Cu_2Cl}$ 79·32, $\dot{\mathrm{C}}\mathrm{u}_2$ 12·56, insol. 3·30, $\ddot{F}e$ 0·05 = 95·23. Domeyko mentions that the mineral is remarkable for evolving in the mine an odor of chlorine which incommodes the miners. This, he says, is due to the production of ozone, which accompanies the oxidation of the Cu_2Cl.

NATROLITE, Min. p. 426.—Composition discussed, *Rammelsberg*, ZS. G. Ges., xxi., 96, 1868.
Loch Thorn, Greenock, anal., *Young*, Chem. News, xxvii., 55, 1872.
Stempel, anal. (*Klippert*), *v. Koenen*, Jahrb. Min., 1875, 87.

404 E. Nefedieffite, *P. Pusirewsky* (Verh. Min. Ges. St. Petersburg, II., vii., 1872), in Jahrb. Min., 1873, 420.
Amorphous, very similar to lithomarge (Steinmark). H. = 1·15. G. = 2·335. Fracture conchoidal. Color white to rose-red. Opaque, on the edges translucent. Feel greasy. Several analyses (not quoted in Jahrb. Min.) gave very discordant results, but their mean agrees most closely with the formula $H_6MgAl_2Si_5O_{17}$, although Pusirewsky prefers, on account of its simplicity, the formula $H_4MgAl_2Si_5O_{16}$, though it agrees even less well with the analyses. Scarcely soluble in acids. In water 0·2 p. c. dissolves, the solution giving an alkaline reaction; over sulphuric acid 11·30 p. c. H_2O is given off (in 22 days), which it again absorbs on exposure to the air. At 250° C. it loses 19·13 p. c. H_2O, and 4·73 p. c. more when heated to the melting point.

NEOLITE, Min. p. 406.—Freiberg, a mineral of similar character, Frenzel, Jahrb. Min., 1874, 676.

NEPHELITE, Min. p. 327.—As a microscopic constituent of rocks, *Zirkel*, Jahrb. Min., 1868, 697.
Monte Somma, cryst., *Strüver*, Atti Accad. Sci. Torino, iii., 123, 1867; altered to sodalite, same, ibid., vii., 329.

NEPHRITE, Min. p. 233 et al.—So called, from Turkistan, analyses, *v. Fellenberg*, Jahrb. Min., 1869, 231; 1870, 484; 1871, 173.
New Zealand, descriptions and anal., *Kenngott*, Jahrb. Min., 1871, 293.
Occurrence described in the Karakash valley, Turkestan, *Stoliczka*, Q. J. G. Soc., xxx., 568, 1874.

NICCOLITE, Min. p. 60 (rothnickelkies), Hembach (Wittichen), Baden, anal., *Petersen*, Pogg., cxxxiv., 82.
Description, *Kokscharow*, Min. Russl., v., 155.
Wolfach, Baden, anal. (Sb_2 = 28·22 p. c.) *Petersen*, Pogg., cxxxvii., 396, 1869.
Telhadella mine, Portugal, anal. (*Winkler*), *Breithaupt*, Jahrb. Min., 1872, 818.

NICKEL, nickeliferous sand from Frazer River, *Blake*, Am. J. Sci., III., vii., 238.

NIGRESCITE, *Hornstein*, ZS. G. Ges., 1867, 342.—Appendix I., p. 12.

NIOBITE. Synonym of columbite used by Rammelsberg.

Nitroglauberite. From Atacama (Dr. Schwartzemberg). Composition, $4\dot{N}a\dddot{S} + 6\dot{N}a\ddot{\ddot{N}} + 5\dot{H}$. An analysis gave $\dot{N}a\dddot{S}$ 33·90, $\dot{N}a\dddot{S}$ 60·35, $\dot{H}$ 5·75. Occurs in a fibrous, translucent mass, or consisting of imperfect crystals; permanent in the air. When dissolved with just sufficient water at 40° to 50° C., the double salt separates out unchanged on cooling; but treated with cold water in quantity insufficient to dissolve the whole, the salt is decomposed into crystals of mirabilite, and soda-nitre which remains in solution. Also found by Domeyko at Paposo, 3d Append. Min. Chili, 1871.

478 A. Nohlite, *Nordenskiöld* (Geol. För. Stockholm, Förhandl. I., p. 7), Jahrb. Min., 1872, 534.
Massive. H. = 4·5-5·0. G. = 5·04. Color black-brown. Streak brown. Fracture uneven, splintery. Opaque. Brittle. Vitreous lustre.
Analysis.

$\ddot{\ddot{C}}b$	$\ddot{U}$	$\ddot{Z}r$	$\dot{F}e$	$\dot{C}u$	$\dot{C}e$	$\dot{Y}$	$\dot{M}g(\dot{M}n)$	$\dot{C}a$	$\dot{H}$
50·43	14·43	2·96	8·09	0·11	0·25	14·36	0·28	4·67	4·62 = 100·20

Corresponding approximately to the formula $R^3\ddot{\ddot{C}}b + 1\frac{1}{2}\dot{H}$.

B.B, fuses quietly on the edges to a dull glass. Decrepitates slightly in giving off its water. With borax easily dissolved, giving a bead colored by uranium. Easily decomposed by warm sulphuric acid.

Found in a feldspar quarry at Nohl, near Kongelf, Sweden. One fragment weighing 297 grs. seemed to be a portion of a mass at least 20 times as great.

Nohlite stands near samarskite, but differs from it in its percentage of water.

NONTRONITE, Min. p. 461.—(Chloropal, Dana), anal., *Thorpe*, J. Ch. Soc., II., viii., 29, 1870.

NOSITE (nosean), Min. p. 333.—A variety of hauynite = a soda-hauynite; discussion of relation to hauynite and lapis lazuli, *Vogelsang*, Vers. Med. Ak. Amsterdam, II., vii., 161, 1873.

OCTAHEDRITE, Min. p. 161.—Binnenthal, cryst., *Klein*, Jahrb. Min., 1872, 900; 1874, 961.
Found at Pfitsch Joch, Tyrol, Tsch. Min. Mitth., 1873, 49.

OKENITE, Min. p. 398.—(Dysclasite), Poonah, India, anal., *Haughton*, R. Geol. Soc. Dublin, II., 414, 1868.

OKTIBBEHITE, Min. p. 16.—In meteoric irons, *Meunier*, Ann. Ch. Phys., IV., xvii., 35.

56 A. Oldhamite, *Maskelyne*, 1862; Phil. Trans. London, 1870, I., p. 195. In small, nearly round spherules (generally coated by sulphate of lime as result of alteration). They have three equal cleavages, at right angles to each other; shown by this fact to be isometric, as also because it gives no evidence of double refraction in polarized light. H. = 4. G. = 2.58. Color pale chestnut-brown, transparent when pure.

Analysis (l. c.) after deducting foreign matter (enstatite, etc.).

	Oldhamite		Incrustation				
	CaS	MgS	CaS	CaO	troilite		
1.	89·37	3·25	3·95	3·43	——	=	100·00
2.	90·25	3·26	4·19	——	2·30	=	100·00

Maskelyne suggests that the MgS may be considered either as a mechanically mixed ingredient, or as a constituent of the mineral. Readily dissolved in acid with the evolution of sulphuretted hydrogen and deposition of sulphur. Found imbedded in enstatite or augite in the Busti meteorite, and apparently also in that of Bishopville.

OLIGOCLASE, Min. p. 346.—Vesuvius, cryst., and anal., *v. Rath*, Pogg., cxxxviii., 464, 1869.
Ytterby, several analyses, *Ludwig*, Pogg., cxli., 149.
Wilmington, Del., anal., *Teclu*, Tsch. Min. Mitth., 1871, 55.
Media, Penn., *T. D. Rand*, Proc. Ac. Philad., 1872, 299.
Bamle, Norway, anal., *Hawes*, Am. J. Sci., III., vii., 579, 1874. See *Tschermakite*.
See also *Feldspar*.

OLIVINE. See CHRYSOLITE.

Opacite, a name proposed by Vogelsang for the black opaque scales or grains occurring in many rocks, which cannot be identified with magnetite, menaccanite, or any other mineral, ZS. G. Ges., xxiv., p. 530, 1872.

OPAL, Min. p. 198.—Optical examination, *Crookes*, Ch. News, xix., 205, 1869.
Minute and careful microscopic investigation, *Behrens*, Ber. Ak. Wien, lxiv., 519, 1871.
Spectra of precious opals, *Behrens*, Jahrb. Min., 1873, 920.
Pseudomorph after chlorite (?), *Rœpper*, Am. J. Sci., II., l., 37.
Precious opals from Esperanza, State of Queretaro, Mexico, occurrence described, M. Barcena, La Naturaleza, ii., 297, 1873, in Am. J. Sci., III., vi., 466, 1873.

ORILEYITE, Appendix I., p. 12.

ORTHITE, Min. p. 285.—Vesuvius, cryst. description, *v. Rath*, Pogg., cxxxviii., 492.
See ALLANITE.

ORTHOCLASE, Min. p. 352.—Cryst. monograph, *Kokscharow*, Min. Russl., v., 154, 329.
Striegau, cryst. and anal., *Becker*, Jahrb. Min., 1869, 236.

Elba, cryst., *Achiardi*, Nuovo Cimento II., iii., Feb., 1870.
Fibia, St. Gotthard, cryst., *Kenngott*, Jahrb. Min., 1869, 753; 1870, 781.
Monte Somma, cryst., *Scacchi*, Atti Accad. Sci. Napoli, March 12, 1870.
Finland, *Wiik*, Œfv. Finsk. Vet. Ac. Helsingfors, xiii., 76, 1870–71.
Sussex Co., N. J., anal., *Leeds*, Am. J. Sci., III., iv., 433, 1872; Delaware Co., Penn., anal., *same*, J. Frank. Inst., III., lx., 63.
Schiltach, cryst., *Klocke*, Ber. Nat. Ges. Freiburg, vi., 4, (Jahrb. Min., 1874, 868).
Is. Rachgoün, (Algeria), anal., *Velain*, C. R., lxxix., 250, 1874.
(Adular), cryst. note, *Zerrenner*, Tsch. Min. Mitth., 1874, 95.

OSBORNITE, *Maskelyne*, Phil. Trans., 1870, p. 198. Appendix I., p. 12.

OSTEOLITE, Min. p. 530.—Waltsch, Bohemia, in basalt, anal. (Preis), K. Böhm. Ges., 1873, 68.

OTTRELITE, Min. p. 506.—Composition, *Laspeyres*, Jahrb. Min., 1869, 339.

OZOCERITE, Min. p. 732.—Boryslaw, Galicia, *Andrar*, Jahrb. Min., 1868, 608.
In Silurian formation, Bohemia, *Boricky*, Ber. Ges. Böhm., Jan. 10, 1873.

PALAGONITE, Min. p. 483.—A related mineral analyzed, *Streng* and *Zoppritz*, Jahresb. Oberhess. Ges., Nat., xiv., 30 (Jahrb. Min., 1873, 427).

PARAGONITE, Min. p. 487.—Virgenthal, anal., *v. Kobell*, Ber. Ak. München, 1869, 366.
Schwarzenberg (Ochsenkopf) Saxony, anal. (essentially a soda-damourite), *Genth*, Am. Phil. Soc., Philad., xiii., 390, 1873.
See also Cossaite, p. 63.

PATTERSONITE, Min. p. 801. Appendix I., p. 18.—*Genth* has analyzed the pattersonite from Unionville with the following results:
$\ddot{\mathrm{Si}}$ 29·90, $\ddot{\overline{\mathrm{Al}}}$ 27·59, $\ddot{\overline{\mathrm{Fe}}}$ 3·12, $\dot{\mathrm{Fe}}$ 9·17, $\dot{\mathrm{Mg}}$ 17·10, $\dot{\mathrm{L}}$ tr., $\dot{\mathrm{Na}}$ 0·58, $\dot{\mathrm{K}}$ 2·33, ign 11·51 = 101·30; the oxygen ration for $\dot{\mathrm{R}}$: $\ddot{\overline{\mathrm{R}}}$: $\ddot{\mathrm{Si}}$: $\dot{\mathrm{H}}$ is nearly 6 : 9 : 10 : 6, or near that of thuringite.

PEALITE, see Geyserite.

PECTOLITE, Min. p. 396.—Fassathal, anal., *Lemberg*, ZS. G. Ges., xxiv., 252, 1872.

PEGANITE, Min., 582.—Nobrya, Portugal, analyses, *Breithaupt*, Jahrb. Min., 1872, 819.

PENCATITE, Min. p. 708.—See predazzite.

PENNINITE, Min. p. 495.—Pseudomorph after feldspar, anal., *Zepharovich*, Tsch. Min. Mitth., 1874, 7.
Zermatt, anal., *v. Fellenberg*, Jahrb. Min., 1868, 746.
Relation to kotschubeite, *v. Leuchtenberg*, Bull. Soc. Imp. St. Pet., xiii., 34, 1869.
Anal., *v. Hamm*, Tsch. Min. Mitth., 1872, 260.
Luppikko, anal., *Jernström*, Œfv. Finsk. Vet. Soc., xvi., 38, 1873.

PERCYLITE, Min. p. 122.—So. Africa, anal., *Maskelyne* and *Flight*, J. Ch. Soc., II., x., 1051.

PETALITE, Min. p. 229.—Elba, cryst., *v. Rath*, ZS. G. Ges., xxii., 668, 1870.

PEROFSKITE, Min. p. 146.—Wildkreuzjoch, cryst., *Hessenberg*, Min. Not., x., 38, 1871; i., 1, 1873 (Pogg., cxliv., 595).

PETZITE, Min. p. 51.—California, anal., *Genth*, Am. J. Sci., II., xlv., 309; Colorado, nal., *Genth*, Am. Phil. Soc. Philad., xiv., 226, 1874.

PHARMACOLITE, Min. p. 554.—Wittichen, Baden, anal., *Petersen*, Pogg., cxxxiv., 86.
Joachimsthal, cryst., and anal., *Tschermak*, Ber. Ak. Wien, lvi., 829, 1867.
Cryst., *Schrauf*, Tsch. Min. Mitth., 1873, 138.

PHENACITE, Min. p. 630.—Color investigated, *Kokscharow*, Verh. Min. Ges. St. Pet., II., v., 322.

PHILLIPSITE, Min. p. 438.—From basalt, cryst. memoir, *Streng*, Jahrb. Min., 1874, 561.
Richmond, Victoria, cryst. description, analyses, *Ulrich*, Contrib. Min. Vict., p. 30.

PHOLERITE, Min. p. 472.—Analysis, *Maskelyne* and *Flight*, Ch. News, xxii., 260; J Ch. Soc., II., ix., 12, 1871.
It is shown by M. and F. that the *meerschaluminite* of Ross, since called *simlaite* by Schrauf (Verh. G. Reichs, 1870, 43) is identical with pholerite. An analysis gave them S̈i 43·14, Ä̶l 41·07, Ḣ 15·78 = 100.

PHOSPHORCHROMITE.—Appendix I., p. 12.

PHOSPHORITE, Min. p. 530.—Deposits in Nassau, *Wicke*, Jahrb. Min., 1869, 88.
Deposits on banks of Dniester, analyses, *Schwackhöfer*, Jahrb. k. Reichs, xxi., 211.
From Belmez, *de Reydellet*, Bull. Soc. G., III., i., 350, 1873.

PICOTITE, Min. p. 147.—Bohemia, in basalt, anal., *Farsky*, Ber. Chem. Böhm. Ges., (Zprávy, etc.), i., 31, 1872.

PICROLITE, Min. p. 465.—In diabase, *Liebe*, Jahrb. Min., 1870, 18; Zermatt, anal., v. Fellenberg, anal., Jahrb. Min., 1868, 747.

PICROMERITE, Min. p. 642.—Stassfurt, crystals examined, *Groth*, Pogg., cxxxvii., 442, 1869.
Kalusz, Galicia, chem. exam., *v. Hauer*, Jahrb. G. Reichs, xx., 141.

PICROPHARMACOLITE, Min. p. 555,—Freiberg, *Frenzel* obtained, Ä̶s = 46·93, Ċa = 25·77, Ṁg = 3·73, Ḣ = 24·01, agreeing with the results of Stromeyer, and he regards it as deserving of a place as a good species, Jahrb. Min., 1873, 786.

PIHLITE, Min. p. 455.—A supposed new mineral from Chesterfield, Mass., in large crystals, pseudomorphous after spodumene, afforded *Julien* (as approximate results) S̈i 55·9, Ä̶l (F̶e) 27·7, Ṅa 10·5, K̇ 4·5. Ḣ = 2. G. = 2·696. Am. Chemist, II., i., 300, Feb., 1871. Very probably identical with the cymatolite of Shepard (Min. p. 456).

PINITE, Min. p. 479.—Iglau, enclosing a kernel of iolite, *Makowsky*, Verh. Nat. Ver. Brünn, ix., 3, 1871.

PITTICITE, Min. 589—Redruth, Cornwall, anal., *Church*, Chem. News, xxiv., 135, 1871.
Freiberg (arseneisensinter), anal, *Frenzel*, Jahrb. Min., 1873, 787.

PLATINUM, Min. p 10—In northern Lapland, Pogg., cxl., 336.
Russian localities, analyses and description, Kokscharow, Min. Russl. v., 177, 371.
In sand from gold washings, California, Am. J. Sci., III., vi., 132.
(Eisenplatin), anal., *Frenzel*, Jahrb. Min., 1874, 684.

PLAGIONITE, Min. p. 89.—Wolfach, Baden, *Sandberger*, Jahrb. Min., 1869, 312.

PLEONASTE, Min. p. 147.—Vesuvius, crystals with the cubic planes, *Hessenberg*, Min. Not., viii., 45, 1868.

PLESSITE, Min. p. 73.—*Meunier*, Ann. Ch. Phys., IV., xvii., 34, 1869.

PLUMBALLOPHANE, *Bombicci*—Appendix I., p. 12.

PLUMBOCALCITE, Min. p. 678.—Bleiberg, Carinthia, anal., *Höfer*, Jahrb. Min., 1871, 80.

PLUMBOCUPRITE, Adam, Tableau Min., 1869, 52. Syn. of cuproplumbite, Dana, Min., p. 43.

PLUMBIODITE, Adam, Tableau Min., 1869, p. 67. Syn. of schwartzembergite, Dana, Min., p. 120.

POLYARGYRITE, *Sandberger* and *Petersen*, Appendix I., p. 12.

POLYCRASE, Min. p. 523.—Anal., *Rammelsberg*, Pogg., cl., 207, 1873.

POLYHALITE. Min. p. 641.—Stassfurt, in halite, *Reichardt*, Jahrb. Min., 1869, 325.
Berchtesgaden, Bavaria anal., *Schober*, Jahrb. Min., 1869, 578.
Hailstatt, cryst. (probably monoclinic), *Tschermak*, Ber. Ak. Wien, lxiii., 332, 1871.
Stebnik, Galicia, analyses, *v. Lill*, Tsch. Min. Mitth., 1874, 89.

PREDAZZITE, Min. p. 708.—According to *Hauenschild* (Ber. Ak. Wien, lx., 795, 1869) *predazzite* and *pencatite* are both mixtures of calcite and brucite. The same conclusion was reached by *Damour*, Bull. Soc. G., France, II., iv., 1050. The subject has been further investigated by *Lemberg* (ZS. G. Ges., xxiv., 229, 1872) with conclusive results. According to the latter the black color is due to the presence of finely divided pyrite (not organic matter, as urged by Hauenschild).

PREHNITE, Min. p. 410.—Composition, analyses, *Rammelsberg*, ZS. G. Ges., xx., 79.
Slate river, L. Superior, anal., *Chapman*, Can. Journal, II., xii., 267, Nov., 1869.
Harzburg, cryst. description, composition, *Streng*, Jahrb. Min., 1870, 314.
Tortola, anal., Ak. H Stockholm, ix., No. 12, 1870 (Cleve's Geol. W. India I., p. 30).
Dumbartonshire, anal., *Young*, Ch. News, xxvii., 55.

600 A. Priceite. Cryptomorphite (?), *Chase*, Am. J. Sci., III., v., 287; Priceite, *Silliman*, Am. J. Sci., III., vi., 128.

Compact, chalky, the powder consisting of minute rhombic crystals. Soft. G. = 2·262–2·298. Color milk-white, without lustre. Feel greasy and unctuous.

Analyses, 1. Silliman, l. c. 2. Chase, variety found in bowlders. 3. Chase, from veins.

		$\dddot{\mathrm{B}}$	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\mathrm{H}}$	NaCl, $\dddot{\overline{\mathrm{Fe}}}$, $\dddot{\overline{\mathrm{Al}}}$		
1.	⅓	(48·82)	31·83	18·29	·96	=	100·00
2.		(47·04)	29·96	22·75	alkalies ·25	=	*100·00
3.		(45·20)	29·80	25·00	" tr.	=	100·00

* Trace Cl.

Silliman gives as the probable formula $\dot{\mathrm{C}}\mathrm{a}^3\dddot{\mathrm{B}}^4 + 6\dot{\mathrm{H}}$.

B.B. gives a green flame, and fuses at a red-heat. In the matrass gives off neutral water. Insoluble in water, but perfectly so in hydrochloric acid.

Found in a hard, compact form in layers, between a bed of slate above, the cavities and fissures of which it filled, and a tough blue steatite below; also occurring in bowlders or rounded masses completely imbedded in the steatite. These masses in the main flow formed a continuous line touching each other, and of uniform size, weighing about 200 lbs. each. Branching off from the main deposit were side flows where the bowlders were smaller, from a weight of 20 lbs. down to small pellets the size of a pea, or even smaller.

Locality, Curry Co., Oregon, five miles north of Chetko.

PROCHLORITE, Min. p. 501.—No. Carolina, with corundum, analyses, *Genth*, Am. Phil. Soc. Philad., xiii., 393, 1873.

PROUSTITE, Min. p. 96.—Wittichen, Baden, anal., *Petersen*, J. pr. Ch., cvi., 144, 1869.
Pseudomorph after stefanite and argentite, *Döll*, Tsch. Min. Mitth., 1874, 87.

PSEUDOMALACHITE, Min. p. 568—(prasine), anal., J. Ch. Soc., II., x., p. 1057.
(Ehlite), anal., *Church*, J. Ch. Soc., II., xi., p. 107.
Cryst., *Schrauf* (triclinic), Tsch. Min. Mitth., 1873, 139.

PSEUDOPHITE, Min. p. 496.—Note, *Kenngott*, Jahrb. Min., 1869, 343.

PUCHERITE, *Frenzel*, J. pr. Ch., II., iv., 227, 361.—Appendix I., p. 12.
Further investigations on crystalline form, showing relation to brookite, *Websky*, Tsch. Min. Mitth., 1872, 245. Analysis, *Frenzel*, Jahrb. Min., 1872, 514, 939.

PYRARGYRITE, Min. p. 94.—Wolfach, Baden, anal., *Senfter*, J. pr Ch., cvi., 143, 1869.
Altered to sulphid of silver from Guanajuato, *Don Severo Navia*, Naturaleza, 1874, 154.
Pseudomorph after silver, *Döll*, Tsch. Min. Mitth., 1874, 86.

PYRICHROLITE, Adam, Tableau Min., 1869, p. 93. Synonym for pyrostilpnite, Dana, Min., 1868, p. 93.

PYRITE, Min. p. 62.—Altenhunden (½ p. c. thallium), *Marquart*, Jahrb. Min., 1868, 608.
Bösingsfelde, *Hessel*, Pogg., cxxxvii., 536, 1869.
Traversella, *Hessenberg*, Min. Not., ix., 60, 1870.
Strüver, complete cryst. memoir, with many figures, and a large number of new forms, Mem. R. Accad. Sci. Torino, II., xxvi., 1869; again *Strüver*, Atti Accad. Sci. Torino, 1871, 374 et. seq.

From the Lölling, *Zepharovich*, cryst., Ber. Ak. Wien, lx., 814, 1869; Lotos, 1870, p. 4.
Chilchiliane (Isère), cryst., *v. Rath*, Pogg., cxliv., 582, 1871.
Containing arsenic, Smith, Chem. News, xxiii., 221, 1871.
Thermo-electrical character, *Friedel*, Ann. Ch. Phys., IV., xvii., 79, 1868. *Rose*, Pogg., cxlii., 1, 1871; *Schrauf* and *Dana*, Ber. Ak. Wien, lxix., 145, 157, 1874. *Brezina*, Tsch. Min. Mitth., 1872, 23.

PYRITOLAMPRITE, Adam, Tableau Min., 1869, p. 39. A name given to the Arseniksilber from Andreasberg, (Dana, Min. p. 35), shown by Rammelsberg to be a mixture.

PYROCHLORE, Min. p. 512.—Scheelingen, Kaiserstuhlgebirge, anal., *Knop*, ZS. G. Ges., xxiii., 656, 1871; see *koppite*.
Miask, Brevig, Fredriksvärn, analyses, *Rammelsberg*, Pogg., cxliv., 191 et. seq., 1871; cl., 198.

PYROLUSITE, Min. p. 165.—Atacama, anal., Domeyko, 2d Append. Min. Chili, p. 8, 1867.

PYROMORPHITE, Min. p. 535.—Schapbach, anal., *Petersen*, Jahrb. Min., 1871, 393.
Containing didymium, *Horner*, Ch. News, xxvi., 109, 1872.

PYROSCLERITE, Min., p. 493.—Related mineral, anal., *Leeds*, Am. J. Sci., III., vi., 22.
St. Philipp, Alsace, anal., *Ebert*, Jahrb. Min., 1875, 70.

PYROSMALITE, Min. p. 414.—Cryst., *Nordenskiöld*, Œfv. Ak. Stockholm, xxvii., 562, 1870.
Nordmarken, Sweden, anal., *Wöhler*, Ann. Ch. Pharm., clvi., 85, 1870.

PYROPHYLLITE, Min. p. 454.—Wermland, anal., *Igelström*, Œfv. Ak. Stockh., 1868, xxv., 38.
Anal. in fossils, *Nägeli*, Ber. Ak. München, 1868, 503.
Ottré, anal., *Koninck*, Bull. Ac. R. Belg., II., xxvi., 469, 1868.
Pagodite, anal., *Church*, Chem. News, xxii, 220, 1870.

PYROXENE, Min. p. 212.—Degerö, anal., *Wiik*, Jahrb. Min., 1868, 185.
Meteorite of Shergotty, *Tschermak*, Ber. Ak. Wien, lxv., 123, 1872, "Ein augitähnliches Mineral" gave him, $\ddot{\text{Si}}$ 52·34, $\dddot{\text{Al}}$ 0·25, $\dot{\text{F}}\text{e}$ 23·19, $\dot{\text{M}}\text{g}$ 14·29, $\dot{\text{C}}\text{a}$ 10·49 = 100·56 ($\dot{\text{C}}\text{a}\dot{\text{M}}\text{g}$, $2\dot{\text{F}}\text{e}$, $\ddot{\text{Si}}$), in physical and optical characters near diopside.
Distinguished from related minerals by the microscope, *Tschermak*, Ber. Ak. Wien, lx., 5, 1869.
Formed by sublimation at Vesuvius, *Scacchi*. Atti Accad. Sci., Napoli, v., Sept. 14, 1872.
Associated with hornblende at Vesuvius, *v. Rath*, Pogg. Erg. Bd., vi., 229, 1873.
Anal., *E. Reyer*, Tsch. Min. Mitth., 1872, 258.
Pyroxene group of minerals, *Tschermak*, Min. Mitth., 1871, 28.
Made artificially, *Lechartier*, C. R., lxxv., 487, 1872.
See also *augite*.

PYRRHITE, Min. p. 763.—St. Miguel, cryst., *Schrauf*, Ber. Ak. Wien, lxiii, 187, 1871.
Elba, *v. Rath*, ZS. G. Ges., xxii., 672, 1870.

PYRRHOTITE, Min. p. 58.—Composition discussed, etc. (see chalcopyrrhotite), *Blomstrand*, Œfv. Ak. Stockholm, xxvii, 24, 1870.
Showing polarity, *Kenngott*, Jahrb. Min., 1870, 354.
Brewster, N. Y., pseudomorph after serpentine, *J. D. Dana*, Am. J. Sci., III., viii., 375, 1874.
Composition discussed, *Knop*, Jahrb. Min., 1873, 524.

QUARTZ, Min. p. 189.—"Die Gesetze regelmässiger Verwachsung mit gekreuzten Hauptaxen, etc,"—*Jenzsch*, Pogg., cxxxiv, 540.
Baveno, cryst., new form, *Becker*, Pogg., cxxxvi., 626.
Enormous crystals from the Tiefen glacier, Pogg., cxxxvi., 637.
Carrara, cryst., *Scharff*, Jahrb. Min., 1868, 822.
Etchings on crystalline faces, *J. Hirschwald*, Pogg., cxxxvii., 548, 1869.
Description of remarkable crystals from Elba, *v. Rath*, ZS. G. Ges., xxii., 619, 658, 727, 1870; *Achiardi*, Nuovo Cimento, II., iii., Feb., 1870; *Bombicci*, Mem. Ac. Sci. Bologna, II., i:.
Color of smoky quartz due to presence of an organic substance containing carbon and nitrogen, *Forster*, Pogg., cxliii., 173.

Wallithal, near Biel, Ober Wallis, cryst., new forms, *Weiss*, Verh. Nat. Ges. Bonn., xxviii., 149, 1871.

Paragenetical investigations; the trapezohedral planes are conditioned by the presence of fluorine or chlorine compounds, being formed simultaneously with the evolution of fluorine or chlorine, in part in consequence of their indirect influence, in part though subsequent etching. *Stelzner*, Jahrb. Min., 1871, 33.

Striegau, Silesia, cryst. memoir, *Websky*, Jahrb. Min., 1871, 732, 785, 897.

(Faserquarz) pseudomorph after crocidolite, *Fischer*, Tsch. Min. Mitth.. 1873, 117; *Wibel*, Jahrb. Min., 1873, 367; *Lasaulx*, ibid., 1874, 165.

Poohnah, cryst., *Scharff*, Jahrb. Min., 1873, 944.

Oberstein, Baveno, etc., cryst., *Websky*, Jahrb. Min., 1874, 113.

Cryst., *Laspeyres*, Jahrb. Min., 1873, 941; 1874, 49, 261.

Pseudomorph after garnet, calcite, anhydrite, barite, pyromorphite, scheelite, etc., *Frenzel*, Min. Lex. Sachsen, 261.

Galenstock, Wallis, crystals with the basal plane, *Bauer*, ZS. G. Ges., xxvi., 194, 1874.

Containing water, the so-called *enhydros*, occurrence and character described, Beechworth, Victoria, *Dunn*, p. 32; *Foord*, p. 71, Trans. Roy. Soc. Victoria, x., 1874.

Remarkable association with calcite, *v. Rath*, Ber. Ak. Berlin, 1874, 683.

Crystalline form discussed, *Kenngott*, Jahrb. Min., 1875, 27.

Rabdionite, *v. Kobell*, Ber. Ak. München, Jan., 1870.—Appendix I., p. 13.

Ralstonite, *Brush*, Am. J. Sci., III., ii., 30.—Appendix I., p. 13.

Nordenskiöld has further investigated the ralstonite from Ivituk, Greenland, and obtained the following results, agreeing essentially with the description given by Brush (l. c.). H. = 4·5. G. = 2·62 (on 0·13 gr.). Characters as described by Brush.

Analysis (on 0·221 gr.).

Al	Ca	Mg	Na	Ka	$\ddot{\text{P}}$	O Fl	$\dot{\text{H}}$
22·94	1·99	5·52	4·66	tr	tr	(50·05)	14·84 = 100

Nordenskiöld finds that if the loss be considered as being fluorine alone, it is insufficient to combines with the bases, so that he concludes there must also be oxygen present.

He writes the formula

$$\left.\begin{matrix}\text{Mg}\\ 3\text{Ca}\\ \text{Na}\end{matrix}\right\}\text{Fl}\ \bar{\text{Al}}\ \text{Fl}_3 + \left.\begin{matrix}\dot{\text{Mg}}\\ 2\dot{\text{Ca}}\\ \dot{\text{Na}}\end{matrix}\right\}\ddot{\bar{\text{Al}}} + 10\dot{\text{H}}$$

He also suggests the following formula, after the type of the spinel group, which it resembles in crystalline form: $\text{R}\ \bar{\text{Al}}\ (\text{O},\text{Fl})_4 + 2\dot{\text{H}}$.

Rammelsbergite, Min. p. 77.—Anal., *Sandberger*, Ber. Ak. München, 1871, 202.

377 A. Rauite, *Paykull*, Ber. Chem. Ges. Berlin, 1874, p. 1334.

Not crystalline. Structure finely granular. Color grayish-black Without lustre. H. = 5. G. = 2·48. An analysis gave, $\ddot{\text{Si}}$ 39·21, $\bar{\text{Al}}$ 31·79, $\bar{\text{Fe}}$ 0·57, $\dot{\text{Ca}}$ 5·07, $\dot{\text{Na}}$ 11·15, $\dot{\text{H}}$ 11·71 = 99·90. The oxygen ratio for $\dot{\text{R}}:\bar{\text{R}}:\ddot{\text{Si}}:\dot{\text{H}} = 1:3:3\frac{1}{3}:2$, or near that of thomsonite. B.B. fuses with difficulty on thin edges.

Occurs on the Island of Lamö, near Brevig, Norway. Formed from the alteration of elæolite. It may be identical with the ozarkite of Shepard (Dana Min., p. 426).

Redondite, Shepard, Am. J. Sci., II., xlvii., 428, l., 96.—Appendix I., p. 13.

Resin, Min. p. 739 et seq.—Samland, Brüsterort, *Spirgatis*, Ber. Ak. München, 1871, 72.

Valley of the Arno. *Guareschi*, Boll. Com. Geol. d'Italia, 1871, 70. See Bombiccite.

Alaska, p. 88; Mesen, p. 90, *Chydenius*, Œfv. Finsk. Vet. Soc., xiii., 71, 1870.

Helbing has described a new resin from a quarry at Enzenau, near Heilbrunn. An analysis gave C 75·01, H 9·51, O 1·37, FeS_2 14·11 = 100·00. The part soluble in ether (19 p. c.) has the composition, $C_{10}\,H_{12}\,O_1$; 9 p. c., soluble in ether and hot alcohol, has the composition $C_{10}\,H_{00}\,O_2$; and 72 p. c., insoluble, gives $C_{40}\,H_{62}$.—Ann. Ch. Pharm., clxxii., 297, 874.

Reissite, *Hessenberg*, Min. Not., ix., 22.—Appendix I., 14.

Restormelite, *Church*, J. Ch. Soc., II., viii., 166.—Appendix I., p. 13.

346 A. Resanite, *Cleve*, Ak. H. Stockh., ix., No. 12 (Nov., 1870). Geol. West India Islands, p. 28. A hydrous silicate of copper and iron, of an olive-green color, uncrystalline. G. = 2·06. Analysis, Fiebelkorn, l. c.,

$\ddot{\mathrm{Si}}$	$\dot{\mathrm{Cu}}$	$\dddot{\overline{\mathrm{Fe}}}$	$\dot{\overline{\mathrm{H}}}$ (loss at 100°)	$\dot{\overline{\mathrm{H}}}$ (ignition)
35·08	23·18	9·91	23·15	8·53 = 99·85

If the iron is protoxide it gives the formula $\dot{\mathrm{R}}^2\,\ddot{\mathrm{Si}}^3 + 9$ aq. It is easily decomposed by HCl. Found with malachite and chrysocolla, at Puerto Rico (Luquillo), West Indies, and named from Don Pedro Resano.

RETINITE, Min. p. 739.—Chydenius, Œfv. Finsk. Vet. Soc., xiii., 92, 1870–71.

RETZBANYITE, Min. p. 100.—Equivalent with cosalite, Frenzel, Jahrb. Min., 1874, 681.

577. Rhagite, Weisbach (Abh. Berg. u. Hüttenwesens), Jahrb Min., 1874, 302. Winkler, J. pr. Ch., II., x., p. 190, 1874.

In crystalline aggregates, spherical or mammillary (isometric), smooth on the surface. H. = 5. G. = 6·82. Color yellowish-green, sometimes wax-yellow. Lustre wax-like. On the edges translucent; brittle; fracture dense and incompletely conchoidal.

Analysis, Winkler (l. c.)

$\dddot{\overline{\mathrm{Bi}}}$	$\overset{\cdot\cdot\cdot\cdot\cdot}{\overline{\mathrm{As}}}$	$\dddot{\overline{\mathrm{Fe}}},\dddot{\overline{\mathrm{Al}}}$	$\dot{\mathrm{Co}}$	$\dot{\mathrm{Ca}}$	$\dot{\overline{\mathrm{H}}}$	gangue
72·76	14·20	1·62	1·47	0·50	4·62	3·26 = 98·43

giving the formula, $\dddot{\overline{\mathrm{Bi}}}{}^5\,\overset{\cdot\cdot\cdot\cdot\cdot}{\overline{\mathrm{A}}}{}^2\,\dot{\overline{\mathrm{H}}}{}^8$. It is related to atelestite.

Easily soluble in hydrochloric acid, with difficulty in nitric acid. In the matrass decrepitates, and crumbles to a yellow powder, giving off its water; on charcoal fusible.

Occurs on bismutite and quarz, accompanied by walpurgite, at the "Weisser Hirsch" mine, near Schneeberg, Saxony.

RHODITE, Adam, Tableau Min., 1869, p. 83.—Rhodium-gold described by del Rio. Dana Min. p. 4.

RHODOCHROSITE, Min. p. 691.—Franklin, N. J., anal., *Roepper*, Am. J. Sci., II., l., 37, 1870; see also Am. J. Sci., III., iv., 146, 1872. See stirlingite.

RIONITE, Jahrb. Min., 1870, 590.—Appendix I., p. 14.

RIPIDOLITE, Min. p. 497.—Kotschubeite, analyses, *Kokscharow*, Min. Russl., v. 369; vi., 92.

Massaschlucht, anal., *v. Fellenberg*, Jahrb. Min., 1868, 746.
Monte Pisani, etc., anal. (Gherardi), *Achiardi*, Boll. Com. Geol. Ital., 1871, 156.
Brewster, N. Y., anal., *Breidenbaugh*, Am. J. Sci., III., vi., 208, 1873.
Zillerthal, anal., Tsch. Min. Mitth., 1874, 244.

RITTINGERITE, Min. p. 94.—Joachimsthal, consists essentially of arsenic, selenium, and silver, monoclinic ($C = 90° 34'$), *Schrauf*, Ber. Ak. Wien, lxv., 227, 1872.

507. A. Rivotite, *Ducloux*, C. R., lxxviii., p. 1471, 1874.

Amorphous, compact, with a stony look. Fracture uneven. Opaque. Color yellowish green to grayish-green. Streak grayish-green.

H. = 3·5–4. G. = 3·55–3·62. Fragile, breaking into pieces at the blow of a hammer.

Analysis, Ducloux (l. c.)

$\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{Sb}}$	$\dot{\mathrm{Ag}}$	$\dot{\mathrm{Cu}}$	$\ddot{\mathrm{C}}$	$\dot{\mathrm{Ca}}$		
42·00	1·18	39·50	21·00	tr	=	103·68

Ducloux gives the formula $\overset{\cdot\cdot\cdot\cdot\cdot}{\mathrm{Sb}}_2 + 4\left.\begin{matrix}\dot{\mathrm{Cu}}\\ \dot{\mathrm{Ag}}\end{matrix}\right\}\ddot{\mathrm{C}}$, urging that the antimony is present in the condition of antimonic acid.

Decrepitates on heating, colors the flame green. On charcoal alone, in reducing flame, leaves a metallic globule with no odor of arsenic nor fumes of antimony. In the closed tube gives off carbonic acid and becomes black. Gives no reaction for sulphur. With the fluxes gives a copper reaction. Treated with hydrochloric acid in the cold gives off carbonic acid, but dissolves only in part.

Occurs in small irregular masses disseminated through a yellowish-white limestone, on the west side of the Sierra del Cadi, province of Lerida.

Named in honor of M. Prof. Rivot of the School of Mines, Paris.

RŒPPERITE. *Rœpper*, Am. J. Sci., II., l., 35.—*Brush*, Appendix I., p. 13.

Kenngott (Jahrb. Min., 1872, 188) has proposed to give the name *rœpperite* to the manganese dolomite, analyzed by Rœpper (l. c.), and the name *stirlingite* to the iron-manganese-zinc-chrysolite. The latter name cannot stand as it has already been given to the mineral most characteristic of the locality (Franklin, N. Y.), that is, the red oxyd of zinc (zincite, *Dana*, but see Min. 5th ed., 5th sub. ed., p. 135), Alger, Min., p. 565, 1844, by him incorrectly written sterlingite. Moreover the other mineral being only a sub-variety does not deserve a name. Almost simultaneously with the note of Kenngott, Brush gave the name rœpperite to the new chrysolite of Rœpper, and there is no question but that this name should be received; it may be added that it is already accepted by *Groth*, Tabellarische Uebersicht der Mineralien, etc., p. 52, 1874.

RŒSSLERITE, Min. p. 556.—Joachimsthal, *Tschermak*, Ber. Ak. Wien, lvi., 828, 1867.

ROMEITE, Min. 547.—Composition, *Kenngott*, Jahrb. Min., 1870, 999.

ROSELITE, Min. p. 560.—This very rare mineral has been recently rediscovered at the Daniel Mine near Schneeberg. Schrauf (Tsch. Min. Mitth., 1874, 137) has investigated it thoroughly, and proved that it is beyond doubt an independent species. According to him its crystalline form is triclinic, a (vert.) : b : $c = 1{\cdot}4463 : 1 : 2{\cdot}2046$. The fundamental angles are: $\xi = 91° \; 0'$, $\eta = 89° \; 26'$. $\zeta = 90° \; 40'$. The habit of the crystals is quite varied, but they are especially characterized by their tendency to the formation of twins. All the crystals investigated by Schrauf proved to be twins, in many cases of the most complex nature. But without figures any description of them would be unintelligible. H. = 3·5. G. = 3·585, Rappold (on crystals, 0·03 gr.); 3·506 Daniel (crystals, 0·04 gr.); 3·738 Rappold (massive and perhaps not perfectly pure), Schrauf. G. = 3·46. Weisbach (Jahrb. Min., 1874, 871).

Analyses, 1. and 2. Schrauf (l. c.); 3. Winkler, J. pr. Ch., II., x., 191, 1874.

		$\dddot{\bar{A}}s_2$	$\dot{C}o$	$\dot{C}a$	$\dot{M}g$	$\dot{\bar{H}}$		
1.	Daniel Mine.	50·9	(12·1)	21·9	4·3	10·8	=100·00	Schrauf.
2.	Rappold Mine.	49·6	(15·9)	19·2	4·8	10·5	=100·00	Schrauf.
3.	Daniel Mine.	49·96	12·45	23·72	4·67	9·69	=100·49	Winkler.

Schrauf writes the formula $\dot{R}^3\dddot{\bar{A}}s_2 + 3\dot{\bar{H}}$ or more exactly $7\dot{C}a, 2\dot{M}g 3\dot{C}o, 8\dddot{\bar{A}}s_2, 10\dot{\bar{H}}$, (for crystals from the Daniel Mine), and $6\dot{C}a, 2\dot{M}g, 4\dot{C}o, 8\dddot{\bar{A}}s, 10\dot{\bar{H}}$ for those from the Rappold mine. The Daniel crystals have a lighter color, corresponding to the smaller percentage of cobalt, and greater amount of lime.

When heated at 100° C., the crystals break into fragments, and take a dark-blue color, but resume their red color on cooling.

ROSTHORNITE, Höfer, Jahrb. Min., 1871, 561.—Appendix I., p. 14.

RUTILE, Min. p. 159.—(Ilmenorutile), *Kokscharow*, Min. Russl., v., 193.
Co. Mayo, Ireland, anal., *Reynolds*, J. R. Geol. Soc. Dublin, II., ii., 164
Associated with hematite, *v. Rath*, Pogg., clii., 21, 1874.

SAHLITE, Min. p. 215.—Valpellina, anal., *v. Rath*, Pogg., cxliv., 387.

SAL AMMONIAC was found abundantly at Vesuvius after the eruptions of 1868 and 1872. The crystals showed the following forms: O, 1, i, 2-2, 3-$\frac{3}{2}$, they have often a yellow color due to a chlorid or a basic chlorid of iron. *Scacchi*, Rend. R. Accad. Sci. Napoli, Oct., 1872.

SAMARSKITE, Min. p. 520.—And related minerals, composition discussed, *Hermann*, J. pr. Ch., cvii., 139, 1869; II., ii., 123. *Rammelsberg*, Pogg., cl., 213, 1873; cryst. note, *Zerrenner*, ZS. G. Ges., xxv., p. 461, 1873. See nohlite.

SANDBERGERITE, Min. p. 104.—A mineral of similar form and composition has been described and analyzed by Achiardi, Lettera a Carlo Regnoli, sopra alcuni Min. del Peru, p. 15, Pisa, 1870. See also Domeyko, 3d App. Min. Chili, 1871.

SANIDINE, Min. p. 352.—*Cryst.*, p. 454, anal., 561, *v. Rath*, Pogg., cxxxv.

SAPONITE, Min. p. 472.—Filling cavities in trap, George Is., north coast of Prince Edward's Is., anal., *Harrington*, Can. Nat., II., vii., 179.

SARCOPSIDE, *Websky*, ZS. G. Ges., xx., 245, 1868.—Appendix I., p. 14.

SCAPOLITE, Min. p. 317.—Buck's Co., Penn., anal., *Leeds*, J. Frank. Instit., III., lx., 63, 1870.

SCHEELITE, Min. p. 605.—Coquimbo, anal., containing 6·2 p. c. V^2O^5, Domeyko 2d Append. Min. Chili, p. 2, 1867.
Riesengebirge, cryst., *Rammelsberg*, ZS. G. Ges., xix., 493, 1867.
Domodossola, Piedmont, Rep. Brit. Assoc., 1869, p. 88.
Russian localities, *Beck* and *Teich*, Verh. Min. Ges. St. Pet., II., iv., 312, 1869.
Schwarzenberg, *Stelzner*, Jahrb. Min., 1869, 745.
Cryst. memoir (many figures), *Bauer*, Würtemberg Nat. Jahrb., 1871, 129 (Pogg., cxliii., 452).
Found at Graussen (Bohemia), Sulzbach, Salzkammergut, ZS. G. Ges., xxiv., 595, 1872.
Traversella, contains didymium, *Horner*, Chem. News, xxviii., 299; (*Sorby*, Proc. Roy. Soc., xviii., 197).
Meymac, Corrèze, anal., *Carnot*, C. R., lxxix, 638, 1874. See meymacite.

SCHEFFERITE, Min. p. 215.—Cryst., *Nordenskiöld*, Œfv. Ak. Stockholm, xxvii., 560, 1870.

SCACCHITE, Adam, Tableau Min., 1869, p. 70.—A chlorid of manganese, supposed by Scacchi to occur at Vesuvius. See Dana, Min., p. 122.

112 B. Schirmerite, Genth, Am. Phil. Soc. Philad., xiv., 230, Aug. 21st, 1874.
Massive, finely granular, disseminated through quartz; no cleavage observed. Fracture uneven; soft; brittle. G. = 6·737. Color lead-gray, inclining to iron-black. Lustre metallic. B.B. fuses easily, and gives the reactions for bismuth, lead, silver and sulphur.
Analyses, 1. (1 p. c. quartz deducted). 2. (1·07 p. c. deducted).

	Pb	Ag	Bi	Zn	Fe	S
1.	12·69	22·82	46·91	0·08	0·03	14·41 = 96·94
2.	12·76	24·75	(47·27)	0·13	0·07	15·02 = 100·00

Atomic ratio for Pb : Ag : Bi : S = 1 : 4 : 4 : 9 nearly, corresponding to PbS, $2Ag_2S$, $2Bi_2S_3$. It is allied to and closely resembles cosalite.
Occurs with other tellurium minerals at the Red Cloud mine, Colorado.
Named from J. F. L. Schirmer, Esq.

Schirmerite, Endlich, Engineering and Mining J., Aug. 29th, 1874.
Color bright lead-gray with tinge of purple. H. = 2–2·5.
Composition (according to analyses not published), (AuFe)Te + 3AgTe.
B.B. magnetic before the oxydizing flame. Occurs massive, disseminated through the ore, giving it a dark-gray color; also in thin streaks. Red Cloud mine, Colorado.
Dr. Genth (l. c.) asserts that this so-called new species "is nothing else but a mixture of petzite either with pyrite, or perhaps with a tellurid of iron," and "is based upon a partial examination of a mixture," and therefore "is not entitled to a name."

SCHREIBERSITE, Min. p. 61.—In meteoric irons, *Meunier*, Ann. Ch. Phys., IV., xvii., 43, 1869.

755 A. Schröckeringite, *Schrauf*, Tsch. Min. Mitth., 1873, p. 137.
Occurs at Joachimsthal on uraninite, in small, six-sided tabular crystals; $i\text{-}\breve{i} \wedge I = 121\frac{1}{2}°$. Prismatic, one bisectrix being normal to $i\text{-}\breve{i}$. Color greenish to yellow. It is a hydrous oxy-carbonate of uranium, containing only traces of $\ddot{S}$. Loss by ignition ($\dot{H}$ and $\ddot{C}$) = 36·7 Contains also a little lime.

SCOLECITE, Min. p. 428.—Chili, anal., Domeyko, 2d App. Min. Chili, p. 47, 1867.
Composition, *Rammelsberg*, ZS. G. Ges., xxi., 96, 1868; *Kenngott*, Jahrb. Min., p. 1870, 908.
Lunddörrsfjäll, anal., *Igelström*, Jahrb. Min., 1871, 361.
(Poohnahlite), India, anal., *Haughton*, J. R. Geol. Soc. Dublin, II., 1868, 114; *Petersen*, Jahrb. Min., 1873, 852.

388 A. Seebachite, *Bauer*, ZS. G. Ges., xxiv., p. 391; xxv., p. 351, and *Rammelsberg*, xxv., p. 96.

Bauer makes the mineral described as herschelite by Ulrich (Geol. and Min. of Victoria, p. 61-66) a new species, under the name of seebachite, and in this he is supported by Rammelsberg.

Analyses (l. c.), 1. Kerl; 2. Lepsius.

	$\ddot{\mathrm{Si}}$	$\bar{\ddot{\mathrm{A}}}\mathrm{l}$	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\mathrm{N}}\mathrm{a}_2$	$\dot{\mathrm{K}}_2$	$\dot{\mathrm{H}}_2$
1.	43·7	21·8	8·5	3·5	tr	22·7 = 99·7
2.	44·77	22·10	7·51	3·18	—	22·07 = 99·63

It occurs with phillipsite in the basalt quarries of Richmond near Melbourne, and according to v. Lang (Phil. Mag., IV., xxviii, p. 506) is identical crystallographically with herschelite from Sicily. (See also Jahrb. Min., 1874, 522.)

SELENWISMUTHGLANZ. See FRENZELITE.

SELLAITE, *Strüver*, Atti Accad. Sci. Torino, iv., 35, 1868.—Appendix I., p. 14.

SELWYNITE, Min. p. 509—(belonging in the pinite group), Appendix I., p. 19.

SERICITE, Min. p. 487.—Doubtful character discussed, *Scharff*, Jahrb. Min., 1868, 309; 1871, 56; 1874, 271.

SERPENTINE, Min. p. 464.—Origin and method of formation, *Tschermak*, Ber. Ak. Wien, lvi., 283, 1867; *v. Drasche*, Tsch. Min. Mitth., 1871, 1.

Composition, *Rammelsberg*, ZS. G. Ges., xxi., 97, 1868.

Finland, anal., *Kullheim*, Œfv. Finsk. Vet. Soc., xiii., 43, 1870–71.

Origin of, varieties chautonnite, aumalite, *Meunier*, C. R., lxxi., 590, 1871.

Pseudomorph after staurolite, *Rand*, Proc. Ac. Nat. Sci. Philad., 1871, 303.

Snarum, anal., Pogg., cxlviii., 329.

Brewster, N. Y., analyses, *Breidenbaugh*, Am. J. Sci., III., vi., 211, 1873; *Hawes*, ibid., viii., 451, 1874.

Brewster, N. Y., pseudomorphs after calcite, dolomite, chlorite, chondrodite, enstatite, amphibole, biotite, brucite, and other unknown minerals, *J. D. Dana*, Am. J. Sci., III., viii., 375, 1874.

(Vorhauserite), anal., *v. Kobell*, Ber. Ak. München, June, 1874; chrysotile, antigorite, marmolite, analyses, same, ibid., 165, 1874.

Pseudomorph after monticellite, *v. Rath*, Ber. Ak. Berlin, 1874, 737.

SIDERITE, Min. p. 688.—Hüttenberg, Carinthia, analyses, *Wolff*, Ber. Ak. Wien, lvi., 299, 867.

Altered to hematite, limonite, etc. (Bohemia), *Boricky*, Ber. Ak. Wien, lix., 605, 1869.

Tuscany, province of Lucca, anal., *Achiardi*, Boll. Com. Geol. Ital., 1871, 134.

Pseudomorph after calcite, *Strüver*, Atti Accad. Sci. Torino, vi., 377, 1871.

Nova Scotia, anal., *Harrington*, Geol. Surv. Canada, 1874, p. 239.

Siegburgite. A new fossil resin, containing 85 p. c. carbon, found at Siegburg near Bonn. Described by Lasaulx at the "Versammlung Deutscher Naturforscher in Breslau," Sept., 874. (Chem. News, xxxi., 131.)

SILVER, Min. p. 9.—Andreasberg, in crystals, *Groddeck*, Jahrb. Min., 1869, 445.

Pseudomorph after stephanite, Przibram, *Zepharovich*, Ber. Ak. Wien, lxix., 33, 1874.

Simlaite, *Schrauf*, = PHOLERITE, which see.

SIMONYITE, *Tschermak*, Ber. Ak. Wien, Nov., 1869.—Appendix I., p. 14.

Reichardt, Jahrb. Min., 1871, 856. *Brezina*, Tsch. Min. Mitth., 1872, 20. See blœdite.

SKUTTERUDITE, Min. p. 71.—Possesses positive and negative thermo-electrical varieties, *chrauf* and *Dana*, Ber. Ak. Wien, lxix., 153, 1874.

SMALTITE, Min. p. 70.—Bunta Brava, anal., corresponding to (Co Ni Fe)^2 As^3, Domeyko 1 App. Min. Chili, p. 11, 1867; see also ibid., p. 22.

Wittichen, Baden, anal., *Petersen*, Pogg., cxxxiv., 70, 1868.

Andreasberg, cloanthite (chathamite), anal., *v. Kobell*, Ber. Ak. München, 1868, 402.

Bieber, Hessen, anal., *Hilger*, Ber. Ak. München, 1873, 136.

Groth shows that some crystals are thermo-electrically positive, others negative, and con- udes (*Rose*, Pogg., cxlii., 1) that it is isomorphous with pyrite and cobaltite. He remarks that this variation in thermo-electrical character is true only of pyrite, cobaltite and smaltite (July, 1874), ignorant of the investigations of *Schrauf* and *Dana* (March, 1874, Ber. Ak. Wien, lxix.), Pogg., clii., 249.

SMARAGDITE, Min. p. 215.—From the diamond rock of Du Toit's Pan, So. Africa, analyses, *Maskelyne* and *Flight*, Q. J. G. Soc., xxx., 412, 1874.

SMITHSONITE, Min. p. 692.—Raibl, Carinthia, anal., Tsch. Min. Mitth., 1871, 55.
Tennessee, contains indium, *Tanner*, Ch. News, xxx, 141, 1874.
Missouri, analyses, Geol. Rep., 1874.

SNARUMITE, Min. p. 316.—Snarum, anal., *Breithaupt*, Jahrb. Min., 1872, 820.

SODALITE, Min. p. 330.—Pseudomorph after nephelite, Monte Somma, *Strüver*, Atti Accad Sci. Torino, vii., 329.

SPHALERITE, Min. p. 48.—Cryst., *Sadebeck*, ZS. G. Gs., xxi., 620, 1869; xxiv., 181, 1872.
Geroldseck, Breisgau, containing thallium, *v. Kobell*, Ber. Ak. München, 1871, 77.
Unkel, cryst., *Lasaulx*, Verh. Nat. Ges. Bonn., xxvii., 133, 1871.
Cryst., (4-4, $\frac{1}{2}5$-$\frac{1}{2}\hat{5}$, new), *Klein*, Jahrb. Min., 1870, 311; Kapnik, cryst., ibid., 1871, 492, Binnenthal, cryst. memoir (new forms), Klein, ib., 1872, 897.
Roxbury, Ct., contains 0·0255 p. c. indium, *Cornwall*, Am. Chemist, Oct., 1873.
In sphærosiderite, *Schnorr*, Jahrb. Min., 1874, 631.

83 A. Spathiopyrite. Sandberger. Der rhombische Arsenkobalt, Jahrb. Min., 1868, 410; 1873, p. 59. Sitzsb. Ak. München, 1873, 135.
Orthorhombic, in rounded or complex crystals, combinations of I and m-$\bar{i}$; also, more rarely, in simple crystals, showing the same planes. Macrodome planes well polished, prismatic planes dull. Angles apparently very near those of leucopyrite, Dana.
H. = 4·5, G. = 6·7. Color tin-white on the fresh fracture, but changes rapidly to a dark steel-gray.
Analysis v. Gerichten (l. c.).

As	S	Co	Ca	Fe
61·46	2·37	14·97	4·22	16·47 = 99·49

Atomic ratio for Co, Fe, Cu to As,S = 2 : 3. It contains no nickel.
Found on smaltite (Speiskobalt), or filling cavities in it, in the cobalt veins at Bieber in Hessen.

SPHENE. See TITANITE.

SPINEL, Min. p. 147.—Anal., *Kokscharow*, Min. Russl., v., 367.
Dornburg, variety in red octahedral crystals, anal., containing 5·68 p. c. TiO_2, *Kosmann*, Ber. Ges. Bonn., xxvi., 144.
No. Carolina, analyses, altered from corundum, *Genth*, Am. Phil. Soc. Philad., xiii., 370, 1873.

SPODUMENE, Min. p. 228.—See PIHLITE.

STAFFELITE, Min. p. 534.—Discussion as to doubtful character of the species, Jahresb. Chem., 1869, 1233; 1871, 1317.
Anal., contains iodine, *Petersen*, Jahrb. Min., 1868, 482; 1872, 96.
Anal., *Haushofer*, J. pr. Ch., II., vii., 147.
Waltsch, Bohemia, anal., *Boricky*, Ber. Böhm. Ges. Prag. Feb. 21, 1873.

STANNITE, Min. p. 68.—Cornwall, anal., *Adger*, Ch. News, xxv., 259, 1872.

STAUROLITE, Min. p. 388.—*Rammelsberg* has confirmed the observations of *Lechartier* (Min. p. 389) that staurolite contains silica as an impurity (ZS. G. Ges., xxv., 53, 1873). *Lasaulx* has carried the matter further and proved that not only quartz, but even garnet, mica, magnetite, and brookite exist in it as impurities (Tsch. Min. Mitth., 1872, 173). The same subject, with similar results, has been investigated by Fischer.
St. Radegrund. cryst. and anal., *Peters* and *Maly*, Ber. Ak. Wien, lvii., 646, 1868.
In metamorphic rocks, *Lebour*, Geol. Mag., x., 102, 1873.
No. Carolina, analyses, *Genth*, Am. Phil. Soc. Philad., xiii., 383, 1873.

STEATITE, Min. p. 451.—Anal., Tsch. Min. Mitth., 1872, 257.

STEPHANITE, Min. p. 106.—(melanglanz), Freiberg, anal., *Frenzel*. Jahrb. Min., 1873, 788; 1874, 636.

Sterlingite. See DAMOURITE.

STETEFELDTITE, Min. p. 188.—An antimonite of copper, resembling stetefeldtite, has been described by Domeyko as occurring at the Potochi copper mine, near Huancavelica, Peru. It is amorphous, compact. Fracture smooth or uneven, in parts coarsely granular. Color black or greenish black. Streak yellowish-green. Lustre weakly resinous. An analysis on the purest material obtainable (though still mixed with some sub-sulphate of copper), gave SbO_4 32·93, CuO 32·27, Fe_2O_3 11·14, ZnO 0·50, SO_3 1·00, H_2O (loss at low redness), 18·53, insoluble, 1·57 = 96·94. B.B. infusible. Dissolves readily in hydrochloric acid. Domeyko regards the mineral as probably having come from the decomposition of chalcostibite, an analysis of which he adds. 3d Appendix Min. Chili, 1871.

587. Stibioferrite. E. Goldsmith, Proc. Ac. Philad., 1873, p. 366.

Generally amorphous. Crystals observed in a cavity and supposed to be the same substance (no reason given) were orthorhombic showing planes *i-ī*, *i-ĭ*, *I* and *O*, approximate measurement gave *I* (*i-ī*) *I*=100° 8′.

H.=4. G.=3·598. Lustre slightly resinous. Color (cryst.) faint yellow; yellow to brownish-yellow (amorphous). Streak dull yellow, brittle, fracture uneven chonchoidal.

Analysis (l. c.).

$\ddot{\mathrm{Sb}}$	$\bar{\mathrm{F}}\mathrm{e}$	$\dot{\mathrm{H}}$	$\ddot{\mathrm{Si}}$	loss		
42·96	3·85	15·26	8·84	1·09	=	100·00

Deducting the iron we obtain as the oxygen ratio $\ddot{\mathrm{Sb}} : \bar{\mathrm{F}}\mathrm{e} : \dot{\mathrm{H}}$, 1·1 : 1 : 1·4 or 1 : 1 : 1½= 2($\ddot{\mathrm{Sb}} + \bar{\mathrm{F}}\mathrm{e}$) + 3$\dot{\mathrm{H}}$. B. B. gives reaction for antimony and iron. Soluble in hydrochloric acid.

Occurs as a coating, sometimes ¼ inch thick, on stibnite from Santa Clara Co., Cal.

STIBIOTRIARGENTITE, *Stibiohexargentite*, *Petersen.*—Appendix I., p. 15.

STIBNITE, Min. p. 29.—New Zealand, anal., *Muir*, Phil. Mag., IV., xlii., 236, 1871.
Santa Clara Co., Cal., anal., *Goldsmith*, Proc. Ac. Philad., 1873, 368.

STILBITE, Min. p. 442.—India, anal., *Haughton*, J. Roy. Geol. Soc. Dublin, ii., 113, 1868.
Composition. *Rammelsberg*, ZS. G. Ges., xxi., 25.
Anal., Ak. H Stockh., ix., No. 12, Nov., 1870 (Cleve's Geol. West India Is., p. 30, 1873).
Stromoë, anal., *Schmid*, Pogg., cxlii, 115.
Dumbartonshire, anal., *Young*, Chem. News, xxvii., 55, 1872.
Seisser Alp. anal., *Petersen*, Ber. Offenbach. Ver., xiv., 102, 1873.

STIRLINGITE, see RŒPPERITE.

454. A. Str govite, Becker and Websky, Jahrb. Min., 1869, p. 236. Websky, ZS. G. Ges., xxv., 388, 1873.

In minute crystals, showing hexagonal prisms under the microscope; sometimes in balls of aggregated crystals, and shown by the behavior in polarized light to belong to the hexagonal system. H.=1. G=3·144. Color dark-green (on alteration changing to brown). Streak green to grayish-green. Analyses: 1. Becker l. c. 2. Websky (G.=2·788), Jahrb. Min., 1869, 236. 3. Websky, Jahrb. Min., 1873, 391.

	$\ddot{\mathrm{Si}}$	$\ddot{\bar{\mathrm{A}}}\mathrm{l}$	$\dot{\mathrm{Fe}}$	$\bar{\mathrm{F}}\mathrm{e}$	$\dot{\mathrm{Mn}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\mathrm{H}}$	loss	
1.	32·62	16·66	16·74	16·04	——	3·16	2·02	12·37	——	= 99·61
2.	32·60	14·08	12·47	21·94	——	3·82	——	14·81	0·28	=100·00
3.	28·43	16·60	11·43	26·21	7·26	0·36	0.36	9·31	——	= 99·96

Analyses 1. and 2. were made on material which had suffered some alteration, so that 3. alone expresses the correct composition. Oxygen ratio $\dot{\mathrm{R}} : \bar{\mathrm{R}} : \ddot{\mathrm{Si}} : \dot{\mathrm{H}}$=(approx.) 3 : 2 : 4 : 2. Easily decomposed by acid with the separation of silica in powder. In closed tube gives off water. B. B. fuses with difficulty to a black glass without coloring the flame.

Occurs as a fine coating over the minerals in druses or cavities in the granite west and north-west of Striegau in Silesia.

STROMEYERITE, Min. p. 54.—Chili, anal., Domeyko, 2d App. Min. Chili, p. 35, 1867. Argentine Republic, anal., Siewert, Tsch. Min. Mitth., 1873, 251.

STRONTIANITE, Min. p. 699.—Clausthal, cryst., *Hessenberg*. Min. Not., ix., 41, 1870.

STRUVITE, Min. p. 551.—Skipton caves, Ballarat, cryst. description, and anal., *Ulrich*, Contrib. to Min. of Victoria, 1870, p. 12.

SULPHATITE, Min. p. 614.—In eastern Texas, *Mallet*, Chem. News, xxvi., 147, 1872.

SULPHUR, Min. p. 20.—Cryst., *v. Rath*, Pogg. Erg. Bd., vi., 349; *Brezina*, Ber. Ak. Wien, lx., 539, 1869.

SUSANNITE, Min. p. 626.—*Kenngott* thinks that susannite is only a form of leadhillite in compound crystals (drillings), but gives no sufficient proof, Jahrb. Min., 1868, 319.

SUSSEXITE, *Brush*, Am. J. Sci., II., xlvi., 140, 240.—Appendix I., p. 15.

SYEPOORITE, see **JEYPOORITE**.

SYLVANITE, Min. p. 81.—Red Cloud Mine, Colorado, *Silliman*, Am. J. Sci., III., viii., 28; *Genth*, anal., Amer. Phil. Soc. Philad., xiv., 228, 1874.

SYLVITE, Min. p. 111.—Stassfurt, cryst. Huyssen, ZS. G. Ges., xx., 460, 1868.
Kalusz, cryst., Tschermak, Ber. Ak. Wien, lxiii., 308, 1871.

656. A. Syngenite, *v. Zepharovich*, Lotos, p. 137, p. 213, June, 1872; Ber. Ak. Wien, lxvii., p. 128, 1873. Kaluszite, *Rumpf*, Tsch. Min. Mitth., 1872, 117, 197; 1873, 147.

Monoclinic, *a* (vert.) : *b* (clinodiag.) : *c*=0·8738 : 1·3699 : 1 or ·63786 : 1 : 72998. *C*=76° 0′. Observed planes *O*, *i-i*, *i-ĭ* −1-*i*, −⅓-*i*, 1-*i*, 2-*i*, *I*, *i*-8, *i*-6, *i*-4, *i*-3, *i*-2, *i*-$\frac{3}{2}$, *i*-2̆, 1-ĭ, −1, -4·4, 1, 2, 2-2. *I* ∧ *I* = 73° 55′ (over *i-i*). *O* ∧ 1-ĭ = 139° 42′. *O* ∧ −1-*i* = 151° 49′. *O* ∧ 1-*i* = 143° 48′. *O* ∧ −1 = 137° 44′; *i-i* ∧ −1 = 124° 19′, *i-ĭ* ∧ −1 = 122° 55′.

In generally small tabular crystals, elongated in the direction of the vertical axis, the plane *i-i* always predominates, and is striated vertically.

Cleavage *I* perfect, also *i-i*. In other directions fracture conchoidal. Plane of optic axes parallel to the orthodiagonal section, acute bisectrix makes an angle of 2° 46′ with *i-i*. Optic-axial angle apparent in air—red = 41° 35′, blue = 46° 22′; actual angle, red = 26·31, blue, 29° 24′ (Vrba). Index of refraction 1·55 (Vrba). Double refraction negative. Dispersion of axes $\rho < \nu$.

H. = 2·5. G. = 2·603 (mean), 2·252 (Rumpf, l. c.). Colorless or milky white.

Analyses, 1. Ullik (mean of four closely agreeing analyses, in one of which was also found 1·42 p. c. NaCl), Tsch. Min. Mitth., 1872, 120; 2. Völker, Ber. Ak. Wien, lxvi., 197, 1872.

	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\mathrm{K}}$	$\dddot{\mathrm{S}}$	$\dot{\mathrm{H}}$		
1.	16·88	28·55	48·45	5·47		= 99.35
2.	16.97	28·03	49·04	5·85	(also 0·46 $\dot{\mathrm{M}}\mathrm{g}$.)	= 99·89

These give the formula $\dot{\mathrm{C}}\mathrm{a}\dddot{\mathrm{S}}$, $\dot{\mathrm{K}}\dddot{\mathrm{S}} + \dot{\mathrm{H}}$, or the same with the artificial salt, which Zepharovich shows to be also monoclinic (ib., p. 139). In form the syngenite is closely related to gypsum, particularly in the angles of the prismatic zone.

In the flame of a Bunsen gas-burner becomes milky, colors the flame violet, and melts easily to a colorless (on cooling white) bead, with a crystalline granular texture. In matrass gives off water, decrepitating violently. Easily attacked by water, dissolving in part with the separation of sulphate of lime. Vrba found that one part of syngenite dissolved in 400 pts. of water. Found in cavities in halite at Kalusz, East Galicia. Name derived from *συγγενής* (related), alluding to its close relation to polyhalite.

TABERGITE, Min. p. 493.—Composition, *Kenngott*, Jahrb. Min., 1869, 202.

TÆNITE, Min. p. 16.—In meteoric iron, *Meunier*, Ann. Ch. Phys., IV., xvii., 31 1869.

TALC, Min. p. 451.—Greiner (Zillerthal), Tyrol, anal., *Ullik*, Ber. Ak. Wien, lvii., 946, 1868.

Swayne Co., No. Carolina, anal., of a compact variety, *Adger*, Chem. News, xxv., 270, 1872.

Pseudomorph after pectolite, Bergen Hill, *Leeds*, Am. J. Sci., III., vi., 23, 1873.

TALCOSITE, *Ulrich*.—Appendix I., p. 15.

TAMMITE. Mr. Tamm has analyzed a dark steel-colored crystalline powder, locality unknown, very hard. G. = 12·5. He obtained W 88·05, Fe 5.60, Mn 0.15, undetermined 6·20 = 100·00. The loss he says is not due to oxygen. He calls his unknown substance ferrotungsten, and proposes, in case the character of the mineral is sustained, to give it the name *Crookesite*. Mr. Crookes justly says that the name *tammite* should be preferred. Chem. News, xxvi., July, 1872.

TANTALITE, Min. p. 514.—Composition, *Hermann*, Bull Soc. Mosc., 1867, iv., 464.
Finland and Sweden, analyses, *Rammelsberg*, Pogg., cxliv., 56, 1871.

Tapalpite, Don *Pedro L. Monroy*, Naturaleza, Aug., 1869, p. 76. Tellurwismuth, *Rammelsberg*, ZS. G. Ges., xxi., 81.—Appendix I., p. 15.

TAPIOLITE, Min. p. 518.—Sukkula, Finland, *Rammelsberg*, anal., Pogg., cxliv, 79, 1871.

TELLURATE OF COPPER AND LEAD, discovered by Mr. Knabe, at the Iron Rod Mine, Silver Star District, Montana, occurring in fissures in the rock. At the Green Campbell Mine it is found as a thin coating upon the selvage of the foot wall. Proved to contain copper, lead, and telluric acid. The sample sent to Dr. Genth consisted of an apparently uniform siskine-green powder. He speaks (priv. contrib.) of proposing to investigate the material further, and, if its supposed character is sustained, will give it a distinctive name. *Genth*, Am. Phil. Soc. Philad., xiv., 229, 1874.

TELLURWISMUTH. See TAPALPITE.

TELLURIUM, Min. p. 19.—*Genth*, Am. J. Sci., II., xlv., 313, 1868.
Colorado, *Silliman*, Am. J. Sci., III., viii., 27, 1874; Genth, Am. Phil. Soc., Philad., 1874, Aug. 21.
Sacramento, Chili, note, *Bertrand*, Jahrb. Min., 1870, 455.

TEPHROITE, Min. p. 259.—Franklin, N. J., anal., *Mixter*, Am. J Sci., II., xlvi., 231, 1868.

TETRADYMITE, Min. p. 30.—Orawitza, anal., *Frenzel*, Jahrb. Min., 1873, 799.
Thermo-electrical properties, *Schrauf* and *Dana*, Ber. Ak. Wien, lxix., 151, 1874.
Montana, anal., *Genth*, Am. Phil. Soc. Philad., xiv., 224, 1874.

TETRAHEDRITE, Min. p. 100.—Russia, cryst., *Jeremejew*, Koksch. Min. Russl., v., 369.
Neubulach, Würtemberg, anal. (Bi = 6·33 p. c.), *Petersen*, Jahrb. Min., 1870, 464
Cerro Blanco, anal., by *Sieveking*, Domeyko, 3d Appendix Min. Chili, 1871; Ghalgayic, anal. (freibergite), ibid. See also 2d Appendix, p. 19, 1867, and 4th Appendix, p. 15, 1874.
Horhausen, near Neuwied, cryst., *Klein*, Jahrb. Min., 1871, 493.
Brixlegg, Tyrol, anal., *Untchy*, Jahrb. Min., 1872, 874.
Cryst. memoir and relation to sphalerite and chalcopyrite, *Sadebeck*, ZS. G. Ges., xxiv., 427, 1872.

THOMSENOLITE, Min. p. 129.—Cryst., belonging to a so-called clino-quadratic system, a (vert.) : $b : c = 1·0444 : 1 : 1$. $C = 92°\ 30'$, anal., *Nordenskiöld*, Œfv. Ak. Stockh., 1873, 84. See *Schrauf*, Tsch. Min. Mitth., 1874, 161.

THOMSONITE, Min. p. 424.—Anguilla, W. I., anal., *Nordström*, Ak. H. Stockholm, ix., No. 12, Nov., 1870 (Cleve's Geol. W. India Is., p. 30, 1870).
Seisser Alp. anal., *Haushofer*, J. pr. Ch., ciii., 305.
Mugdock Water Tunnel, *Young*, Chem. News., xxvii., 55, 1872.

THORITE, Min. p. 413.—(Orangite), cryst., *Nordenskiöld*, Œfv. Ak. Stockh., xxvii., 554, 1870.

TIN. See CASSITERITE.

TITANITE, Min. p. 383.—Rothenkopf, Tyrol, cryst., *Zepharovich*, Ber. Ak. Wien, lx., 815, 1869.
Cryst. memoir, *Hessenberg*, Min. Not., viii., 1, 1868; ix., 45, 1870; xi., 19, 21, 1873; see also Jahrb. Min., 1874, 828.
Sulzbach, cryst., *Schrauf*, Ber. Ak. Wien, lxii., 704, 712, 1870.

Tocornalite, Domeyko, 2d Append. Min. Chili, p. 41, 1867.

Amorphous, structure granular. Color a pale-yellow, by the action of the air it grows darker, and passes to a grayish-green, and finally to a grayish-black and black. Soft, easily reduced to a powder. Streak yellow.

Composition Ag I + $\mathrm{Hg}^2\mathrm{I}$. An analysis gave Ag 33·80, Hg 3·90, I 41·77, siliceous residue 16·65 = 96·12. The loss is due to some water belonging with the residue, and probably some iodine.

In the closed tube gives off first water, then a yellow ring, followed by a mixed sublimate (mercurial), and finally a red ring. With carbonate of soda in the matrass gives only pure mercury. Decomposed by nitric acid. From the mines of Chañarcillo, Chili.

TOPAZ, Min. p. 376.—*Blum*, cryst. note, Jahrb. Min., 1869, 721.

Altenberg and Schlaggenwald, cryst. memoir, *Groth*, ZS. G. Ges., xxii., 381, 1870.

Thermo (= pyro)-electrical character, *Hankel*, Jahrb. Min., 1871, 287.

Analyses, *Klemm*, Jahrb. Min., 1874, 189.

TORBERNITE, Min. p. 585.—Analyses, *Winkler*, J. pr. Ch., II., vii., 10, 11, 13; *Schrauf*, Tsch. Min. Mitth., 1872, 181.

TOURMALINE, Min. p. 365.—Switzerland, colorless, *Wiser*, Jahrb. Min., 1868, 465.

Isola del Giglio, anal., *Bechi*, Boll. Com. Geol. Ital., 1870, 84.

Elba, cryst. and anal., *v. Rath*, ZS. G. Ges., xxii., 663, 1870; *Achiardi*, Nuovo Cimento, II., iii., Feb., 1870.

Many analyses, and discussion of composition, *Rammelsberg*, Pogg., cxxxix., 379, 547, 1870.

No. Carolina, with corundum, *Genth*, Am. Phil. Soc. Philad., xiii., 378, 1873.

335 A. Trautwinite, E. Goldsmith, Proc. Ac. Philad., 1873, 9, 348, 365.

Microcrystalline; observed forms, hexagonal prism, pyramid, also triangular prism. H. = 1–2. Color green. Lustre dull (under microscope vitreous). Streak light-gray.

Analysis (l. c.):

$\ddot{\mathrm{Si}}$	$\dddot{\bar{\mathrm{Cr}}}$	$\dddot{\bar{\mathrm{Fe}}}$	$\dddot{\bar{\mathrm{Al}}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Mg}}$
21·78	38·39	13·29	0·81	18·58	0·11 = 100·84

Oxygen ratio for bases to silica = 11 : 6, perhaps 2 : 1. B.B. gives reaction for chromium, insoluble in acids. Occurs on chromite; from Monterey Co., Cal.

TREMOLITE, Min. p. 233.—Related minerals, *Tschermak*, Min. Mitth., 1871, 37.

TRIDYMITE, Min. p. 805.—Appendix I., p. 19.—From Alleret (Dep. Haute Loire), Lasaulx, Jahrb. Min., 1869, 66.

Formed artificially, *Rose*, Ber. Ak. Berlin, June, 1869, p. 469.

Double-refraction positive like quartz, *Schultze*, Ber. Ges. Bonn, xxvi., 119, 1869.

Observed with microscope in thin rock-sections, *Zirkel*, Pogg., cxl., 492 (Jahrb. Min., 1870, 823).

In porphyry at Waldböckelheim, *Streng*, Tsch. Min. Mitth., 1871, 49.

As inclosures in quartz crystals, Lotos, Dec., 1872; *Sandberger*, Jahrb. Min., 1868, 466, 723.

From various new localities, *Möhl*, Jahrb. Min., 1873, 608.

Cryst. memoir, with a complete description of the many and interesting twins, *v. Rath*, Pogg., clii., 1, 1874.

TRINKERITE, *Tschermak*, J. pr. Ch., II., ii., 250.—Appendix I., p. 16.

TRIPLITE, Min. p. 543.—Sierra von Cordoba, Argentine Republic, several analyses, *Siewert*, Tsch. Min. Mitth., 1873, 225 et seq.

TRÖGERITE, *Weisbach*, Jahrb. Min., 1871, 870; 1873, 315.—Appendix I., p. 16.

Winkler has analyzed the trögerite of Weisbach with the following results; Analyses 1. 3 p. c. impurities deducted. 2. 4½ p. c. deducted. 3. on pure material.

	$\dddot{\bar{\mathrm{As}}}$	$\dddot{\bar{\mathrm{U}}}$	$\dot{\mathrm{H}}$
1.	18·48	63·44	18·08 = 100·00
2.	18·83	62·42	18·75 = 100·00
3.	19·64	63·76	14·81 = 98·21

which correspond to the formula $3\dddot{\bar{\mathrm{U}}}\,\dddot{\bar{\mathrm{As}}} + 12\dot{\mathrm{H}}$.

On heating it gives off water, and takes a golden-brown color, but resumes a yellow on cooling. J. pr. Ch., II., vii., 6, 1873.

TROILITE, Min. p. 57.—*Meunier* concludes that the composition of troilite is $(\text{FeNi})^7\text{Si}^8$ (not FeS), Ann. Ch. Phys., IV., xvii., 36, 1869; C. R., lxviii., 763, 1874. *Rammelsberg*, Abh. Ak. Berlin, 1870, 84).

TSCHEFFKINITE, Min. p. 387.—Composition, *Hermann*, J. pr. Ch., cvi., 332, 1868.

314 A. Tschermakite, *v. Kobell*, J. pr. Chem., II., viii., 411, 1873.

Massive, cleavage on two surfaces, making an angle of 94°. Striations on face of better cleavage. H. 6. G. 2·64. Phosphorescent. Color grayish to white. Translucent. Lustre vitreous. Analysis, l. c.;

$\ddot{\text{Si}}$	$\ddot{\bar{\text{Al}}}$	$\dot{\text{Mg}}$	$\dot{\text{Na}}$($\dot{\text{K}}$ tr)	$\dot{\text{H}}$
66·57	15·80	8·00	6·80	2·70 = 99·87

This would give the formula $3\bar{\text{R}}\ \ddot{\text{Si}} + \ddot{\bar{\text{Al}}}\ \ddot{\text{Si}}_2$, or that of a magnesian oligoclase. It occurs with kjerulfine and quartz at Bamle, Norway.

G. W. Hawes (Am. J. Sci., III., vii., 579, 1874) has analyzed a mineral from the above locality, and labelled tschermakite, with the following results: G. = 2·67.

	$\ddot{\text{Si}}$	$\ddot{\bar{\text{Al}}}$	$\ddot{\bar{\text{Fe}}}$	$\dot{\text{Ca}}$	$\dot{\text{Mg}}$	$\dot{\text{K}}$	$\dot{\text{Na}}$	ign.
½	66·04	20·37	0·29	1·29	1·10	0·21	9·91	0·96 = 100·17

This gives a composition very near that of albite.

The mineral agreed in all its physical characters with the description of tschermakite, but was almost destitute of magnesia, which suggests the idea that the material analyzed by v. Kobell may have been impure.

Des Cloizeaux has since (C. R., lxxx., Feb. 8. 1875) found that the so-called tschermakite from Bamle is identical with albite in optical properties. He quotes, moreover, the following analysis by Pisani: $\ddot{\text{Si}}$ 66·37, $\ddot{\bar{\text{Al}}}$ 22·70, $\dot{\text{Ca}}$ 1·40. $\dot{\text{Mg}}$ 0·95, $\dot{\text{Na}}$ 9·70, $\dot{\text{H}}$ 0·70 = 101·82. G. = 2·60. This gives the oxygen ratio for $\dot{\text{R}} : \bar{\text{R}} : \ddot{\text{Si}} = 1 : 3 : 11$, or nearly that of albite.

TURGITE, Min. p. 167.—Terry Cope, N. S., *How*, Phil. Mag., IV., xxxvii., 268.

Salisbury, Conn., anal. and description, *Brush* and *Rodman*, Am. J. Sci., II., xliv., 219.

TURNERITE. See MONAZITE.

TYRITE. See FERGUSONITE.

TYROLITE, Min. p. 570.—Libethen, Hungary, anal., $\dot{\text{Ca}}\ddot{\text{C}}$ essential not an impurity, *Church*, J. Ch. Soc., II., xi., p. 108, Feb., 1870.

Tyrol, *Pichler*, Jahrb. Min., 1871, 53.

ULEXITE, Min. p. 598.—Nevada and Arizona, *Silliman*, Am. J. Sci., III., vi., 130.

Newport Station, Nova Scotia, in crystals, *How*, Phil. Mag., IV., xxxix., 275, 1870; xli., 275, 1871.

Atacama, anal., Domeyko, 4th App. Min. Chili, p. 35, 1874.

ULLMANNITE, Min. p. 73.—Rinkenberg, Carinthia, Verh. G. Reichs. 1871, 8, p. 131.

From the Lölling, crystals showing inclined hemihedrism, *Zepharovich*, Ber. Ak. Wien, lx., 809, 1869; Lotos, Jan., 1870.

Waldenstein, analyses, *Rumpf* and *Ullik*, Ber. Ak. Wien, lxi., 7, 1870.

URANINITE, Min. p. 154.—Colorado, Am. J. Sci., III., v., 386, 1873.

URANOPHANE, Min. p. 805.—Discussion of composition, = a thomsonite in which ⅔ alumina is replaced by uranium, *Websky*, ZS. G. Ges., xxi., 92, 1869; see also *Weisbach*, Jahrb. Min., 1873, 326.

624 A. Uranosphærite. Weisbach, Jahrb. Min., 1873, 315; Winkler, J. pr. Chem., II., vii., 5.

In half-globular aggregated forms, sometimes with a dull, or slightly lustrous surface, sometimes rough and drusy, showing under the miscroscope that they are made up of minute acutely-terminated crystals. Structure concentric, also radiated. H. = 2-3, G. = 5·36. Color orange-yellow, brick-red (Winkler). Lustre greasy. Streak yellow.

Analyses, Winkler, l. c., 1. impurities (11 p. c.) deducted, 2. perfectly pure material.

	$\dddot{\bar{\text{U}}}$	$\dddot{\text{B}}\text{i}$	$\dot{\text{H}}$
1.	50·32	44·12	5 56
2.	50·88	44·34	4·75

These give the formula $\dddot{\text{B}}\text{i}\ 2\dddot{\bar{\text{U}}} + 3\dot{\text{H}}$.

Decrepitates on heating, and falls to pieces to a mass of crystalline needles, with silky lustre, homogeneous and of brown color.

Occurs with other related uranium minerals at the mine Weisser Hirsch, near Schneeberg, Saxony.

573 C. Uranospinite. Weisbach, Jahrb. Min., 1873, 315; Winkler, J. pr. Ch. II., vii., 11.

Orthorhombic. In scale-like crystals, with quadratic or rectangular outlines. Cleavage perfect, parallel to the planes of the scales. H. = 2-3. G. = 3·45. Color siskine-green.

Analysis, Winkler (l. c.);

$\overset{\therefore\therefore}{\text{A}}\text{s}$	$\dddot{\bar{\text{U}}}$	$\dot{\text{C}}\text{a}$	$\dot{\text{H}}$
19·37	59·18	5·47	16·29 = 100·31

which corresponds approximately with the formula $\dot{\text{C}}\text{a},\ \dddot{\bar{\text{U}}}\ \overset{\therefore\therefore}{\text{A}}\text{s} + 8\dot{\text{H}}$.

Weisbach regards it as an arsenate corresponding to autunite. Winkler succeeded in making uranospinite artificially with the following composition: $\overset{\therefore\therefore}{\text{A}}\text{s}$ 23·01, $\dddot{\bar{\text{U}}}$ 59·01, $\dot{\text{C}}\text{a}$ 5·62. $\dot{\text{H}}$ 14·27 = 101·91.

Found with other related uranium minerals, at the mine Weisser Hirsch, near Schneeberg, Saxony.

URANOTIL, *Boricky*, Jahrb. Min., 1870, 780; see also Jahrb. Min., 1873, 296, 316.—Appendix I., p. 16.

445 D. Vaalite, *Maskelyne* and *Flight*, Q. J. G. Soc., xxx., 409, Nov., 1874.

Monoclinic. $C = 76° 30'$. Occurring in hexagonal prisms; $I \wedge I = 60° 10'$. $I \wedge O = 96° 40'$ (calc. = 96° 41′).

Cleavage *O* easy, *I* much less so. Normal to *O* coincident, or very nearly so, with the mean line of the optic axes; optic-axial angle very small; double-refraction negative.

Color drap, in spots fine blue.

Analysis (l. c.)

$\dddot{\text{S}}\text{i}$	$\dddot{\bar{\text{A}}}\text{l}$	$\dddot{\bar{\text{F}}}\text{e}$	$\dot{\text{M}}\text{g}$	$\dot{\text{N}}\text{a}$	$\dot{\text{H}}$	$\ddot{\text{C}}$	$\dddot{\bar{\text{C}}}\text{r}$
40·83	9·80	6·84	31·34	0.67	9·72	tr	tr = 99·20.

giving the formula $\dddot{\bar{\text{R}}}\ \dddot{\text{S}}\text{i} + 2\,(3\dot{\text{M}}\text{g},\ 2\dddot{\text{S}}\text{i},\ 2\dot{\text{H}})$. Oxygen ratio for $\dot{\text{R}} : \dddot{\bar{\text{R}}} : \dddot{\text{S}}\text{i} : \dot{\text{H}} = 6 : 3 : 10 : 4$. Expands on heating on a platinum foil to six times original size, in powder no expansion at all. Loses no water at 100 C. Occurs in an altered bronzitic rock from the diamond-diggings, called Du Toit's Pan, So. Africa.

Valleriite, Blomstrand, Œfv. K. Akad. Stockholm, xxvii., p. 19, 1870.

Massive, without a trace of crystalline texture. Color very like that of pyrrhotite. Lustre perfectly metallic; fracture uneven. Resembling graphite in its unusual softness (yields to the nail, and can be cut with a knife), and in its property of leaving a dark streak, when scratched on paper. G. = 3·14.

Analyses (l. c.) in part from different samples, (neglecting a small insoluble portion).

	Fe	Al	Cu	Mg	Ca	Na	K	S	$\dot{\text{H}}$
1.	29·32		17·00	6·26	—	0·59	0·31	22·20	—
2.	—	—	—	—	—	—	—	—	10·77
3.	—	—	18·66	—	—	—	—	22·73	—
4.	27·18	2·29	18·91	4·97	—	0·31	0·16	22·68	—
5.	25·50	3·18	16·51	7·80	0·18	—	—	—	—
Mean	26·34	2·73	17·77	6·34	0·18	0·45	0·23	22·54	10·77 = 87·35

The variation in Cu and Mg in the analyses is regarded by Blomstrand as showing a possible variation in the composition of the species. Regarding all the Cu as combined as CuS, and giving the remainder of the sulphur to the iron (FeS_2), and calculating the other metals as oxyds, we obtain :

CuS	FeS^3	$\overline{\mathrm{Fe}}$	$\overline{\mathrm{Al}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Ca}}$	$\dot{\mathrm{Na}}$	$\dot{\mathrm{K}}$	$\dot{\mathrm{H}}$
26·74	29·40	15·01	5·14	10·57	0·25	0·61	0·27	10·77=98·76

Giving essentially the formula $2CuS,\ FeS^3 + 2\dot{\mathrm{Mg}}\overline{\mathrm{Fe}} + 4\dot{\mathrm{H}}$.

B. B., loses its lustre and becomes darker. In the matrass gives off water and a slight coating of sulphur. The water is strongly combined, and is given off only at a full red heat.

Very rare; occurs in small (large as hazelnuts) fragments in a dark-greenish limestone, which is much mixed with mica and other minerals, at the Aurora Mine, Nya-Kopparberg, Sweden.

Named for the Swedish mineralogist Vallerius. [A very doubtful compound.]

VANADINITE, Min. p. 610.—So. Africa, anal., *Maskelyne* and *Flight*, J. Ch. Soc., II., x., 1053, 1872.

The researches of Roscoe have shown that vanadic acid is V_2O_5, not V_2O_3, which explains the similarity of vanadinite crystals to those of pyromorphite, Phil. Trans., 1869, 1870.

VANADIOLITE, *Hermann*, J. pr. Ch., II., i., 445. Appendix I., p. 16.

VANADITE, Min. p. 610.—Cryst., *Schrauf*, Ber. Ak. Wien, lxiii., 167, 1871.

VARISCITE, Min. p. 582.—According to *Petersen* $\overline{\mathrm{Al}}\overset{\cdot\cdot}{\mathrm{P}}, + 4\dot{\mathrm{H}}$, perhaps identical with callaite (turquoise), Jahrb. Min., 1871, 357; *Kenngott*, Jahrb. Min., 1872, 193.

VERMICULITE, Min. p. 493.—Pelham, Mass., *Adams*, Am. J. Sci., II., xlix., 272; *Shepard*, ibid., l., p. 96.

Relation to the micas, in optical characters and chemical composition, *Cooke*, Mem. Am. Ac. Boston, 1874, 35.

See jefferisite.

VESUVIANITE, Min. p. 276.—Arendal, anal., Damour, Ann. Ch. Phys., IV., xxiii., 157, 1871.

Cryst. (new forms) Jeremejew, Verh. Min. Ges. St. Pet., II., vii., 1873; Jahrb. Min., 1873, 423. Comp. *Rammelsberg*, ZS. G. Ges., xxv., 421.

Canzucoli, anal., Lemberg. ZS. G. Ges., xxiv., 249, 1872.

Altered to fassaite, Döll, Tsch. Min. Mitth., 1874, 85.

Anal., *Janovsky*, Ber. Chem. Ges. Berlin, 1873, 1456.

541 A. Veszelyite, Schrauf, Anzeig. K. Ak. Wien, 1874, p. 135.

Triclinic. *a* (vert.) : *b* (brach.) : *c* := 0·71516 : ·96529 : 1. $\xi = 92^\circ\ 1$, $\eta = 101^\circ\ 3'$, $\zeta = 91^\circ\ 9'$. Observed planes *I*, *I′*, *i*-ĭ, 1-ĭ, 1-ī, 2-2, 2-2. $I \wedge i$-ĭ=134° 18′, $I \wedge I'$=93° 2′, *i*-ĭ ∧ 1-ĭ=126° 36′, 1-ĭ ∧ 1-ĭ=109° 50′. Crystals formed by combination of prism and domes.

In crystalline crusts on garnet-rock. H.=4. G.=3·5.

Analysis (on a very minute quantity) $\dot{\mathrm{Cu}}$=57.2, $\dot{\mathrm{H}}$=16·0 or $4\dot{\mathrm{Cu}}\overset{\cdot\cdot}{\mathrm{P}} + 5\dot{\mathrm{H}}$, with traces of iron, but no arsenic. Loses at 100° C. one equivalent of water, and the remainder at a red heat. Occurs at Morawicza in the Banat.

Victorite. See ENSTATITE.

VILLARSITE, Min. p. 409.—Genth, Am. Phil. Soc. Philad., xiii., 364, 1873.

VIRIDITE.—A collective name proposed by Vogelsang (ZS. G. Ges., xxiv., p. 529, 1872) for all the indeterminable transparent *green* compounds, which are observed in rocks and may be regarded as hydrous protoxyd silicates of iron and magnesia. They are generally in scaly or fibrous forms and are often the result of the decomposition of hornblende, chrysolite, etc. The name is also used by Dathe (ib., xxvi., p. 10), who shows its relation to Liebe's diabantachronnyn and Sandberger's aphrosiderite.

VIVIANITE, Min. p. 556.—Cryst. description with important correction of hitherto accepted angles, *v. Rath*, Pogg., cxxxvi., 405.

Analyses, *Maskelyne* and *Flight*, J. Ch. Soc., II., ix., 6.

VOLTAITE, Min. p. 652.—Kremnitz, anal., *Tschermak*, Ber. Ak. Wien, 1867, lvi., 831.

WACKENRODITE, Adam, Tableau Min., 1869, p. 76. A variety of wad containing 12·33 p. c. $\dot{\mathrm{Pb}}$; see Dana, Min., p. 182, anal. 6.

WAD, Min. p. 181.—Groroilite, district Jacala, Mexico, *M. Barcena,* Naturaleza, iii., 136, 1874.

WAGNERITE, Min. p. 538.—Anal., showing the presence of 4 p. c. alkalies, *v. Kobell,* J. pr. Ch., II., vii., 275, 1873.

WALPURGITE, Weisbach, Jahrb. Min., 1871, 870; 1873, 315; in Appendix I., p. 16.
Winkler has analyzed the walpurgite of Weisbach, with the following results:

$\ddot{\bar{\mathrm{A}}}\mathrm{s}$	$\bar{\mathrm{U}}$	$\ddot{\bar{\mathrm{B}}}\mathrm{i}$	$\dot{\mathrm{H}}$
11·88	20·29	61·43	4·32 = 97·92
13·03	20·54	59·34	4·65 = 97·56

These correspond to the formula $5\ddot{\bar{\mathrm{B}}}\mathrm{i}, \ddot{\bar{\mathrm{A}}}\mathrm{s} + 3\bar{\mathrm{U}}\,\ddot{\bar{\mathrm{A}}}\mathrm{s} + 10\dot{\mathrm{H}}$.

In a red-heat the crystals take a brown color, which passes into an orange-yellow on cooling. No decrepitation on heating takes place, and no change of form. Decomposed by nitric acid, leaving a white residue of arsenate of bismuth, which goes into solution on the addition of hydrochloric acid. J. pr. Ch., II., vii., p. 6, 1873.

520 C. Wapplerite, *Frenzel,* Tsch. Min. Mitth., 1874, 279.

Triclinic. Crystals minute and highly modified, resembling augite or wolframite in habit. Also in incrustations sometimes crystalline, or globular, sometimes glassy, with a reniform surface. Cleavage clinodiagonal. H. 2-2·5. G. 2·48. Color white. Translucent, the crystals colorless. Lustre strongly vitreous. [Crystallographic determination by Schrauf, (priv. contrib., dated Vienna, March 20th, 1875). Triclinic. *a* (vert.) : *b* : *c* = 0·29037 : 1 : 1·11002. $\xi = 90°\ 13'\ 55''$; $\eta = 95°\ 20'$; $\zeta = 90°\ 10'\ 35''$. Observed planes, $i\text{-}\breve{i}$, $i\text{-}\breve{2}$, $i\text{-}\breve{2}'$, I, I', $i\text{-}\bar{i}$, $1\text{-}\breve{i}$, $1\text{-}\breve{i}'$, $3\text{-}\breve{i}$, $3\text{-}\breve{i}'$, $10\text{-}\bar{i}$, $-2\text{-}\breve{2}$, $2\text{-}\breve{2}$, $-2\text{-}\breve{2}'$, $2\text{-}\breve{2}'$, $-4\text{-}\breve{4}$, $4\text{-}\breve{4}$, $-4\text{-}\breve{4}'$ $4\text{-}\breve{4}'$, $-3\text{-}\breve{\tfrac{3}{2}}$, $-3\text{-}\breve{\tfrac{3}{2}}'$, $-5\text{-}\breve{\tfrac{5}{2}}$, $-5\text{-}\breve{\tfrac{5}{2}}'$, $-7\text{-}\breve{\tfrac{7}{2}}$, $-7\breve{\tfrac{7}{2}}'$. $i\text{-}\breve{i} \wedge I = 132°\ 0'$; $i\text{-}\breve{i} \wedge I' = 131°\ 46\tfrac{1}{8}'$; $i\text{-}\breve{i} \wedge 1\text{-}\breve{i} = 104°\ 50'$; $i\text{-}\breve{i} \wedge -2\text{-}\breve{2}' = 123°\ 14'$.]

The crystals are characterized by prevalence of zones, by which means nearly all of the planes could be determined.

Wapplerite undergoes alteration, by taking up one equivalent of water, forming white opaque pseudomorphs which have been described as *rœsslerite* (Dana, Min., p. 556).

Analyses, Frenzel (l. c.).

$\ddot{\bar{\mathrm{A}}}\mathrm{s}$	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\mathrm{M}}\mathrm{g}$	$\dot{\mathrm{H}}$
47·70	14·15	8·29	29·40 = 99·58
47·69	15·60	7·35	29·49 = 100·13

These give for the composition $2\dot{\mathrm{C}}\mathrm{a}\,\ddot{\bar{\mathrm{A}}}\mathrm{s} + 8\dot{\mathrm{H}}$, where some lime is replaced by magnesia. Of the water 5 atoms go off at 100° C., the remainder at 360°.

Found with pharmacolite at Joachimsthal.

WARRINGTONITE, Min. p. 664.—See *brochantite.* Domeyko, 2d Appendix, Min. Chili, p. 23, 1867.

WARWICKITE, Min. p. 600.—Description and analysis, *J. L. Smith,* Am. J. Sci., III., viii., 432, 1874.

WAVELLITE, Min. p. 575.—Chester Co., Penn., anal., *Hermann,* J. pr. Ch., cvi., 69, 1869. County of Cork, anal., *Church,* J. Ch. Soc., II., xi., 110, Feb., 1873.

WEBSTERITE. See ALUMINITE.

WERNERITE, Min. p. 319.—Bucks Co., Penn., anal., *Leeds,* Am. J. Sci., III., viii., 432, 1874.

WESTANITE, *Blomstrand,* J. pr. Ch., cv., 341.—Appendix I., p. 16.

813 B. Wheelerite. O. Loew, Am. J. Sci., III., vii., p. 571.

A resin, yellowish in color, found in the Cretaceous beds of northern New Mexico, filling the fissures of the lignite, or interstratified in thin layers in it. Most abundantly observed in the vicinity of Nacimiento.

Two analyses gave Loew (l. c.)

	C	H
1.	73·07	7·95
2.	72·87	7·88

which agree closely with the formula $n\,(C_5H_6O)$, where n is probably 5 or 6.

Soluble in ether, less so in bisulphide of carbon. In concentrated sulphuric acid dissolves, producing a dark-brown solution, from which it is precipitated by water. In alcohol the principal portion is readily dissolved, while a small part remains insoluble. The hot alcoholic extract of the resin deposits, on cooling, a few yellow flocculi. The solution, on evaporation, gives a yellowish resin very brittle, and becoming strongly electric on friction · it melts at 154° C.

Named for Lieut. G. M. Wheeler, U. S. Army.

WHEWELLITE, Min. p. 718.—Cryst., *Schmid*, Pogg., cxlii., 111, (Ann. Ch. Pharm., xcvii., 225).

WHITNEYITE, Min. p. 37.—From southern Arizona, analyses, Am. J. Sci., II., xlv., 306. A variety from Fortuna di Paposa, Chili, *Bertrand*, Ann. d. Mines, VII., i., 413, 1872.

459 B. Willcoxite. Genth, Am. Phil. Soc. Philad., xiii., p. 397, 1873.

In scales white to greenish or grayish-white, with pearly lustre, and resembling talc.

Analyses, Kœnig (l. c.). 1. Shooting Creek; 2. Cullakenee Mine.

	$\ddot{\mathrm{Si}}$	$\overline{\mathrm{Al}}$	$\overline{\mathrm{Fe}}$	$\dot{\mathrm{Fe}}$	$\dot{\mathrm{Mg}}$	$\dot{\mathrm{Li}}$	$\dot{\mathrm{Na}}$	$\dot{\mathrm{K}}$	ign.	
1.	28·96	37·49	1·26	2·44	17·35	tr	6·73	2·46	4·00	= 100·69
2.	29·50	37·56	1·40	2·38	17·20	tr	6·24	2·42	3·32	= 100·02

Oxygen ratio $\dot{\mathrm{R}} : \overline{\mathrm{R}} : \ddot{\mathrm{Si}} : \dot{\mathrm{H}} = 6 : 12 : 10 : 2$ nearly, or $3(2\dot{\mathrm{R}}, \ddot{\mathrm{Si}}) + 2\ (2\overline{\mathrm{R}}\ \ddot{\mathrm{Si}}) + 2\dot{\mathrm{H}}$.

B. B. fuses in fine splinters with difficulty to a white enamel, coloring the outer flame yellow. In hydrochloric acid decomposed with difficulty, with separation of silica in scales. Rare, occurring as a coating about a nucleus of corundum, and resulting from its alteration, at Shooting Creek and Cullakenee Mine, Clay Co., No. Carolina.

Named in honor of Col. Joseph Willcox.

WILLEMITE, Min. p. 262.—Franklin, N. J., analyses, *Mixter*, Am. J. Sci., II., xlvi., 230, 1868; sp. gravity for transparent crystals 4·26, 4·25, 4·29, *Cornwall*, Am. Chemist., Oct., 1873, p. 126.

Altenberg, near Aachen, *Arzruni*, Pogg., clii., 281, 1874.

526 C. Winklerite, Breithaupt, Jahrb. Min., 1872, 816.

Amorphous, massive. H.=3. G.=3·432. Color bluish-black to violet-black. Streak dark-brown. Fracture conchoidal, with but slight lustre.

Analysis, Winkler (l. c.) 1. original analysis; 2. same after deduction of $\overline{\mathrm{Fe}}$ and $\ddot{\mathrm{Si}}$.

$\overline{\mathrm{As}}$	$\dot{\mathrm{Cu}}$	$\overline{\mathrm{Co}}$	$\dot{\mathrm{Co}}$	$\dot{\mathrm{Ni}}$	$\overline{\mathrm{Fe}}$	$\dot{\mathrm{Ca}}$	$\ddot{\mathrm{Si}}$	$\ddot{\mathrm{C}}$	$\dot{\mathrm{H}}$	
10·29	13·21	10·34	28·91	2·58	3·05	5·35	2·64	10·37	14·08	=100·82
10·83	13·89	10·86	33·10			5·62		10·00	14·80	=100·00

Breithaupt thinks that the mineral may have been formed by the gradual decomposition of erythrite (cobalt bloom) by water containing carbonic acid in the presence of some copper-mineral.

In the matrass gives off water. On charcoal decrepitates, but does not alter its appearance. B. B. infusible, coloring the flame green. With the fluxes gives reaction for cobalt. Effervesces with hydrochloric acid and the solution thus obtained upon heating evolves chlorine.

Found at Pria near Motril in Spain, occurring with galapectite, also with erythrite and malachite.

WINKWORTHITE, *How*, Phil. Mag., April, 1871.—Appendix I., p. 17.

Kenngott (Jahrb. Min., 1872, 300) repeats the suggestion of Brush that winkworthite is a mixture of gypsum and howlite.

WISERINE, Min. p. 528.—Cryst. memoir, with many new planes and discussion of relation to xenotime and zircon. Brezina remarks that the wiserine from the Binnenthal is very different in habit from that of other localities, and may possibly be a distinct species, Tsch. Min. Mitth., 1872, 8. Klein shows that the supposed mineral from the Binnenthal is in fact octahedrite, Jahrb. Min., 1872, 900.

WITTICHENITE, Min. p. 98.—Böckelsbach, Wittichen, Baden, anal., *Petersen*, Pogg., cxxxiv., 92; cxxxvi., 500. (Jahrb. Min., 1869, 337.)

WOCHEINITE, Min p. 174.—(beauxite) Kokorjie, Verh. G. Reichs, 1874 289.

WÖHLERITE, Min. p. 291.—Cryst. memoir, showing the species to be monoclinic, *Des Cloizeaux*, Ann. Ch. Phys., IV., xiii., 425, 1868.
Analyses, *Rammelsberg*, Pogg., cl, 211, 1873.

WOLFACHITE, *Sandberger*, Jahrb. Min., 1869, 313.—Appendix I., p. 17.

WOLFRAMITE, Min., p. 601.—Bayonka, Urals, anal., *Des Cloizeaux*, Am. J. Sci., II., xlviii., 137, 1868.
A variety from Schlaggenwald, *Zerrenner*, B. u. H. Zeit., xxviii., 429, 437.
Crystalline form proved to be monoclinic, *Des Cloizeaux*, Ann. Ch. Phys., IV., xix., 168, 1870.
From Russian localities, *Beck* and *Teich*, Verh. Min. Ges. St. Pet., II., iv., 312.
Relation to columbite, *Jeremejew*, Verh. Min. Ges. St. Pet., II., vii., 1872.
Cryst. form (hübnerite), relation to columbite, *Groth* and *Arzruni*, Pogg., cxlix., 235.
Meymac, Corrèze, anal., *Carnot*, C. R., lxxix., 637, 1874.

WOLLASTONITE, Min. p. 210.—Vesuvius, cryst., *v. Rath.*, Pogg., cxxxviii., 484; Monte Somma, anal., ib., cxliv., 390.
Elba, cryst., *Achiardi*, Nuovo Cimento, II., iii., Feb., 1870.
Santorin, cryst. memoir, *Hessenberg*, Min. Not., ix., 28. 1870.
Orawitza, anal., *Lemberg*, ZS. G. Ges., xxiv., 251, 1872.
In phonolyte from Freiburg, Breisgau, *v. Rath*, Jahrb. Min., 1874, 521.
Piquet describes (Ann. des Mines, VII., i., 415, 1872) what he calls a *new silicate of lime* from Merida (Portugal). It occurred in a vein of dioryte containing magnesite, quarz, apatite. An analysis gave Clemencin (l. c.) $\ddot{\mathrm{Si}}$ 48·36, $\dddot{\bar{\mathrm{Al}}}$($\dddot{\bar{\mathrm{Fe}}}$ tr) 1·56, $\dot{\mathrm{C}}\mathrm{a}$ 46·41, $\dot{\mathrm{M}}\mathrm{g}$ 1·30, $\ddot{\mathrm{C}}$ 1·00, $\dddot{\mathrm{S}}$ 0·56, $\dot{\mathrm{H}}$ 1·11=100·30. H.=3·5–4. G.=2 80. Color white. Structure radiated. As Kenngott remarks (Jahrb. Min., 1873, 944) there seems to be no good reason for separating it from wollastonite.

WOLLONGONGITE, *Silliman*, Am. J. Sci., II., xlviii., 85. Appendix I., p. 17.

WOODWARDITE, Min. p. 666.—Anal., *Pisani*, C. R., lxv., 1143, 1871; *Maskelyne* and *Flight*, anal., J. Ch. Soc., II., ix., 1., 1871.

WULFENITE, Min. p. 607.—Wahsatch Mts., *Silliman*, Am. J. Sci., III., iii., 200; vi., 128.
Rucksberg and Phoenixville, cryst., *Schrauf*, Ber. Ak. Wien, lxiii., 184, 1871.
Pzribram, hemimorphic forms, *Zerrenner*, Tsch. Min. Mitth., 1874, 91.

XANTHIOSITE, Adam, Tableau Min., 1869. p. 43. An uncertain arsenate of nickel ($\dot{\mathrm{N}}\mathrm{i}^3\bar{\mathrm{A}}\mathrm{s}$) from Johanngeorgenstadt, analyzed by Bergemann (Dana Min., p. 548).

XENOTIME, Min. p. 528.—*Hessenberg*, cryst., Jahrb. Min., 1874, 833.
See *Wiserine*.

YTTROCERITE, Min. p. 125.—*Nordenskiöld*, Œf. Ak. Stockh., xxvii., 549, 1870.

YTTROTANTALITE, Min. p. 519.—Ytterby, anal., *Rammelsberg*, ZS. G. Ges., xxi., 560, 1869; Pogg., cl., 200, 1873.

ZEPHAROVICHITE, *Boricky*,—Ber. Ak. Wien, lix., 593, 1869.—Appendix I., p. 17.

572 A. Zeunerite *Weisbach*, Jahrb Min., 1872, 207; 1873, 315; see also *Winkler*, J. pr. Ch., II., vii., p. 8, 1873; *Laube*, Lotos, xxii., 1872, p. 210; *Frenzel*, Jahrb. Min., 1873, 947.
Tetragonal. In crystals sometimes tabular, sometimes pyramidal, with planes *I*, *O*, *m*. Cleavage, basal perfect, the surface having a pearly lustre. H.=2-2·5. G.=3·2. Color grass-green and apple-green. In appearance and physical characters very similar to torbernite (Min. p. 585), with which it is isomorphous according to Weisbach.*
Analyses, Winkler, 1. l. c., 2. quoted by Weisbach l. c.

	$\bar{\mathrm{A}}\mathrm{s}$	$\dddot{\bar{\mathrm{U}}}$	$\dot{\mathrm{C}}\mathrm{u}$	$\dot{\mathrm{H}}$		
1.	20·94	55·86	7·49	15·68		= 99·97
2.	15·1	55·6	8·7	14·5	($\dot{\mathrm{F}}\mathrm{e}$ 5·2, $\dot{\mathrm{C}}\mathrm{a}$ 1 2)	= 100·8

---

* See *Schrauf*, Tsch. Min. Mitth., 1872, 181.

From analysis 1. Winkler writes $\dot{\mathrm{C}}\mathrm{u}\ 2\ \overset{\cdots}{\bar{\mathrm{U}}}\ \overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\mathrm{A}}}\mathrm{s} + 8\dot{\mathrm{H}}$.

First found with other uranium minerals at the mine Weisser Hirsch, near Schneeberg, Saxony; the crystals rest upon quartz or upon iron ochre. Since identified from Geisterhalde, near Joachimsthal, Laube (l. c.), and from Huel Gorland, Cornwall (on smoky quarz with chalcocite and melaconite), and from Zinnwald, Saxony (on quarz), Frenzel (l. c.).

Winkler (l. c. p. 14) has made zeunerite artificially, having the following composition: $\dot{\mathrm{C}}\mathrm{u}$ 7·01, $\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\mathrm{A}}}\mathrm{s}$ 22·11, $\overset{\cdots}{\bar{\mathrm{U}}}$ 57·21, $\dot{\mathrm{H}}$ 14·65 = 100·98.

ZINCITE, Min. p. 135.—Artificial oxyd of zinc in twinned crystals, v. Rath, Pogg., cxliv., 580. 1871.

Hayes has investigated the zincite from New Jersey, and thinks he has confirmed his previous observations that the red color is due to the presence of scales of hematite (Am. J Sci., III., iv., 191, 1872). The writer has made a study of some thin sections under the microscope, and has found that while there are present, at times, irregular scales (the hematite of Hayes) the red or yellow color is always uniformly diffused, and is not due to these scales. See Dana, Min. p. 136.

ZIRCON, Min. p. 272.—Observed in the hypersthenyte, near Harzburg, *Rose*. ZS. G. Ges., xxii., 754.

Expailly, France, anal., *Mylander*, Jahrb. Min., 1870, 488.

Ceylon, analyses, *Forbes*, Chem. News, xxv., 305, June, 1872.

Zirlite. Pichler has given this name to an opal-like hydrate of alumina closely related to, if not identical with, gibbsite. Found at Zirl, in the Tyrol (Jahrb. Min., 1871, 57; 1875, 51).

Zoblitzite. See LIMBACHITE.

ZOISITE, Min. p. 290.—Tuscany, province of Lucca, *Achiardi*, Boll. Com. Geol. Ital., 1871, 137.

No. Carolina, *J. L. Smith*, Am. J. Sci., III., vi., 184; *Genth*, Am. Phil. Soc. Philad., viii., 374, 406, 1873.

Thulite, Norway, anal., Herter, ZS. G. Ges., xxiii., 268.

Rammelsberg, ZS. G. Ges., xxiv., 649.

Zonochlorite, Foote, Rep. Amer. Assoc., 1873, p. 65.

Associated with laumontite, stilbite, prehnite and related minerals in the amygdoid of Neepigon Bay, Lake Superior.

Massive, banded with different shades of dark-green. H.=6½–7. G.=3·113. Water determinations gave 8·7, 12·9 and 7·03 p. c., and the presence of iron and alumina, also lime and soda (spectroscope) was proved. B. B. fuses with difficulty to a dark glass, and with fluxes reacts for iron. Upon this very imperfect examination the author concludes that the species is new. [Probably identical with chlorastrolite, Dana, Min., p. 412.]

PARAGONITE.—**Cossaite.** Gastaldi has given this name to a mineral which in oxygen ratio and chemical composition is identical with paragonite, but he separates it from this species on the ground of the absence of distinct micaceous cleavage. He first identified it in an antique ring (possibly a bracelet) dug up in the neighborhood of Turin, but he has also found it at the mines of Borgofranco, near Ivrea, and at Mt. Blasier.

The description as given by Prof. Cossa is as follows:

Structure crystalline, finely lamellar; in some portions having a micaceous aspect (Borgofranco; this tendency to micaceous structure is absent in the mineral from Mt. Blasier). Opaque, slightly translucent on the edges. H. = 2.5. G. = 2·896 and 2·890. Color green. Streak white.

Analyses; 1. and 2. by Cossa, l. c. 1. Borgofranco; 2. Mt. Blasier; 3. paragonite, Rammelsberg (Dana, Min., p. 488).

	$\ddot{\bar{\mathrm{S}}}\mathrm{i}$	$\overset{\cdots}{\bar{\mathrm{A}}}\mathrm{l}$	$\overset{\cdots}{\bar{\mathrm{F}}}\mathrm{e}$	$\dot{\mathrm{M}}\mathrm{g}$	$\dot{\mathrm{C}}\mathrm{a}$	$\dot{\mathrm{N}}\mathrm{a}$	$\dot{\mathrm{K}}$	$\dot{\mathrm{H}}$	
1. Cossaite.	46·67	39·02	2·01	——	——	6·37	1·36	4·91 = 100·33	Cossa.
2. "	46·68	39·88	1·06	——	——	6·91	0·84	5·08 = 100·45	Cossa.
3. Paragonite.	46·81	40·06	tr.	0·65	1·26	6·40	tr.	4·82 = 100·	Ramm.

The oxygen ratio for $\dot{\mathrm{R}} : \overset{\cdots}{\bar{\mathrm{R}}} : \ddot{\bar{\mathrm{S}}}\mathrm{i} : \dot{\mathrm{H}} = 1 : 9 : 12 : 2$.

B.B. fusible with difficulty; exfoliates and becomes opaque white, moistened with cobalt solution; after ignition gives an intense blue color. Not decomposed by hydrochloric acid. Gastaldi calls the cossaite a soda-oncosin (pinite). He adds the following analysis by Cossa of what he considers a normal oncosin from Fenestrelle: $\ddot{Si}$ 47·96, $\dddot{\bar{A}}l$ 31·03, $\dot{C}a$ 1·07, $\dot{M}g$ 3·42, $\dot{K}$ 10·44, $\dot{N}a$ 4·08, $\dot{H}$ 2·41 = 100·41. (*O.* ratio $\dot{R} : \dddot{R} : \ddot{Si} = 1 : 3 : 6$.) Very similar to cossaite in physical characters. B.B. fusible. (Atti Accad. Sci. Torino, x., Dec., 1874).

652 A. Guanovulite, *Wibel*, Ber. Chem. Ges. Berlin, 1874, 392.

Found in crystalline deposits filling the eggs of birds in Peruvian guano. H. = 2. G. = 2·33–2·65. Color yellowish-white. Lustre silky. An analysis gave, after deduction of impurities, $\dot{K}$ 35·49, NH_4O 5·09, $\dddot{S}$ 49·60, $\dot{H}$ 9·82 = 100·00. Wibel writes the formula $NH_4O\dddot{S} + 2\dot{K}\dddot{S} + 3(\dot{K}\dddot{S},\dot{H}\dddot{S}) + 4$ aq.

In water it dissolves, leaving a very small residue, and giving a light-yellowish solution, which has a salty taste. Insoluble in ether or alcohol. Heated in a glass tube it first loses water and ammonia, then becomes black, and on stronger heating melts and gives off much sulphuric acid.

J. E. Wolff
Nov. 1880
$5.00 2nd H.